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A Report to Congress on Long-Term Stewardship

Volume I – Summary Report

U.S. Department of Energy
Office of Environmental Management

Office of Long-Term Stewardship

9826

- "Caution - Do Not Dig" Marker

  Fermi Marker located 20 miles outside of Chicago, Illinois, identifying the site of buried radioactive wastes that include materials from Enrico Fermi's uranium-graphite pile at the University of Chicago. *Plot M., Palos Forest Preserve, Illinois, November 1995.*

- "RCRA Cap"

  Ten acres of black, high-density polyethylene cover a mixed waste landfill at the Oak Ridge Reservation Site. The cap is designed to prevent gases from escaping, reduce erosion, and keep rainwater from leaching contaminants into groundwater. Installed in 1989, the cap is designed to last from 15 to 20 years. Maintenance and monitoring will be required at least until 2019. *Solid Waste Storage Area 6, Oak Ridge Reservation, Tennessee, January 1994.*

AVAILABILITY OF THE REPORT TO CONGRESS:

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AT A GLANCE...

A Report to Congress Detailing DOE's Existing and Anticipated Long-Term Stewardship Obligations

Long-term stewardship is a critical element for continued progress in site clean-up and closure. DOE is already performing long-term stewardship activities at 34 sites that have been cleaned up and closed and at portions of many other sites.

The Department of Energy has prepared its most comprehensive report to date on its anticipated long-term stewardship obligations for sites that will continue to have residual wastes or contamination after cleanup has been completed. The *Report to Congress: Long-Term Stewardship* (January 2001) recognizes that:

- DOE has been, and intends to continue, performing waste cleanup to standards that do not allow for unrestrictive land use (e.g., industrial or recreational) in most cases;
- Even if unrestricted land use were to be sought, it is often technically and economically infeasible;
- Consequently, long-term stewardship will required for many years into the future; and
- Given the need for long-term stewardship to ensure the continued effectiveness of cleanup work DOE intends to establish reliable management plans to carry out the long-term stewardship mission.

DOE's obligation for long-term stewardship includes all activities necessary to protect human health and the environment at sites that will continue to have residual wastes or contamination. Activities include:

- **Institutional controls** (e.g., surveillance, record-keeping, inspections, access control, and posting signs); and
- **Engineered controls** for preventing migration of residual wastes or contamination (e.g., ongoing pump and treat operations, groundwater monitoring, cap repair, and maintenance of entombed buildings and other structures or barriers).

Following site cleanup and closure, residual wastes or contamination will remain at some sites or portions of sites, including:

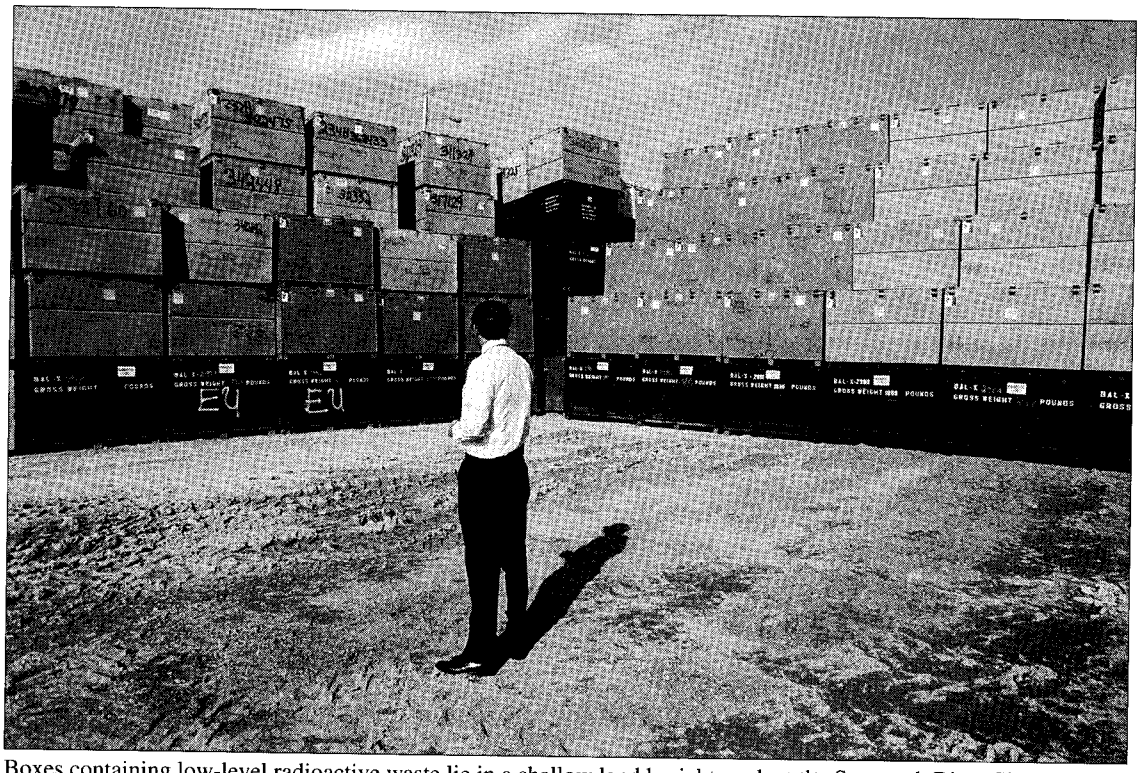
- Former uranium mill sites and mill tailings disposal sites;
- Radioactive and hazardous waste burial grounds;
- Residually contaminated soil and groundwater; and
- Entombed buildings and structures.

DOE expects to conduct long-term stewardship activities at more than 100 sites. These sites include:

- 67 sites where cleanup is completed now or will be completed by 2006 but residual wastes or contamination will remain;
- 29 sites where cleanup of portions of the sites will be completed by 2006; and
- Potentially, as many as 33 additional sites where remediation and associated long-term stewardship activities have not yet been determined at this time but DOE may be responsible for long-term stewardship after 2006.

The FY2000 NDAA Long-Term Stewardship Report contains the most comprehensive compilation to date of existing and anticipated long-term stewardship requirements at DOE sites. The Report:

- Fulfills a Congressional requirement to provide an accounting of DOE's long-term stewardship activities at sites and portions of sites as of 2006;
- Provides plans for DOE's obligations after sites are cleaned up and closed and serves as a baseline for more detailed planning;
- Identifies the scope and timing of existing and anticipated long-term stewardship activities (summarized in Volume I and on a site-specific basis in Volume II);
- Provides preliminary cost estimates for long-term stewardship activities; and
- Identifies key next steps and issues to be resolved in order to better plan and manage long-term stewardship activities.
- For electronic copies of this report please visit our long-term stewardship information center website at http://lts.apps.em.doe.gov/center/
- To obtain copies of this Report or for more information on the environmental management activities of the U.S. Department of Energy, contact The Environmental Management Information Center at 1-800-736-3282.



Boxes containing low-level radioactive waste lie in a shallow land burial trench at the Savannah River Site. New methods for disposal of low-level waste are being developed by the Department. *Savannah River Site, South Carolina. January 7, 1994.*

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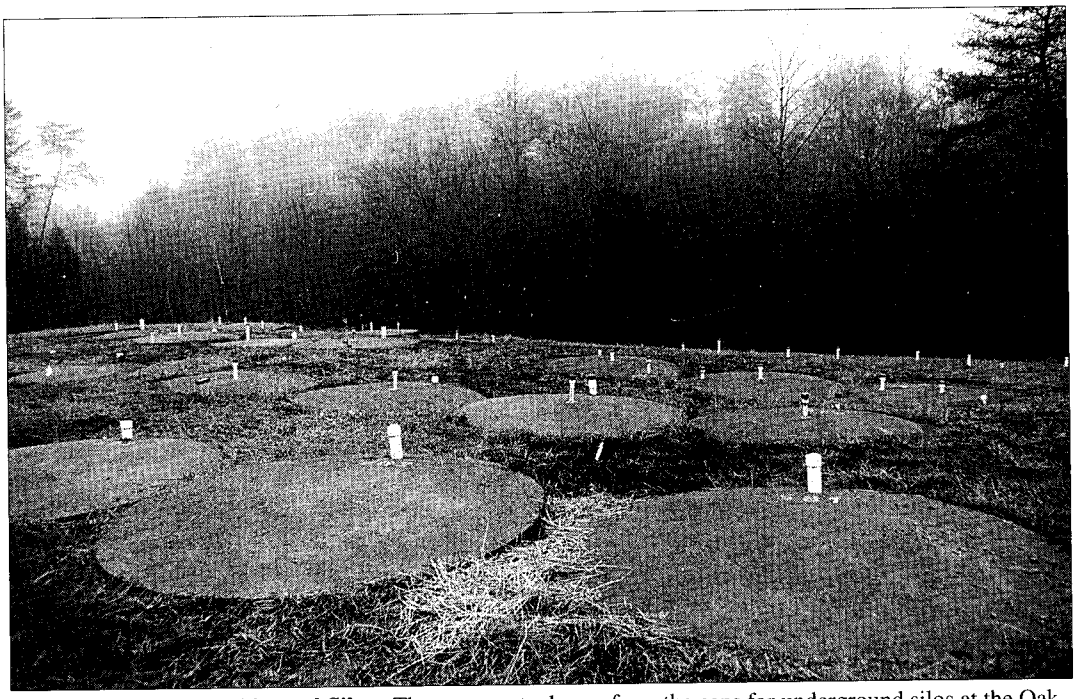
Low-Level Waste Disposal Site. This engineered trench at the Savannah River Site contains approximately 30,000 stacked carbon-steel boxes of waste with each box measuring 4 by 4 by 6 feet. In 1996 the trench was backfilled with dirt to form a mound, which was seeded with grasses and sloped to reduce runoff. Long-term monitoring and maintenance will be needed to ensure the integrity of this waste containment system. *Engineered Low-Level Trench 4, Savannah River Site, South Carolina, January 1994.*



Below Ground Waste Disposal Silos. These concrete domes form the caps for underground silos at the Oak Ridge Reservation, each measuring 8 feet in diameter. These disposal silos are 15-20 feet deep and were placed in the ground at least two feet above the highest known groundwater levels. These silos were used from 1986 to 1993 for the disposal of laboratory equipment, construction debris, and other dry waste contaminated principally with cesium-137, strontium-90, and cobalt-60. Although no final cleanup decisions have been made, long-term groundwater monitoring is currently being conducted and may be required for decades. *Melton Valley Area, Solid Waste Storage Area 6, Oak Ridge Reservation, Tennessee, January 1994.*

Chapter 1

Introduction and Background

CHAPTER 1: INTRODUCTION AND BACKGROUND

During World War II and the Cold War, the Federal government developed and operated a vast network of industrial facilities for the research, production, and testing of nuclear weapons, as well as for other scientific and engineering research. These processes left a legacy of radioactive and chemical waste, environmental contamination, and hazardous facilities and materials at well over a 100 sites in 30 States and one U.S. Territory. Hundreds of thousands of acres of residually contaminated soils, contaminated groundwater, surface water and sediment contamination, and contaminated buildings are present at many sites across the country. These sites range in size from less than one acre, containing only a single facility, to large sites spanning over 100,000 acres with huge uranium enrichment plants and plutonium processing canyons.

Since 1989, the U.S. Department of Energy's (DOE) Environmental Management (EM) program has made significant progress in addressing this environmental legacy. Millions of cubic meters of waste have been removed, stabilized, or disposed of, resulting in significant risk and cost reduction. In addition, DOE began disposing of transuranic (i.e., plutonium-contaminated) waste in the nation's first deep geologic repository – the Waste Isolation Pilot Plant in New Mexico. DOE is now carrying out its long-term stewardship obligations at dozens of sites, including smaller sites where DOE has completed cleanup work for the entire site and many larger sites where DOE has remediated portions of the site.

DOE generally conducts cleanup activities to achieve standards allowing for reasonably foreseeable land use.[1,2] In some cases, the agreed-upon cleanup levels meet the "reasonably anticipated future land use" standard but do not allow for unrestricted use (i.e., some sites will be restored to a level appropriate for use other than unrestricted or residential use). Furthermore, at this time, due to the nature and extent of contamination, it is technically and economically infeasible to restore many DOE sites to levels

WHAT IS "CLEANUP"?

The term "cleanup"in the context of DOE's Environmental Management (EM) program is often confused with the vernacular use of the term to mean that contamination has been eliminated to a pristine, pre-contamination condition. However, in the environmental remediation business, the term "cleanup" refers to the process of addressing contaminated land, facilities, and materials in accordance with applicable requirements. Cleanup does not imply that all hazards will be removed from the site. This function encompasses a wide range of activities, such as stabilizing contaminated soil; treating groundwater; decommissioning process buildings, nuclear reactors, chemical separations plants, and many other facilities; and exhuming sludge and buried drums of waste. The term "remediation" is often used synonymously with cleanup.

In *Accelerating Cleanup: Paths to Closure*, the Department defines site cleanup as complete when the following five criteria have been met.*

- Deactivation or decommissioning of all facilities currently in the EM program has been completed, excluding any long-term surveillance and monitoring.
- All releases to the environment have been cleaned up in accordance with agreed-upon cleanup standards.
- Groundwater contamination has been contained and long-term treatment (remedy) or monitoring is in place.
- Nuclear materials have been stabilized and/or placed in safe long-term storage.
- Legacy waste has been disposed of in an approved manner (legacy waste was produced by past nuclear weapons production activities).

* *Accelerating Cleanup: Paths to Closure*, DOE/EM-0362, June 1998. "Status Report on Paths to Closure" U.S. Department of Energy Office of Environmental Management, March 2000.

[1] For information on how reasonably foreseeable land use assumptions are developed, see *Land Use in the CERCLA Remedy Selection Process*, U.S. Environmental Protection Agency, OSWER Directive No. 9355.7-04, May 25, 1995.

[2] Also see *RESRAD Manual for Implementing Residual Radioactive Material Guidelines* (Yu et al. 1993), Version 5.0.

acceptable for unrestricted use.[3] Therefore, many contaminated soil areas will not be suitable for residential use; contaminated groundwater plumes may not be restored for potable uses for many years into the future; and contaminated surface waters may not be remediated because doing so will create extensive damage to ecological systems.

At the time cleanup is completed, most sites will transition into the longest "phase" of the environmental life cycle – that of long-term stewardship. The activities necessary to ensure protection of human health and the environment from hazards remaining after cleanup, stabilization, or disposal are referred to as "long-term stewardship." Long-term stewardship activities are directly linked to the types of cleanup actions being performed.

LONG-TERM STEWARDSHIP

For purposes of this Report, "long-term stewardship" refers to all activities necessary to ensure protection of human health and the environment following completion of cleanup, disposal, or stabilization at a site or a portion of a site. Long-term stewardship includes all engineered and institutional controls designed to contain or to prevent exposures to residual contamination and waste, such as surveillance activities, record-keeping activities, inspections, groundwater monitoring, ongoing pump and treat activities, cap repair, maintenance of entombed buildings or facilities, maintenance of other barriers and containment structures, access control, and posting signs.

Long-term stewardship, as used in this Report, is distinct from two other stewardship programs - the Nuclear Materials Stewardship Program, which provides for management and disposition of nuclear materials that are used or being stored at DOE sites (including the storage of materials not defined as waste for which there is no planned future use), and the Stockpile Stewardship Program, which is intended to ensure the safety and the reliability of the existing stockpile of nuclear weapons.

Decisions regarding what to do with contaminated soils or facilities, and the subsequent cleanup actions taken to implement these decisions, will result in a specific end state for the site. For some sites (e.g., those with disposal cells), the current status of monitoring contained contamination will represent the final end state. In other words, no additional work is anticipated unless an unexpected condition occurs (e.g., remedy fails). For other sites (e.g., sites with entombed reactors, containment systems), the long-term stewardship phase represents a point where hazards are controlled, yet additional work may be required. For these sites, long-term stewardship represents an "interim" phase until new technologies become available or existing technologies can be deployed at a more reasonable cost.

1.1 Purpose of this Report

The *Fiscal Year 2000 National Defense Authorization Act* (FY 2000 NDAA) Conference Report requested the Secretary of Energy to submit to Congress a Report on DOE's existing and anticipated long-term stewardship obligations at sites where environmental restoration activities are complete or will be complete by 2006. The primary purpose of this Report is to respond to that request.

The request for this Report in the FY 2000 NDAA reflects a continuing Congressional interest in long-term program costs and management. First, Congress is increasingly aware that DOE's responsibilities will not be eliminated when "cleanup" is complete and is interested in understanding the estimated size of the remaining responsibilities. Second, in order to support a credible long-term stewardship program, Congress has expressed a strong interest in learning as much as possible about "portions of sites" where cleanup and stabilization are currently complete or will be complete. Third, during the past 10 years, Congress has appropriated substantial funding (nearly $60 billion) for DOE to conduct environmental management activities, and DOE needs to demonstrate the degree of success achieved by that funding.

[3] Unrestricted use generally means that conditions are safe for any exposure scenario, including residential use, subsistence farming, and subsistence fishing. However, it does not necessarily imply cleanup to pristine or background conditions.

REPORT TO CONGRESS

"The conferees direct the Secretary of Energy to provide to the Armed Services Committees of the Senate and House of Representatives, not later than October 1, 2000, a Report on existing and anticipated long-term environmental stewardship responsibilities for those Department of Energy (DOE) sites or portions of sites for which environmental restoration, waste disposal, and facility stabilization is expected to be completed by the end of calendar year 2006. The Report shall include a description of what sites, whole and geographically distinct locations, as well as specific disposal cells, contained contamination areas, and entombed contaminated facilities that cannot or are not anticipated to be cleaned up to standards allowing for unrestricted use. The Report shall also identify the long-term stewardship responsibilities (for example, longer than 30 years) that would be required at each site, including soil and groundwater monitoring, record-keeping, and containment structure maintenance. In those cases where the Department has a reasonably reliable estimate of annual or long-term costs for stewardship activities, such costs shall be provided.

The Secretary shall attempt to provide sufficient information to ensure confidence in the Department's commitment to carrying out these long-term stewardship responsibilities and to undertake the necessary management responsibilities, including cost, scope, and schedule.

The conferees recognize that in many cases residual contamination will be left after cleanup or will be contained through disposal, and that such residual contamination and wastes will require long-term stewardship to ensure that human health and the environment are protected."

(Conference Report on S.1059, National Defense Authorization Act for Fiscal Year 2000, *Congressional Record*, August 5, 1999).

DOE has increasingly focused on the need for long-term stewardship. For example, one of the six Environmental Management principles is the development of an "effective long-term stewardship program - at many sites after cleanup is completed...."[4] Moreover, DOE recognizes the need to ensure that science and technology investments are adequate to address the needs for cost-effective long-term stewardship. DOE has placed a particular emphasis on the need for a better understanding of the existing management roles and responsibilities for long-term stewardship and the relationship between long-term stewardship and science and technology needs.[5,6,7]

This interest and concern about long-term stewardship, both within DOE and externally, has emerged in large part from DOE's focus on accelerating site cleanup and improving management of the cleanup program. In 1999, DOE published *From Cleanup to Stewardship, A Companion Report to Accelerating Cleanup: Paths to Closure and Background Information to Support the Scoping Process Required for the 1998 PEIS Settlement Study* (also known as the Background Report), that began to address long-term stewardship issues and provides substantial background information and anticipated long-term stewardship activities at DOE

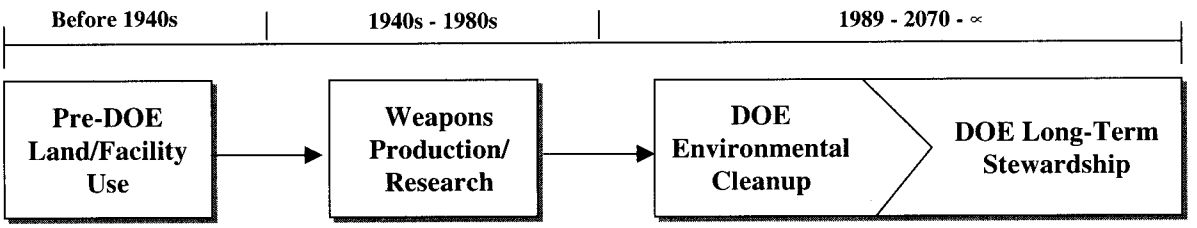
[4] From the statement of Dr. Carolyn L. Huntoon, Assistant Secretary for Environmental Management, U.S. Department of Energy. "Hearing on the FY 2000 Budget Request Subcommittee on Strategic Committee on Armed Services United States Senate," February 29, 2000.

[5] *Planning and Implementing RCRA/CERCLA Closure and Post-Closure Care When Waste Remains Onsite.* U.S. Department of Energy, Office of Environmental Policy and Assistance, RCRA/CERCLA Information Brief, DOE/EH-413-9910, October 1999.

[6] *RCRA Closure and Post-Closure Plans*, U.S. Department of Energy, Office of Environmental Guidance, RCRA Information Brief, DOE/EH-231-009-1291, December 1991.

[7] "Science and Technology Needs for Long-Term Stewardship," Memorandum, December 1999 (http://lts.apps.em.doe.gov/stewlink0.asp).

Exhibit 1-1. Long-Term Stewardship: How Did We Get Here?



Pre-DOE Land/Facility Use	Weapons Production/ Research	DOE Environmental Cleanup	DOE Long-Term Stewardship
•Open space •Natural ecosystems •Residential •Private sector commercial/industrial/ agriculture activities	•Land withdrawn/ transferred from public sources •Private sector facilities leased/expanded •DOE constructs large manufacturing/research infrastructure	•DOE conducts –environmental restoration –waste management –facility disposition •Scientific research, energy research, and weapons stockpile management missions, as well as other national security missions, continue at some DOE sites	•Many DOE sites close after cleanup completed •Some sites continue weapons stockpile management and research missions •DOE conducts long-term stewardship of closed and active sites with residual hazards

sites.[8] An examination of these and other long-term stewardship issues is being prepared by DOE pursuant to a December 1998 lawsuit settlement agreement.[9] The resulting Report, *The Draft National Study on Long-Term Stewardship*, addresses national, programmatic, and cross-cutting issues related to long-term stewardship.[10] These initiatives are described further in Appendix A.

This Report represents the most comprehensive compilation of the Department's anticipated long-term stewardship obligations to date and provides summary information for site-specific, long-term stewardship scope, cost, and schedule. It is based on data submitted by DOE's Field staff and their contractors on current and anticipated long-term stewardship activities. This Report provides a "snapshot" of DOE's current understanding of those activities and highlights areas where significant uncertainties still remain. In addition to responding to the FY 2000 NDAA Congressional request, this Report provides a mechanism for DOE to better communicate future long-term stewardship needs and challenges to stakeholders, as well as to Congress, and provides DOE with the information necessary to better plan for and to manage a long-term stewardship program. This Report does not establish policy regarding the Department's management of long-term stewardship in that it does not prescribe actions or make recommendations. However, it does highlight significant issues that DOE may need to address in the near future.

1.2 Why Address Long-Term Stewardship Now?

As the Department accelerates cleanup activities at sites, the need to carry out and prepare for post-cleanup long-term stewardship is also accelerated. Recognizing the need to ensure that human health and the

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[8] *From Cleanup to Stewardship, A Companion Report to Accelerating Cleanup: Paths to Closure and Background Information to Support the Scoping Process Required for the 1998 PEIS Settlement Study*, U.S. Department of Energy, Office of Environmental Management, October 1999.

[9] Natural Resources Defense Council, et al, v. Richardson, et al., Civ. No. 97-936 (SS) (D.D.C.), December 12, 1998.

[10] The *National Study on Long-Term Stewardship* was released for public comment in November of 2000.

environment remain protected after cleanup, stabilization, and disposal are completed, the Environmental Management program established the Office of Long-Term Stewardship in 1999, thus emphasizing the Department's commitment to seeking effective long-term stewardship. DOE recognizes the importance of addressing long-term stewardship now in order to improve the management and to estimate the cost of long-term stewardship. These needs are discussed as follows.

WHY ADDRESS LONG-TERM STEWARDSHIP NOW?

- To provide for smooth transition from cleanup to long-term stewardship through technical, financial, and managerial planning
- To emphasize that the "cleanup" goal, in many cases, is to reduce and control -- versus eliminate -- risk and cost
- To ensure that Congress, regulators, and other stakeholders have a clear understanding of what the cleanup mission will "produce" and clarify that there is an attainable end-point
- To set realistic expectations and show interim successes and results
- To identify technology research and development needs
- To assure regulators and the public that DOE will not walk away from its enduring obligations

Improving the Management of Long-Term Stewardship

DOE now considers long-term stewardship to be an integral part of decision-making during the site remediation process. As such, DOE now requires the preparation of a long-term stewardship plan during the early stage of the cleanup process so that the long-term stewardship technical requirements and costs can be considered during the cleanup process.

The importance of integrating long-term stewardship into the cleanup process was emphasized in a recent report by the National Research Council of the National Academy of Science.[11] The Council's report found that the effectiveness of cleanup relies on the effectiveness of three measures: "...contaminant reduction, contaminant isolation and stewardship measures, and that stewardship measures include measures to maintain contaminant isolation and reduction technologies...." A "key point" made in the Council's report is that "stewardship is a pervasive concept and not simply a set of measures to be implemented once remediation is complete." This Report reflects a significant step forward in the Department's understanding of the long-term stewardship implications of its ongoing cleanup process. The Department will continue to increase its knowledge of these long-term implications so that, unlike some decisions made in the past, the Department will consider the long-term consequences of current cleanup activities and other decisions as much as possible.

DOE is beginning to better understand the scope, schedule, and cost of these activities and to better appreciate the inherent uncertainties in planning and estimating long-term stewardship "projects." As DOE moves toward managing long-term stewardship in a project framework, the first step will be to identify projects. In fact, in preparing this Report, a significant effort was required to identify sites and portions of sites where long-term stewardship activities are or will be occurring. Once "projectized," DOE will be better able to develop a scope, cost, and schedule using traditional project management tools. Furthermore, using a project framework, DOE can better document the uncertainties surrounding the long-term stewardship scope, cost, and schedule estimating process. Over time and with more experience, DOE expects that the long-term stewardship cost estimates will become more reliable.

The enduring success of the cleanup activities (e.g., removal and containment) implemented today will depend on the effective long-term stewardship of tomorrow. Maintaining and operating a long-term stewardship program over extended periods of time is an unprecedented task with many unknowns and many

[11] National Research Council, Board on Radioactive Waste Management, *Long-Term Institutional Management of U.S. Department of Energy Legacy Waste Sites,* August 2000.

technical and policy uncertainties, as discussed in Chapter 2. These uncertainties impact DOE's overall ability to estimate the scope of the program, as well as its ability to manage the program in the future in the most cost-effective and efficient manner.

Baselines will need to be developed for the long-term stewardship phase. At sites, or portions of sites, where active cleanup activities are complete, the scope, schedule, and cost of long-term stewardship activities can be clearly defined (i.e., stewardship can be defined as a "project"). A transition from having long-term stewardship included within existing baselines as merely a set of "activities" to a more traditional project management framework focused on long-term stewardship activities, where long-term stewardship activities are easily isolated, will allow the Department to integrate long-term stewardship into existing project management systems. While a long-term stewardship baseline will be different than a traditional project baseline, the concepts of project management are still applicable. For example, many long-term stewardship activities will take place in phases (i.e., a groundwater pump and treat system may transition to monitored natural attenuation at an agreed upon point in time or as specified objectives are reached); each phase should be managed as a component in the overall long-term stewardship project baseline. This "projectizing" process will aid DOE in effectively planning, managing, and integrating long-term stewardship activities across the complex.

Estimating the Cost of Long-Term Stewardship

Estimating the cost of long-term stewardship depends on a number of factors, including the scope and schedule of the activities, as well as uncertainties, such as the reliability of the contaminant isolation and reduction controls, the reliability of the long-term stewardship measures, and a variety of external factors such as climate, human intrusion, and the discovery of additional contamination. Estimating the cost of long-term stewardship requires an understanding of the scope of activities - both technical and institutional - required for each site and for portions of these sites. This understanding of scope and associated costs is increasingly being displayed by Field staff through the development of long-term stewardship plans. Until more detailed long-term stewardship plans are developed and more experience is gained in conducting long-term stewardship activities at various sites, significant uncertainty in DOE's long-term stewardship cost estimates will remain.

Also, as in any planning process, the degree of uncertainty in cost estimates is greater for the long-range out years than for the near-term years. This situation is similar to the challenge posed to the Department in 1994, when the first attempt was made to estimate overall cost and schedule for the Environmental Management (EM) program. Most sites did not at that time develop or maintain project life-cycle plans. Life-cycle planning is now routine for most EM activities, which has allowed the program to move toward developing more rigorous cost estimates of future activities.

No existing institution has yet acquired experience in protecting public health and the environment from hazards for such a long period of time. This lack of experience is a point made in the recent National Research Council report, which includes a quote by the former Director of the Oak Ridge National Laboratory, Alvin Weinberg: "We nuclear people have made a Faustian bargain with society. On the one hand, we offer, in the catalytic nuclear burner, an inexhaustible source of energy... But the price that we demand of society for this magical energy source is both a vigilance and a longevity of our social institutions that we are quite unaccustomed to."

Consequently, the cost estimates in this Report are only as good as the information currently available on the anticipated universe of sites, cleanup remedies, and the anticipated scope of long-term stewardship activities.

More reliable cost estimates for conducting long-term stewardship activities are available at sites where cleanup has been completed, especially for those sites currently managed by DOE's Grand Junction Office, which manages numerous small mill tailings sites where remediation is complete or nearly complete. However, even at the sites that have developed cost estimates, there is considerable uncertainty. For example, the budget for conducting long-term stewardship Field activities is clearly identified, and the Grand Junction Office includes costs for conducting routine monitoring and maintenance. However, it is not clear if the cost estimates include activities such as responding to Freedom of Information Act requests or providing information to future site users.

Site-specific long-term stewardship activities including estimated costs are provided in Volume II, and further discussion of the costs associated with long-term stewardship is provided in Volume I in Chapter 3: Results, as well as Appendices E, F and G of Volume I.

1.3 Organization of This Report

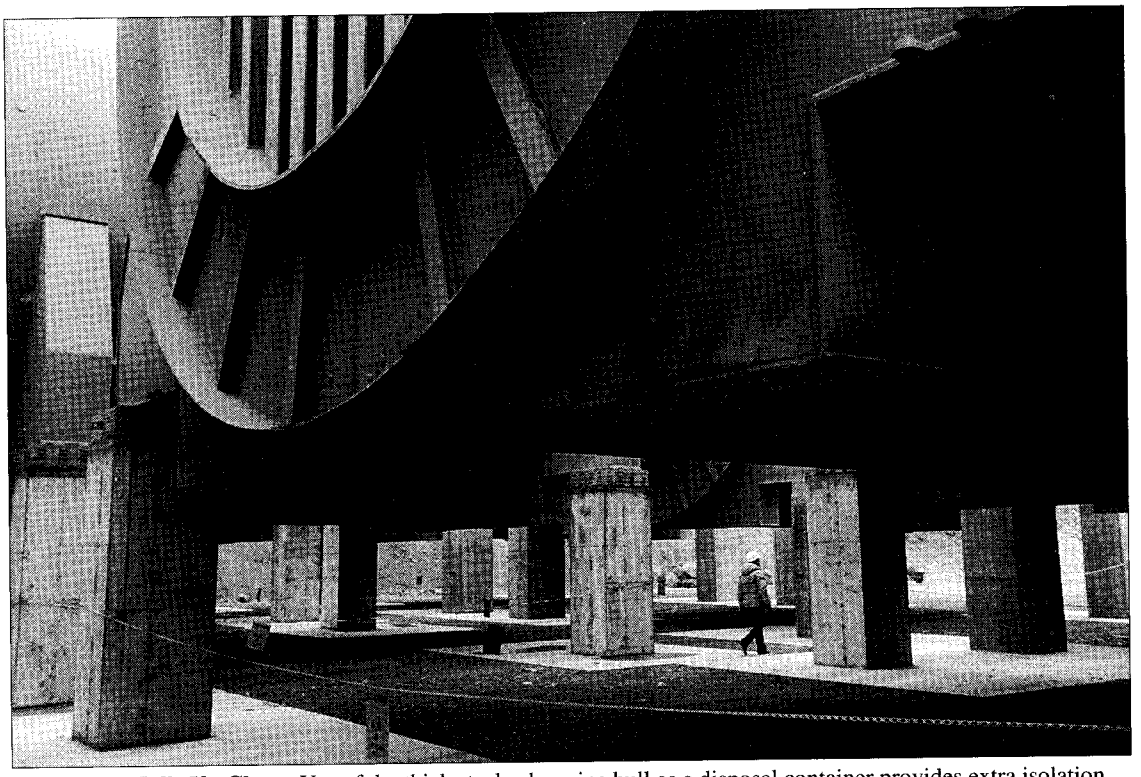
This Report to Congress is presented in two volumes:

- *Volume I, Report to Congress: Long-Term Stewardship Report* contains four chapters that provide a summary-level discussion of the anticipated long-term stewardship activities at DOE sites; establish preliminary site-specific long-term stewardship baselines for cost, scope, and schedule; and discuss key findings and results.

  - Chapter 1 introduces the purpose and provides background
  - Chapter 2 describes the scope and assumptions
  - Chapter 3 presents the results
  - Chapter 4 discusses next steps

- *Volume II, Site Summaries* includes site-specific summaries for the sites where DOE is expected to conduct long-term stewardship, sites where DOE participated in cleanup but is not responsible for long-term stewardship, as well as other sites where DOE may be responsible for long-term stewardship. The site summaries are organized alphabetically by State and include the following for each site: the overall site history, accomplishments to date in conducting environmental remediation activities, the regulatory regime under which long-term stewardship is being or will be conducted, and a summary of long-term stewardship activities that will be required as a result of residual waste or contamination. The summary also provides information on estimated long-term stewardship costs and the basis for the cost estimates (costs were not provided for sites where DOE may not be responsible for long-term stewardship, and 21 FUSRAP sites where the extent of long-term stewardship is yet to be determined). For sites where remediation activities at all site portions are (or will be) completed by 2006, the summary presents an entire site description. For sites where only portions will have active remediation completed or waste stabilized by 2006, the site summaries are broken into portion-by-portion descriptions. Site and portion maps accompany the discussions. A complete list of sites included in Volume II is provided in Appendix B.

Hull sections of decommissioned nuclear-powered submarines are put in disposal trenches. The used nuclear fuel is removed from the sections of the submarine hulls that contain nuclear reactors. The radioactively contaminated hull sections with the defueled reactors inside are then transported by barge to Hanford, where they are placed in a trench for burial. *Trench 94, Hanford Site, Washington. July 12, 1994.*



Submarine Hulls Up Close. Use of the thick steel submarine hull as a disposal container provides extra isolation between the environment and the low-level waste and hazardous lead that remain after the spent nuclear fuel has been removed. *Trench 94, Hanford Site, Washington. December 20, 1993.*

Chapter 2

Scope and Assumptions

CHAPTER 2: SCOPE AND ASSUMPTIONS

This chapter summarizes the scope of this Report and the assumptions used by DOE in developing the information provided in this Report. In particular, this section discusses:

- the scope of sites for which DOE expects to conduct long-term stewardship activities;
- the specific long-term stewardship activities that DOE anticipates it will perform at sites; and
- the expected timing of long-term stewardship.

Along with each of these discussions, this section also identifies the uncertainties involved and the assumptions used in predicting the scope of sites and activities and the timing of long-term stewardship. The methodology used to collect and analyze site data used for this Report is contained in Appendix C.

2.1 SCOPE

This Report presents a comprehensive - albeit not detailed - view of the anticipated scope of DOE's long-term stewardship responsibility. It reflects the results of the first significant data collection effort designed specifically to improve the Department's understanding of the nature and extent of long-term stewardship activities anticipated at DOE sites across the country. This Report was developed to respond to the requirements established by the FY 2000 NDAA, as well as other reasons (discussed in Section 1.1 of this Report), and reflects current planning, the current state of understanding, and information currently available on long-term stewardship.

Consistent with the Congressional request, this Report focuses on sites where remediation for the entire site or portion(s) of a site is anticipated to be complete by 2006 and where DOE is expected to be responsible for long-term stewardship (see Exhibit 2-1). In most cases, this includes sites where cleanup is currently managed by DOE and where DOE has a clear and planned responsibility for long-term stewardship. To respond to broader Congressional interest, and to support DOE program management planning, this Report also includes some additional information about sites where DOE may be responsible for long-term stewardship activities, but the extent of remediation and associated long-term stewardship activities have yet to be determined. Because of the uncertainty about the nature and the extent of the long-term stewardship requirements for these sites, less information is available. Generally, the information in this Report is limited to qualitative information on these sites, (e.g., the names and histories of the sites) consistent with what the Department has already reported in previous documents, such as *Paths to Closure* and *From Cleanup to Stewardship.*[12,13] DOE will develop more detailed information on costs and technical requirements for long-term stewardship at these sites as the cleanup process matures and the nature and the extent of the long-term stewardship needs at these sites are better known.

The scope of long-term stewardship described in previous documents (e.g., *From Cleanup to Stewardship*) was based on the implied site "end states" as described in earlier reports and from data collected to serve other EM initiatives. For example, information was extracted from waste disposition data and planning tools (e.g., disposition maps); the *Baseline Environmental Management Report*, which was designed to estimate the overall cost and schedule for the EM program; and *Paths to Closure*, which was an effort focused on

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[12] *Accelerating Cleanup: Paths to Closure*, DOE/EM-0362, June 1998. "Status Report on Paths to Closure" U.S. Department of Energy Office of Environmental Management, March 2000.

[13] *From Cleanup to Stewardship, A Companion Report to Accelerating Cleanup: Paths to Closure and Background Information to Support the Scoping Process Required for the 1998 PEIS Settlement Study*, U.S. Department of Energy, Office of Environmental Management, October 1999.

"DOE SITES" VERSUS SITES FOR WHICH DOE MAY HAVE LONG-TERM STEWARDSHIP RESPONSIBILITY

As used in this Report, the term "DOE sites" does not necessarily include the full universe of sites that may become part of DOE's long-term stewardship responsibilities. Other sites may become DOE's responsibility for long-term stewardship include the following:

Sites regulated under *Title II of the Uranium Mill Tailings Radiation Control Act of 1978* (UMTRCA). These are commercial uranium mining and milling sites that contained uranium mill tailings and were in operation at the time of enactment. UMTRCA Title II requires that the host State or the Federal government monitor and maintain all closed Title II mill tailings disposal sites. When a host State declines to become the long-term steward for a mill tailings disposal cell, these responsibilities are assigned to the U.S. Department of Energy (DOE). Once the site is transferred to DOE, DOE becomes a licensee to the NRC under Title 10 of the Code of Federal Regulation Section 40.28, which is the *General License for Custody and Long-Term Care of Uranium of Thorium Byproduct Material Disposal Sites*. Currently two such sites out of a total of 28 are under DOE custody. The balance of the sites may be transferred to DOE over a period of years upon satisfactory completion of site remediation. Therefore, these sites are included in the scope of this Report. In addition to the known 28 sites, other uranium mill tailings sites could be transferred to DOE under the Title II program.

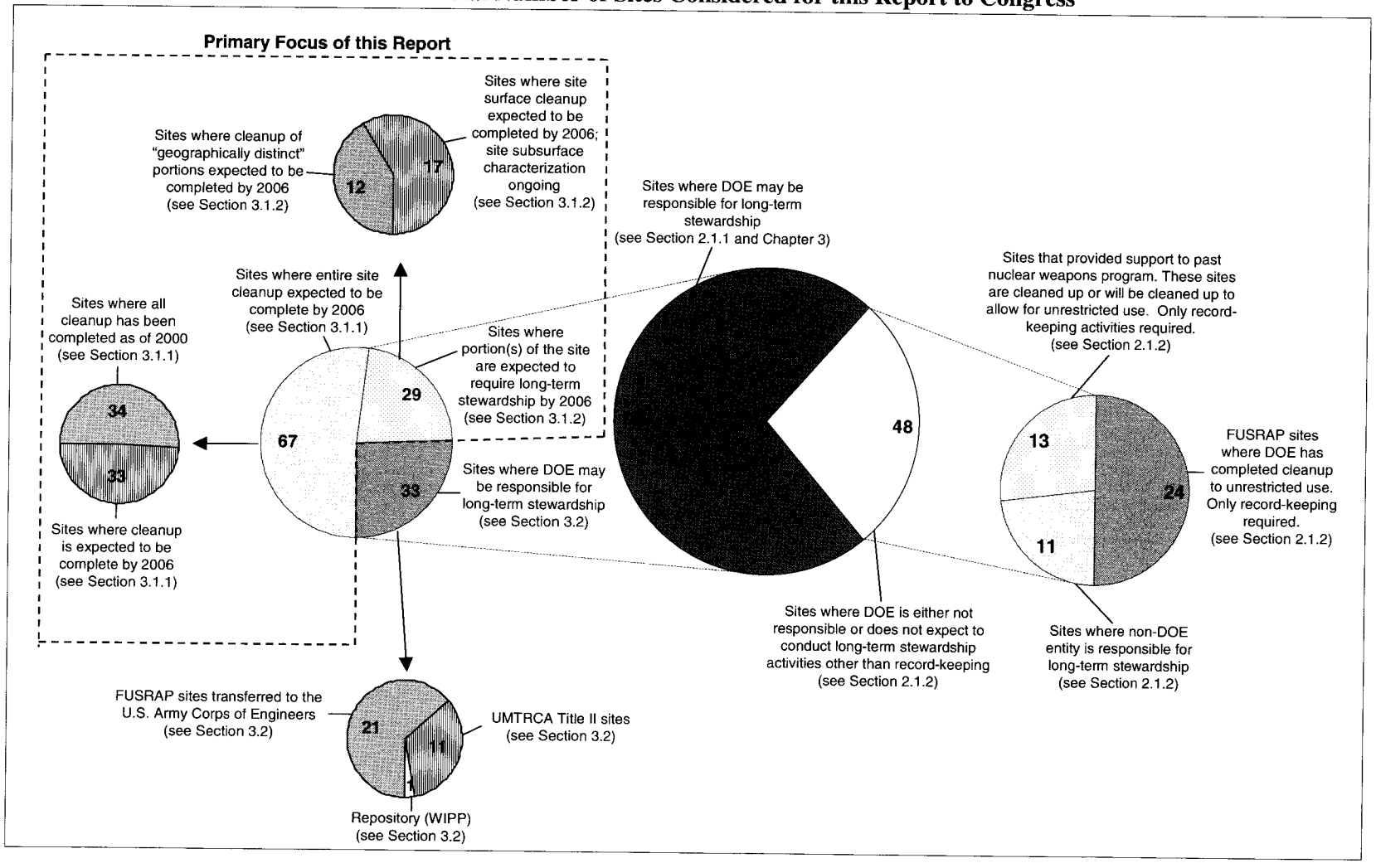
Sites regulated under the Nuclear Waste Policy Act, Section 151(b) and (c). Excluded from this analysis is an uncertain number of low-level radioactive waste sites under Section 151(b) and (c) of the Nuclear Waste Policy Act, as amended (NWPA). Section 151(b) provides DOE the authority to assume title and custody of low-level radioactive waste and the land on which it is disposed, upon request of the owner of the waste site and following termination of the NRC license (subject to certain conditions). DOE's authority under this section is discretionary, not mandatory, and its current policy is that it does not intend to accept responsibility for these 151(b) sites. For this reason, they are currently not included in this Report. However, it is possible that at some later time such sites may ultimately become the responsibility of DOE and, hence, increase the number of sites that fall within the scope of DOE's long-term stewardship program.

Section 151(c) of the NWPA provides that if the low-level radioactive waste involved is the result of a licensed activity to recover zirconium, hafnium, and rare earths from source materials, DOE shall assume title and custody of the waste and land, upon request of the owner of the site, when the site has been decontaminated and stabilized in accordance with NRC requirements and has made financial arrangements for long-term maintenance and monitoring. At present, only one such site – the Parkersburg Site in West Virginia – has been transferred to and is being managed by DOE pursuant to Section 151(c), and this site is included in this Report. It is uncertain at this time whether additional such sites will come under DOE's management.

accelerating cleanup, site closure, and project completion.[14] While useful for a first estimate, these various data sources do not necessarily provide adequate detail to capture the long-term stewardship activities. The data collected for this Report allow for examination of long-term stewardship issues with greater granularity, including examining portions of sites versus site-wide analyses; differentiating information by affected media type; and quantifying the volume of contamination and the extent of residual contamination and waste. This Report represents the next step in developing a complete scope and understanding of DOE's long-term stewardship program. Most Field offices have more detailed information than is summarized in these publicly available documents (some of which is not explicitly identified as "long-term stewardship" information).

[14] The *Baseline Reports* in 1995 and 1996 were the first post-Cold War effort to describe DOE's cleanup program and analyze the impacts of various program alternatives. The *Paths to Closure* reports in 1998, 1999, and 2000 sought not only to describe the EM program, but to identify ways to accelerate the cleanup, site closure and project completion process and reduce overall costs. Data from both reports were used to develop the initial estimates of the scope of long-term stewardship.

Exhibit 2-1. Total Number of Sites Considered for this Report to Congress[15]

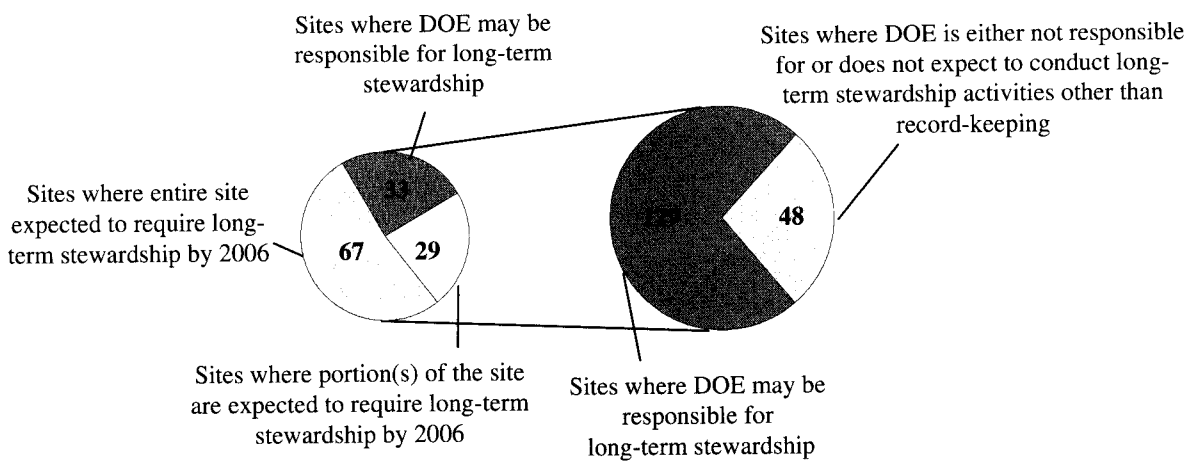


[15] This report does not include sites managed by the Naval Nuclear Propulsion Program -- a joint DOE/U.S. Navy program. The sites included in this program are the Knolls Atomic Power Laboratory near Schenectady, NY; Kesselring Site, located about 25 miles north of the Knolls Atomic Power Laboratory near West Milton/Saratoga Springs, NY; the Bettis Laboratory, near Pittsburgh, PA; the Windsor Site of the Knolls Atomic Power Laboratory in Windsor, CT; and the Naval Reactors Facility located at the Idaho National Engineering and Environmental Laboratory.

2.1.1 DOE Expects to Conduct Long-Term Stewardship Activities at up to 129 Sites[16]

Based on data submitted for this Report and the methodology used for the development of this Report (see Appendix C), DOE is conducting or expects to conduct long-term stewardship activities at up to 129 sites (see Exhibit 2-2). By 2006, DOE expects to conduct long-term stewardship activities at 96 of these sites. The extent of long-term stewardship activities at these 96 sites, depend on the nature of remaining residual contaminants. DOE may be responsible for long-term stewardship activities at an additional 33 sites post 2006; however, the extent of remediation activities and the extent of long-term stewardship activities, if any, for many of these sites are not known at this time.

Exhibit 2-2. DOE Expects to Conduct Long-Term Stewardship Activities at up to 129 Sites

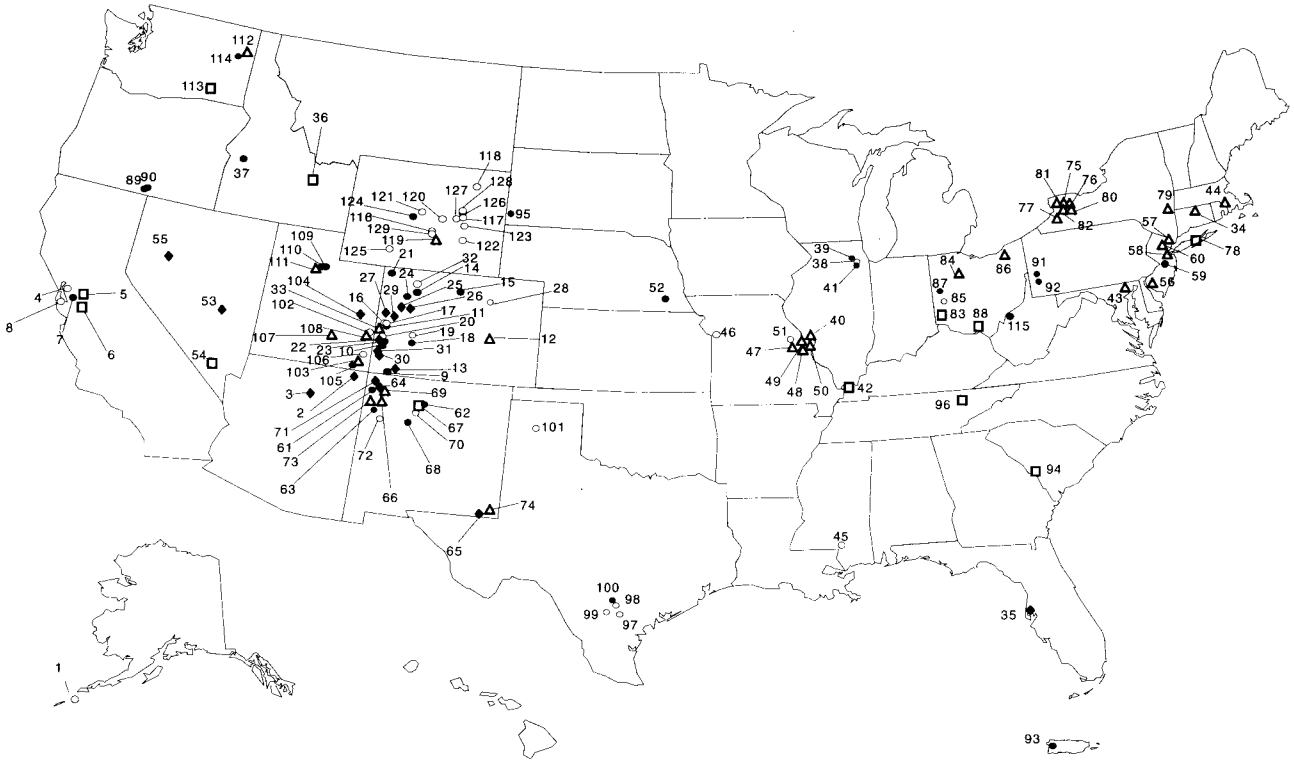


The specific locations and names of the 129 sites are provided in Exhibit 2-3 and Table 2-1. These sites can be described as follows:

- Remediation activities are expected to be entirely completed for 67 sites by 2006. At these sites, the only remaining environmental management commitment will be performing long-term stewardship activities. Remediation activities for 34 of the 67 sites are already complete as of 2000 (see Section 3.1.1).
- At 29 sites, DOE is either conducting or expects to conduct long-term stewardship activities at portions of the sites where remediation activities have been or will be completed by 2006. At 12 of the 29 sites, DOE anticipates having completed remediation activities at geographically distinct portions of the sites by 2006. At the remaining 17 sites, DOE anticipates completing surface remediation work by 2006 but will have ongoing responsibility for subsurface characterization and remediation beyond 2006 (see Section 3.1.2).
- DOE may be responsible for long-term stewardship activities at as many as 33 additional sites (see Section 3.2), but the extent of remediation and associated long-term stewardship activities have yet to be determined.

[16] The 129 sites include 33 sites where DOE may be responsible for conducting long-term stewardship activities. Twenty-one of the 33 sites are FUSRAP sites where responsibility was transferred to the U.S. Army Corps of Engineers (Corps) in accordance with the Energy and Water Development Appropriations Act for FY 1998. At these sites, the Corps is responsible for remediation and DOE is responsible for long-term stewardship activities, if necessary. The cleanup decisions for these sites are not yet final and, therefore, the extent of long-term stewardship required for these sites, if any, is not yet known.

Exhibit 2-3. Map of 129 Sites that May Require Long-Term Stewardship (see Table 2-1 for names of sites)



- • 34 sites where cleanup has been completed and DOE is conducting long-term stewardship activities as of 2000
- ○ 33 sites where cleanup is expected to be completed and DOE will conduct long-term stewardship activities by 2006
- 29 sites where portion(s) of the site are expected to require long-term stewardship by 2006
  - □ 12 sites with geographically distinct portions requiring long-term stewardship by 2006
  - ♦ 17 sites where surface cleanup is completed by 2006 and will require long-term stewardship but subsurface characterization and remediation activities will be on-going after 2006
- △ 33 sites where DOE may be responsible for long-term stewardship, if long-term stewardship activities are necessary

Table 2-1. 129 Sites That May Require Long-Term Stewardship (see Exhibit 2-3 for locations)

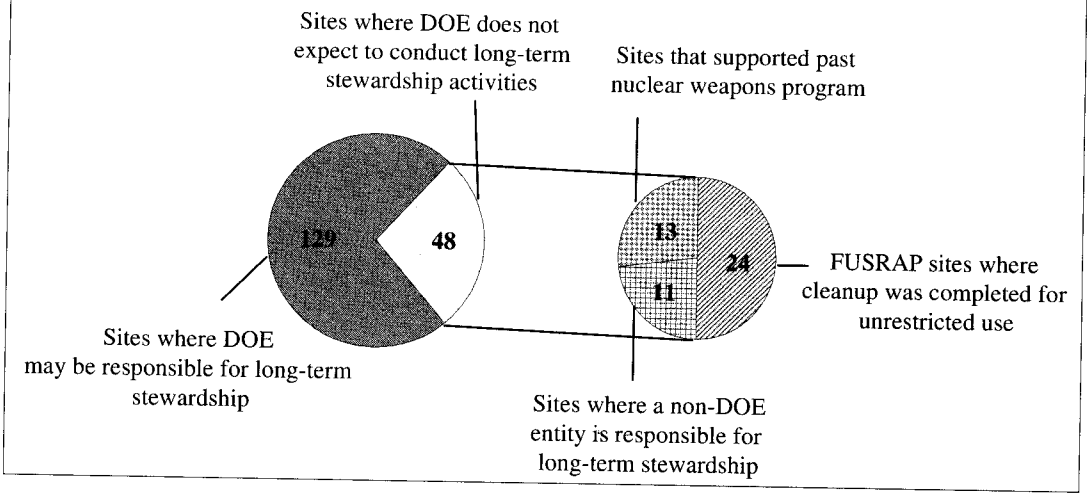
No.	State	Site	No.	State	Site	No.	State	Site
1	AK	Amchitka Island	44	MA	Shpack Landfill	87	OH	Piqua Nuclear Power Facility
2	AZ	Monument Valley Site	45	MS	Salmon Site	88		Portsmouth Gaseous Diffusion Plant
3		Tuba City Site	46	MO	Kansas City Plant	89	OR	Lakeview Mill
4	CA	Lawrence Berkeley National Laboratory	47		Latty Avenue Properties	90		Lakeview Site
5		Lawrence Livermore National Laboratory - Livermore	48		St. Louis Airport Site	91	PA	Burrell Site
6		Lawrence Livermore National Laboratory - Site 300	49		St. Louis Airport Site Vicinity Properties	92		Canonsburg Site
7		Sandia National Laboratories - CA	50		St. Louis Downtown Site	93	PR	Center for Energy and Environmental Research
8		Stanford Linear Accelerator	51		Weldon Spring Site	94	SC	Savannah River Site
9	CO	Bodo Canyon Cell	52	NE	Hallam Nuclear Power Facility	95	SD	Edgemont Site
10		Burro Canyon Disposal Cell	53	NV	Central Nevada Test Area	96	TN	Oak Ridge Reservation
11		Cheney Disposal Cell	54		Nevada Test Site	97	TX	(Chevron) Panna Maria Site
12		(Cotter) Cañon City Site	55		Project Shoal	98		(Conoco) Conquista Site
13		Durango Mill	56	NJ	DuPont & Company	99		(Exxon) Ray Point Site
14		Estes Gulch Disposal Cell	57		Maywood Chemical Works	100		Falls City Site
15		Fort St. Vrain Independent Spent Fuel Storage Facility	58		Middlesex Sampling Plant	101		Pantex Plant
16		Grand Junction Mill 1	59		Princeton Plasma Physics Laboratory	102	UT	(Atlas) Moab Mill
17		Grand Junction Mill 2	60		Wayne Site	103		(EFN) White Mesa Site
18		Gunnison Disposal Cell	61	NM	Ambrosia Lake	104		Green River Site
19		Gunnison Mill	62		Bayo Canyon	105		Mexican Hat Site
20		(HECLA) Durita Site	63		Bluewater Site	106		Monticello Mill Site and Vicinity Properties
21		Maybell Mill Site	64		Gasbuggy Site	107		(Plateau) Shootaring Canyon Site
22		Naturita Mill	65		Gnome-Coach	108		(Rio Algom) Lisbon Valley Site
23		Naturita Site	66		(Homestake) Grants Site	109		Salt Lake City Mill
24		Naval Oil Shale Reserves Site	67		Los Alamos National Laboratory	110		South Clive Disposal Cell
25		Rifle (New) Mill	68		Lovelace Respiratory Research Institute	111		11e.(2) Disposal Site
26		Rifle (Old) Mill	69		(Quivira) Ambrosia Lake Site 2	112	WA	(Dawn) Ford Site
27		Rio Blanco	70		Sandia National Laboratories - NM	113		Hanford Site
28		Rocky Flats Environmental Technology Site	71		Shiprock Site	114		(WNI) Sherwood Site
29		Rulison	72		(SOHIO) LBAR Site	115	WV	Parkersburg Site
30		Slick Rock (North Continent) Mill 1	73		(UNC) Church Rock Site	116	WY	(ANC) Gas Hills Site
31		Slick Rock (Union Carbide) Mill 2	74		Waste Isolation Pilot Plant	117		(Exxon) Highlands Site
32		(UMETCO) Maybell Site 2	75	NY	Ashland Oil #1	118		Hoe Creek Underground Coal Gasification Site
33		(UMETCO) Uravan Site	76		Ashland Oil #2	119		(Kennecott) Sweetwater Site
34	CT	CE	77		Bliss and Laughlin Steel	120		Naval Petroleum Reserve No. 3 Landfill/Landfarm
35	FL	Pinellas STAR Center	78		Brookhaven National Laboratory	121		(Pathfinder) Lucky Mc Site
36	ID	Idaho National Engineering and Environmental Lab	79		Colonie	122		(Pathfinder) Shirley Basin Site 2
37		Lowman Site	80		Linde Air Products	123		(Petrotomics) Shirley Basin Site 1
38	IL	Argonne National Laboratory East	81		Niagara Falls Storage Site	124		Riverton Site
39		Fermi National Accelerator Laboratory	82		Seaway Industrial Park	125		Rock Springs Oil Shale Retort Site
40		Madison	83	OH	Fernald Environmental Management Project	126		Spook Site
41		Palos Forest (Site A/Plot M) Preserve	84		Luckey	127		(UMETCO) Gas Hills Site
42	KY	Paducah Gaseous Diffusion Plant	85		Miamisburg Environmental Management Project	128		(Union Pacific) Bear Creek Site
43	MD	W. R. Grace and Company	86		Painesville	129		(WNI) Split Rock Site

2.1.2 48 Sites Where DOE Is Either Not Responsible or Does Not Expect to Conduct Long-Term Stewardship Activities Other than Record-Keeping

DOE identified 48 sites, noted in previous DOE documents, where it is either not responsible or does not expect to conduct long-term stewardship activities other than record-keeping. The categories of these sites are discussed below and illustrated in Exhibit 2-4. Generally, there are two reasons why DOE does not expect to be responsible for long-term stewardship activities at sites where DOE has been involved in the cleanup:

- Legal or other agreements identify an entity other than DOE as being responsible for long-term stewardship, if needed.
- Some sites have been or will be cleaned up to standards allowing for unrestricted use, requiring no long-term stewardship other than record-keeping activities by DOE.

Exhibit 2-4. At 48 Sites, DOE is Either Not Responsible or Does Not Expect to Conduct Long-Term Stewardship Activities Other than Record-Keeping



Sites Where a Non-DOE Entity is Responsible for Long-Term Stewardship

There are 11 sites where, upon completion of cleanup, DOE does not currently anticipate being responsible for long-term stewardship activities. At these sites, DOE is responsible for site cleanup activities but is not the owner of the sites and not expected to be responsible for long-term stewardship. In the case of the West Valley Demonstration Project in New York, the nature of and responsibility for long-term stewardship activities are currently being negotiated with the State of New York and, therefore, are yet to be determined. DOE does not own this site, but is responsible for most of the site's cleanup activities.

11 SITES WHERE NON-DOE ENTITY IS RESPONSIBLE FOR LONG-TERM STEWARDSHIP

California	Energy Technology Engineering Center
	General Atomics
	General Electric Vallecitos Nuclear Center
	Laboratory for Energy Related Health Research
Kentucky	Maxey Flats Disposal Site
Missouri	Westlake Disposal Site
New Mexico	South Valley Superfund Site
New York	West Valley Demonstration Project*
Ohio	Ashtabula Environmental Management Project
	Battelle Columbus - King Avenue Site
	Battelle Columbus - West Jefferson Site

** DOE's long-term stewardship responsibility, if any, is currently undetermined.*

Sites Which Have Been or Will Be Cleaned to Unrestricted Use Levels, Requiring No Long-Term Stewardship Activities Other than Record-Keeping

There are 37 sites where DOE has completed or has plans to complete cleanup to levels allowing for unrestricted use and where long-term stewardship activities are expected to be limited to record-keeping only.[17] These sites include

- 24 Formerly Utilized Sites Remedial Action Program (FUSRAP) sites, and
- 13 sites that supported past nuclear weapons or power programs.

The 24 FUSRAP sites were cleaned up to unrestricted use by DOE during the period prior to 1997, when DOE was still responsible for the FUSRAP program. These sites were contaminated during the 1940s and 1950s as a result of researching, developing, processing, and producing uranium and thorium and storing processing residues. Cleanup work at the sites began in the late 1970s. DOE completed cleanup at these sites allowing for unrestricted use. DOE's only remaining responsibility is to maintain records of the completed cleanup. For example, one such site is the Aliquippa Forge site located just west of the Ohio River in Pennsylvania. Completion of remediation of low-level radioactive waste in 1994 included building decontamination and excavation of contaminated soil and concrete. The current site owner is the Beaver County Corporation for Economic Development. DOE's only remaining role is maintaining records of the cleanup.

24 FUSRAP SITES WHERE DOE HAS COMPLETED CLEANUP ALLOWING FOR UNRESTRICTED USE

California	University of California	New York	Baker and Williams Warehouses
Connecticut	Seymour Specialty Wire		Niagara Falls Storage Site Vicinity Properties
Illinois	Granite City Steel	Ohio	Alba Craft
	National Guard Armory		Associate Aircraft
	University of Chicago		B&T Metals
Massachusetts	Chapman Valve		Baker Brothers
	Ventron		Herring-Hall Marvin Safe Co.
Michigan	General Motors	Oregon	Albany Research Center
New Jersey	Kellex/Pierpont	Pennsylvania	Aliquippa Forge
	Middlesex Municipal Landfill		C.H. Schnoor, PA
	New Brunswick Site	Tennessee	Elza Gate
New Mexico	Acid/Pueblo Canyons		
	Chupadera Mesa		

The 13 sites that supported past nuclear weapons or power programs include various former test sites and research facilities. At these sites, DOE has completed or expects to complete cleanup to levels allowing for unrestricted use. Now, only record-keeping activities by DOE are required. For instance, DOE anticipates completing all remediation activities by 2006 at the Ames Laboratory in Iowa. In 1998, the Iowa Department of Public Health approved the site for unrestricted use; however, DOE will continue to perform groundwater monitoring through 2002 and other actions through 2006. Consequently, DOE anticipates no long-term stewardship activities, beyond record-keeping activities, to be required.

[17] Although record-keeping is part of long-term stewardship, for the purpose of this Report, record-keeping is not considered active long-term stewardship.

13 SITES THAT SUPPORTED PAST NUCLEAR WEAPONS OR POWER PROGRAMS

Alaska	Project Chariot	New Mexico	Holloman Air Force base
California	Geothermal Test Facility		Pagano Salvage Yard
	Oxnard Facility	New York	Separation Process Research Unit
	Salton Sea Test Base	North Dakota	Belfield[a]
Florida	Peak Oil PRP Participation		Bowman[a]
Hawaii	Kauai Test Facility	Pennsylvania	Shippingport[b]
Iowa	Ames Laboratory		

[a] *Any long-term responsibility for these sites resides with the State of North Dakota.*
[b] *Supported commercial nuclear power demonstration projects.*

2.1.3 Uncertainties in Estimating the Number of Sites

The estimated number of sites at which DOE expects to perform long-term stewardship activities has remained fairly constant since 1995, when DOE first began conducting analyses of the potential scope of long-term stewardship. However, there are several factors that could increase the number of sites significantly.

As discussed earlier, the scope of this Report includes only sites for which DOE clearly has responsibility for any required long-term stewardship activities currently or in the future. This includes 96 sites where DOE expects to conduct long-term stewardship for either the entire site or portion(s) of the site.

However, DOE is also responsible for long-term stewardship at sites categorized under the Formerly Utilized Sites Remedial Action Program (FUSRAP) and the Uranium Mill Tailings Radiation Control Act (UMTRCA) Title II, and may be responsible for sites under NWPA Section 151, but the timing and extent of DOE's long-term stewardship obligations at these sites still remains uncertain at this time. This is further elaborated below.

- **FUSRAP Sites.** The FY 1998 Energy and Water Appropriations Act transferred responsibility for cleanup of 21 sites being managed as part of FUSRAP from DOE to the U.S. Army Corps of Engineers (Corps) (see Section 3.2). Subsequently, DOE and the Corps completed a Memorandum of Understanding (MOU) that requires that DOE take responsibility for sites after cleanup (beginning two years following "closure" of the cleanup project) to conduct required long-term stewardship activities, if any. The extent of DOE's long-term stewardship responsibilities will depend on the final cleanup decisions made for each site and are uncertain at this point.

- **UMTRCA Title II Sites.** A number of privately owned sites that were contaminated with uranium mill tailings resulting from the processing of uranium for sale to the Federal government and to private clients. Upon completion of remediation work, DOE will maintain records and conduct maintenance and monitoring to ensure continued appropriate land use. The Department began a program in September 2000 to develop a database of sites that will improve the efficiency with which these sites are tracked.[18] Similar to the FUSRAP sites, the extent of DOE's long-term stewardship responsibility will depend on the final cleanup decisions made for each UMTRCA Title II site.

[18] In response to a question, "The government never has released any sort of comprehensive list of all the private sites. Would you consider compiling a registry?" Secretary of Energy, Bill Richardson, stated, "I would be receptive to such an idea. We've already started to develop databases that can be shared with the public. I believe it's important that we be open with the public and our workers, and we should do a full accounting" (USA Today on September 6, 2000).

- **NWPA Section 151 Sites**. Another source of potential long-term stewardship liability for DOE arises from Sections 151(b) and (c) of the NWPA. Section 151(b) provides "authority," but not a requirement, for DOE to take responsibility for long-term stewardship at low-level waste disposal sites after cleanup is complete (provided certain conditions are met, e.g., financial arrangements and compliance with NRC closure, decommissioning, and decontamination requirements). DOE is seeking to avoid or minimize any liability to the Government from additional facilities and to ensure, pursuant to the law, that any facilities transferred to DOE for long-term stewardship occur only at no cost to the Government. It's current policy is to not seek responsibility for long-term stewardship of these sites. However, DOE understands that there may arise circumstances under which DOE may need to accept such responsibility. For example, if a facility owner lacks the funds to conduct long-term stewardship (i.e., as a result of bankruptcy), there might be only a few options for ensuring that long-term stewardship activities are in place to protect health and the environment. It is possible that the owner would have established and have available funding through a surety bond. It is also possible that the State where the site is located could take responsibility for long-term stewardship. In any case, it is too uncertain at this time to predict whether such sites would come under DOE's responsibility for long-term stewardship. (Before accepting any such responsibility, DOE would need to understand the nature and extent of the potential liabilities. This research and analysis could help provide an informed basis from which to discuss any proposed transfer.)

  Section 151(c) of the NWPA provides that if the low-level radioactive waste involved is the result of a licensed activity to recover zirconium, hafnium, and rare earths from source materials, DOE shall assume title and custody of the waste and land, upon request of the owner of the site, when the site has been decontaminated and stabilized in accordance with NRC requirements and has made financial arrangements for long-term maintenance and monitoring. At present, only one such site – the Parkersburg Site in West Virginia – has been transferred to and is being managed by DOE pursuant to Section 151(c), and this site is included in this Report. It is uncertain at this time whether additional such sites will come under DOE's management.

The number of sites for which DOE has long-term stewardship responsibility may also decrease over time, depending on a number of factors. A change in law could transfer long-term responsibility of some sites to another governmental, Tribal, or private entity. New developments in science and technology could provide solutions to contaminated sites currently included in the scope of long-term stewardship because they are technically or economically infeasible to clean up. At some sites, the radiological contaminants have short half-lives, so that in a matter of decades or centuries the hazard may no longer exist. Many varied situations like these could affect DOE's responsibilities over time.

2.1.4 Activities Required for Long-Term Stewardship

For sites to achieve closure and begin the phase of long-term stewardship, the first critical activity is to develop detailed long-term stewardship plans. Detailed planning early on, which includes clearly defining the end state, will ensure that all decision-makers and stakeholders understand the final cleanup objectives (e.g., the end state, including cleanup levels and land use), how those objectives will be achieved (e.g., the remedies selected), and the requirements for maintaining the site after remediation activities are completed (e.g., long-term stewardship requirements and their implications for future land use). Sites will need to identify and document the scope, schedule, costs, and uncertainties associated with long-term stewardship activities in sufficient detail to ensure effective and efficient management of these activities, including

appropriate exit strategies.[19] Documentation may be in a variety of forms. For example, for sites where the only ongoing activities will be long-term stewardship, this information can be documented in a long-term stewardship plan. (The Grand Junction Office already requires long-term stewardship plans for all sites managed under its long-term stewardship program.[20]) For other sites, such as sites with ongoing research or defense missions, long-term stewardship activities may be included in site-wide management plans, Land Use Control and Assurance Plans (LUCAPs), or other comparable documents that would provide sufficient detail (e.g., technical scope, uncertainties, activities, and cost) needed to effectively manage long-term stewardship at these sites.[21]

Long-term stewardship involves a wide variety of activities, depending on the site conditions and/or the residual hazards. Some long-term stewardship activities have been mandated by regulation, compliance agreements, DOE Orders, or site-specific documents, while others are yet to be defined. Although statutory and regulatory requirements provide guidelines for long-term stewardship, existing requirements do not clearly delineate the measures needed in the future for long-term stewardship; nor do they ensure the development of effective implementation strategies.

Long-term stewardship activities currently range from record-keeping, surveillance, monitoring, and maintenance at sites with residual contamination posing hazards of little concern, to possibly maintaining permanent access restrictions at sites having hazards of greater concern. They are generally described as the activities necessary to maintain either institutional controls or engineered controls (e.g., contaminant reduction and isolation measures) in place at the sites. Institutional controls are designed to control future land or resource use of a site with residual contamination by limiting land development or restricting public access to the resources. Institutional controls include physical systems (e.g., fences or other barriers), governmental controls (e.g., ordinances and building permit requirements), and proprietary controls (e.g., deed restrictions and easements). Engineered controls are barriers constructed to prevent contaminant migration or to prevent intrusion to an otherwise restricted area. Examples of engineered controls include caps and liners, leachate collection systems, and monitoring and containment systems.[22]

Examples of long-term stewardship activities include monitoring for potential contaminant migration and assessing, on an ongoing basis, the effectiveness of existing remedies (e.g., disposal cells, physical access restrictions, permits, and other legal or institutional controls). Table 2-2 describes examples of long-term stewardship activities by media that will be conducted at DOE sites. Further discussion of long-term stewardship activities is included in Chapter 3 of this Report. Site-specific activities are described in Volume II.

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[19] *Developing Exit Strategy for Environmental Restoration Projects.* DOE Office of Environmental Management, March 2000.

[20] An example of a long-term surveillance plan for a site transferred to the Grand Junction Office for long-term stewardship is available at http://www.doegjpo.com/programs/ltsm.

[21] Region IV Federal Facilities Branch: (Memorandum from Jon D. Johnstown, Chief) "Assuming Land Use Controls at Federal Facilities." U.S. EPA, Region IV. 4WD-FFB. April 13, 1998. See http://www.epa.gov/region04/waste/fedfac/landusea.htm.

[22] See *Institutional Controls in RCRA & CERCLA Response Actions.* U.S. Department of Energy, Office of Environmental Health. DOE/EH-413-0004. August 2000.

Table 2-2. Examples of Long-Term Stewardship Activities by Media

Media Subject to Long-Term Stewardship Requirements	*Examples of Long-Term Stewardship Activities*
Groundwater: All contaminated groundwater that cannot or has not been remediated to levels appropriate for unrestricted use or met alternate regulatory levels	• Verification and/or performance monitoring • Use restrictions, access controls (site comprehensive land use plan) • Five-year (or comparable) review requirements • Resource management to minimize potential for exposure
Soil: All surface and subsurface soil where residual contamination exists or where wastes remain under engineered, vegetative, or other caps	• Institutional controls to limit direct contact or food chain exposure • Maintaining engineered, asphalt, or clean soil caps • Permit controls, use restrictions, markers (site comprehensive land use plan) • Five-year (or comparable) remedy review requirements
Engineered Units: All land-based waste disposal units with engineered controls	• Monitoring and inspections, per agreements, orders, or permits • Institutional controls, including restricted land use • Maintenance, including repairing caps • Five-year (or comparable) review requirements • Land and resource planning to minimize potential for exposure (site comprehensive land use plans)
Facilities: Buildings and other structures that are no longer in use, are contaminated, or for which future plans call for maintaining the structure with contamination in place	• Monitoring, inspections, and safeguard and security measures • Access restrictions • Five-year (or comparable) review requirements • Site reuse or redevelopment controls to minimize the potential for exposure (site comprehensive land use plan)
Surface Water/Sediments: All surface water and sediments that cannot or have not been remediated to levels appropriate for unrestricted use	• Monitoring, signage, land use restrictions • Five-year review

2.1.5 Uncertainties in Estimating the Scope of Long-Term Stewardship Activities

A key reason for uncertainties in estimating the scope and the associated schedule of long-term stewardship activities is the quality and completeness of available data. Uncertainties also reflect the current status of ongoing activities. Site personnel are currently characterizing the sites, assessing risk, and developing paths forward that will ultimately lead to long-term stewardship activities. The data collected for this Report represent, at best, a preliminary understanding of the nature of the challenge ahead. While data collected during this effort are much improved over the data used to develop the *Background Report*, the fact remains that there is a clear need to better understand the scope, schedule, and cost associated with managing long-term stewardship, as well as the impacts of uncertainties on the Department's ability to manage these activities.

The long-term stewardship plans required by the Long-Term Surveillance Program of DOE's Grand Junction Office include specific information on the location and the type of remaining hazards, required long-term monitoring activities, and detailed cost estimates for these activities. Most sites do not have staff dedicated to long-term stewardship planning. Therefore, the data received are often only estimates, may conflict with other data collection efforts, and may not accurately reflect the long-term responsibilities. Increased

understanding will allow the Department to better manage site-specific, long-term stewardship activities, better identify and plan for the technical uncertainties, and better direct the science and technology program to eventually address some of the residual contamination.

Many sites, such as Hanford, the Savannah River Site, and the Oak Ridge Reservation, have complex contamination and remediation challenges ahead. There are areas of multiple, co-mingled contaminants in groundwater plumes, and the extent of subsurface contamination remains unknown. These sites also have technically challenging problems in implementing an end state for the former production reactors and the processing canyons. Many remediation decisions are awaiting results of site characterization and investigation efforts. Until these decisions are made, significant uncertainty remains as to what the long-term obligations for the Department will be. While it is clear that long-term stewardship will be required at these sites because of existing disposal cells and some other known conditions (e.g., groundwater contamination that will be monitored and contained rather than remediated), the list of activities and associated costs to manage these activities in the future remains uncertain.

At other sites, where cleanup decisions have been made, a different type of uncertainty exists. Decisions have been made based on criteria identified in existing cleanup programs (e.g., RCRA, CERCLA) that include such factors as protectiveness of human health and the environment, long and short-term effectiveness, implementability, and overall community acceptance. However, these decisions are based on current regulatory requirements, an understanding of the overall site conditions, and assumed future land use, all of which may change at some point in the future.

There may also be a significant amount of additional record-keeping that is not currently included within the scope of this analysis. At sites where cleanup has been completed to levels allowing for unrestricted use, some record-keeping effort will still be required. The record-keeping will be needed because prospective site users may need to learn about the historic site use and known or suspected contamination, and whether the site was cleaned up. In this case, a record of the cleanup is necessary to explain whether any contamination was found and, if so, whether this historic contamination was removed, and the levels to which the contamination was cleaned up. By having ready access to these records, future site users can avoid potentially expensive and potentially dangerous site sampling to determine what the records could more readily show: whether the site has been "cleaned up" and to what level. It is also important to maintain records of previous cleanup if unknown contamination or other hazards are discovered in the future. Maintenance of records about the levels of residual contamination remaining for each site and portions of a site where cleanup has occurred is necessary, even if those levels are considered "safe for unrestricted use" by current standards. However, these standards could change and become more strict in the future. Maintaining these records does not necessarily imply that the Department of Energy agrees to undertake additional cleanup if standards become more restrictive.

The level of cleanup is based on the expected future land use. If the land use changes, or the underlying exposure standards on which those land uses were based change, then reliable records will be required to decide if additional cleanup or other protections are needed. The Department has indicated to the State and Tribal Government Working Group that, if a site has been remediated to levels appropriate for the specified land use, and communities decide that they desire further cleanup to allow for less restrictive land uses, then the cost of such additional cleanup should not be borne by the Department of Energy.[23]

Technical uncertainties also make estimating the scope of long-term stewardship very difficult. These

[23] Letter from James Owendoff to Armand Minthorn and Tom Winston, Co-Convenors of the State and Tribal Government Working Group (STGWG) Executive Committee on Closure for Seventh Generation, May 24, 1999 (page 1).

uncertainties include the nature of the hazards remaining onsite and the effectiveness of monitoring and maintenance of barriers and institutional controls. Other unknowns include the availability of adequate technologies in the future to address residual contaminants, the future development of better remedial and surveillance technologies, and the long-term management of data. These uncertainties should be included in site long-term stewardship plans to assist future stewards in addressing issues at the sites, should they arise. Examples of technical uncertainties associated with long-term stewardship are presented in Table 2-3.

Table 2-3. Examples of Technical Uncertainties by Media

Media	*Technical Uncertainties*
Groundwater	• What is the likelihood that residual contaminants will move toward or degrade a current or potential potable water source? • Are dense non-aqueous phase liquids (DNAPLs) or long-lived radionuclides present in concentrations and/or locations different than those identified? • Will treatment, containment, and monitoring programs remain effective and protective? • Will ambient conditions change significantly enough to diminish the effectiveness of the selected remedy (e.g., monitored natural attenuation) or allow resuspension of stabilized contaminants in sediments?
Soil	• What is the likelihood of future contaminants migration if ambient conditions change? • How will changes in land use affect the barriers in place to prevent contaminant migration and potential exposure? • What is the likelihood of cap failure sooner than anticipated? • What is the effect of contaminant degradation on remedy components (e.g., cap, vegetation)?
Engineered Units	• What is the effect of contaminant degradation on remedy components (e.g., liners, leachate collection systems, caps)? • At what point in time will the remedy require significant repair or reconstruction? • Is the monitoring system robust enough to provide early detection of remedy failure?
Facilities	• Will current controls remain adequate to maintain protection of facilities? • How will fixed residual contamination remain adequately controlled given current facility uses?
Surface Water/ Sediments	• What are impacts of remedies on ecosystems? • Will current control remain adequate? • What is likelihood of future contaminant migration?

2.1.6 Timing of Long-Term Stewardship

Long-term stewardship is expected to be the longest phase of the nuclear weapons production enterprise's life cycle. The Cold War lasted for approximately 50 years; the cleanup is expected to require roughly another 50 years.[24] Many of the residual contaminants unable to be removed during the cleanup process are expected to remain hazardous virtually forever. Consequently, containment or land use controls will be required for centuries or, in some cases, millennia – orders of magnitude longer than the duration of the Cold War and the active Environmental Management program combined.

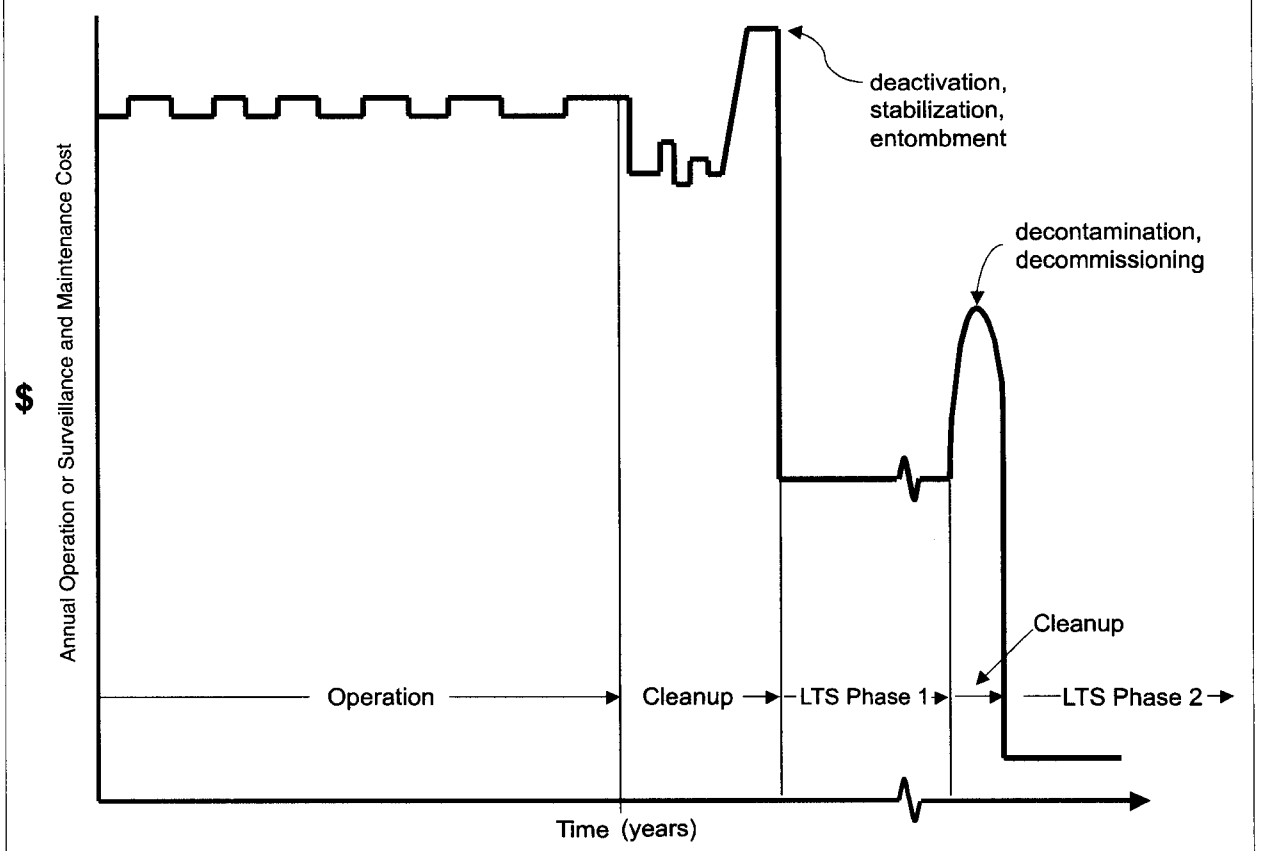
Generally, long-term stewardship activities begin when the active cleanup, stabilization, or disposal has been

[24] *Accelerating Cleanup: Paths to Closure,* DOE/EM-0362, June 1998. *Status Report on Paths to Closure*, U.S. Department of Energy Office of Environmental Management, March 2000.

completed in accordance with an applicable regulatory requirement or management plan. However, planning for long-term stewardship should begin well in advance of cleanup completion (i.e., during the cleanup planning process). In some cases, the cleanup plan addresses an entire "geographic site."[25] In other cases, particularly at the larger and more complex sites, completion of cleanup and beginning of long-term stewardship may occur at a portion of a site long before the entire site reaches closure. Thus far, 34 geographic sites have been cleaned up. These sites are relatively small sites and have a straightforward technical remedy, such as the uranium milling sites. An example of a portion of a larger site is the Experimental Breeder Reactor-1 at the Idaho National Engineering and Environmental Laboratory (INEEL) in Idaho. Cleanup at INEEL's Experimental Breeder Reactor-1 (a portion of the site) was completed in 1964, but the current estimate for completion of cleanup activities for the entire INEEL site is projected to occur much later (2050).

For many sites and facilities, there are also two phases to performing long-term stewardship (see the hypothetical cost profile in Exhibit 2-5). In most cases, "terminal" long-term stewardship begins when a site or a portion of a site has been cleaned up to the agreed-upon end state. The Department assumes that the terminal long-term stewardship activities will be conducted to maintain the end state as long as necessary (i.e., as long as the hazards require isolation). These activities typically will include maintaining some combination of physical and/or institutional controls, conducting site surveillance and monitoring, and

Exhibit 2-5. Hypothetical Cost Profile for an Entombed Reactor or Canyon Facility



[25] A discussion of geographic sites and portions of sites is provided in Appendix C: Methodology.

maintaining copies of records in a Federal repository, as well as transferring the records to the appropriate entities (e.g., State or local agencies). These activities should be documented in a detailed long-term stewardship plan prepared before cleanup or closure of the site or the portion of the site has been completed and the site has been transferred to the designated long-term steward (e.g., the Grand Junction Office).

For some facilities – particularly reactors and large processing canyons – an initial "interim" phase of long-term stewardship is needed after a facility has been deactivated (i.e., nuclear materials and other hazardous materials have been stabilized and removed, and unneeded systems have been shut down), but where further remedial action (e.g., decontamination or decommissioning) is not expected to occur for a significant period of time after the deactivation is completed. The relative timing of the two phases of long-term stewardship as they relate to final "cleanup" activities is illustrated in Exhibit 2-5. This exhibit illustrates a hypothetical cost profile for a large facility that operated for several years, underwent initial stabilization and deactivation, and was entombed for several decades while a final disposition strategy was determined (e.g., original reactors at Hanford). After several decades, the facility underwent final decontamination and decommissioning. The activities that occur during the period of entombment could be defined entirely as the first phase of "long-term stewardship." Once decontamination and decommissioning (i.e., "cleanup") are complete, the facility would be considered in the terminal phase (phase II) of long-term stewardship.

The interim phase of long-term stewardship was identified explicitly in the FY 2000 NDAA language that led to this Report to Congress:

> *The report shall...identify the long-term stewardship responsibilities (for example, longer than 30 years) ... for ... portions of sites for which ... facility stabilization is expected to be completed by the end of calendar year 2006. The report shall contain a description of ... entombed facilities ... and shall also identify the ... containment structure maintenance.*

Hence, if the interim long-term stewardship phase (phase I), beginning prior to 2006, is expected to occur for more than 30 years (e.g., for the entombed Hanford reactors), then the Department's plans for long-term stewardship will have already been determined and information about the interim activities is included in this Report to Congress.

2.2 Assumptions and Data Limitations

A number of assumptions, data limitations, and uncertainties are associated with the data collected for this Report. Programmatic assumptions and data limitations are discussed below. Site-specific assumptions are provided in the site-specific summaries in Volume II of this Report.

2.2.1 Scope

Assumptions

- Sites where DOE is identified as a potentially responsible party (PRP) and is, therefore, a participant in the cleanup, but is not expected to retain any long-term stewardship responsibilities, are not included in the summary results presented in Volume I of this Report to Congress.

- This analysis includes any site or portion of a site that will require use restrictions as a result of residual contamination. This analysis does not include any sites or portions of a site where DOE Field staff and regulators determined there is no residual contamination, or where contamination was remediated to levels that will allow for unrestricted use.

- There are approximately 300 contaminated facilities that are currently excess or projected to be excess to the DOE Offices of Defense Programs (DP), Nuclear Energy (NE), and Science (SC). Currently, 20 of those facilities are scheduled to be transferred to EM in 2002. This transfer, and future transfers of contaminated excess facilities, will increase the scope and cost of EM's facility deactivation and decommissioning effort and potentially increase the scope and cost of long-term stewardship activities associated with these facilities. EM is working with the transferring programs to determine the processes and schedules for transferring these facilities.

- Twenty-one FUSRAP sites transferred to the Corps in 1987 may be returned to DOE two years after remediation is complete. As of the end of 2000, the extent of long-term stewardship that will be required is not known. For the purpose of this Report to Congress, all of these sites may be expected to require long-term stewardship.

Data Limitations

- This Report is prepared based on the best available data to date (as of Summer-Fall 2000).

- This Report does not include an uncertain number of low-level radioactive waste sites under NWPA Section 151(b) and (c). These include low-level radioactive waste disposal sites and low-level radioactive waste sites at certain ore processing facilities -- both of which have been or will be remediated by their commercial owners and for which DOE may be authorized (under certain conditions) to take title to the waste and land for long-term stewardship. These sites are not included, with the exception of one for which DOE already has long-term stewardship responsibility (the Parkersburg Site in West Virginia), because of the uncertainty as to whether such sites will be transferred to DOE for long-term stewardship (see Section 2.1.3).

- The definition of what activities should be included in long-term stewardship differs from site to site.

- Long-term stewardship activities are linked to site cleanup and future use decisions. As these decisions are finalized, the Department's long-term stewardship activities may change accordingly.

- Data provided for this Report are for planning purposes only and in no way preempt any ongoing or future regulatory or other decision-making processes.

Uncertainties

- Changes in scientific understanding of the human health or environmental effects of residual contamination may result in changes to our regulatory standards, resulting in more or less stringent long-term stewardship activities in the future. Similarly, technology developments may enable additional contamination to be removed or change the nature of the long-term stewardship activities required.

2.2.2 Schedule

Assumptions

- The long-term stewardship process is dynamic, and the specific activities at a site will change over time in response to both site-specific and external factors. These factors include regulatory changes, technology developments, demographic shifts, funding levels, and changes in the contamination due to attenuation or ongoing remediation.

2.2.3 **Cost** (For a more detailed discussion, see Section 3.4)

Assumptions

- Cost estimates for activities occurring at sites where cleanup is anticipated to be complete for the entire geographic site during the near-term time period (i.e., through 2006) are more accurate than the longer-range planning estimates (i.e., after 2006).

- Cost estimates are rough estimates based on current site-specific planning assumptions.

Data Limitations

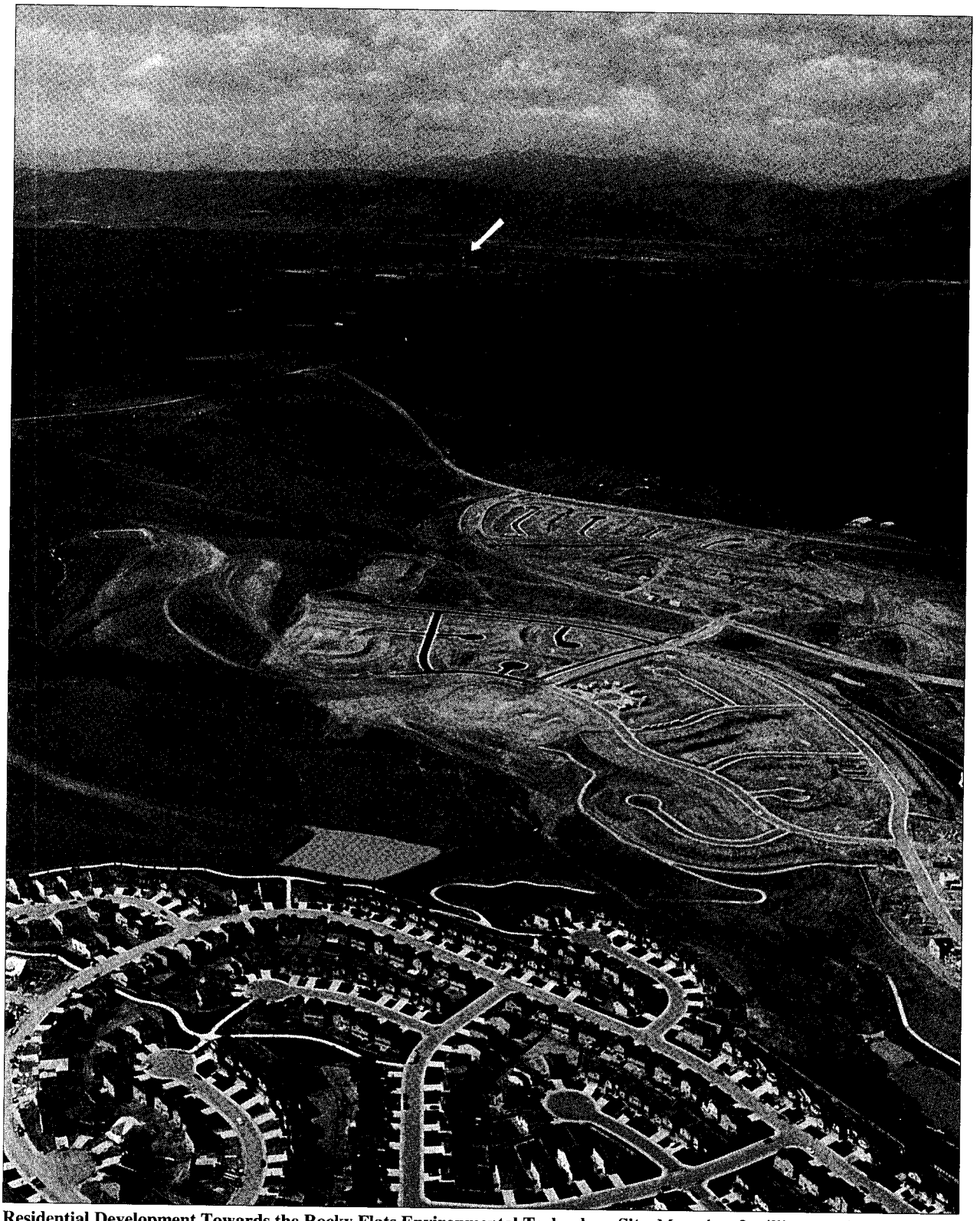
- For sites where cleanup of the entire site has not been completed and no long-term stewardship plan has been prepared, existing data are largely organized according to DOE project rather than by geographic area. Consequently, the information submitted by Field staff does not describe expected long-term stewardship costs and activities at the geographic portion or site level. However, for those sites at which cleanup has been completed and a Long-Term Surveillance Plan has been prepared, costs and activities at the geographically-defined portion level are provided.

- Although at the site-specific level the costs for long-term stewardship are generally more comprehensive than in past reports, it is still difficult, if not impossible, to draw comparisons of costs for long-term stewardship activities between sites. Sites include and report long-term stewardship activities in their budgets differently.

- The estimated long-term stewardship costs cover long-term stewardship activities through 2070 (currently, most DOE site cost estimates extend to 2070), even though the long-term stewardship activities at some sites will be required for a longer period, possibly in perpetuity.

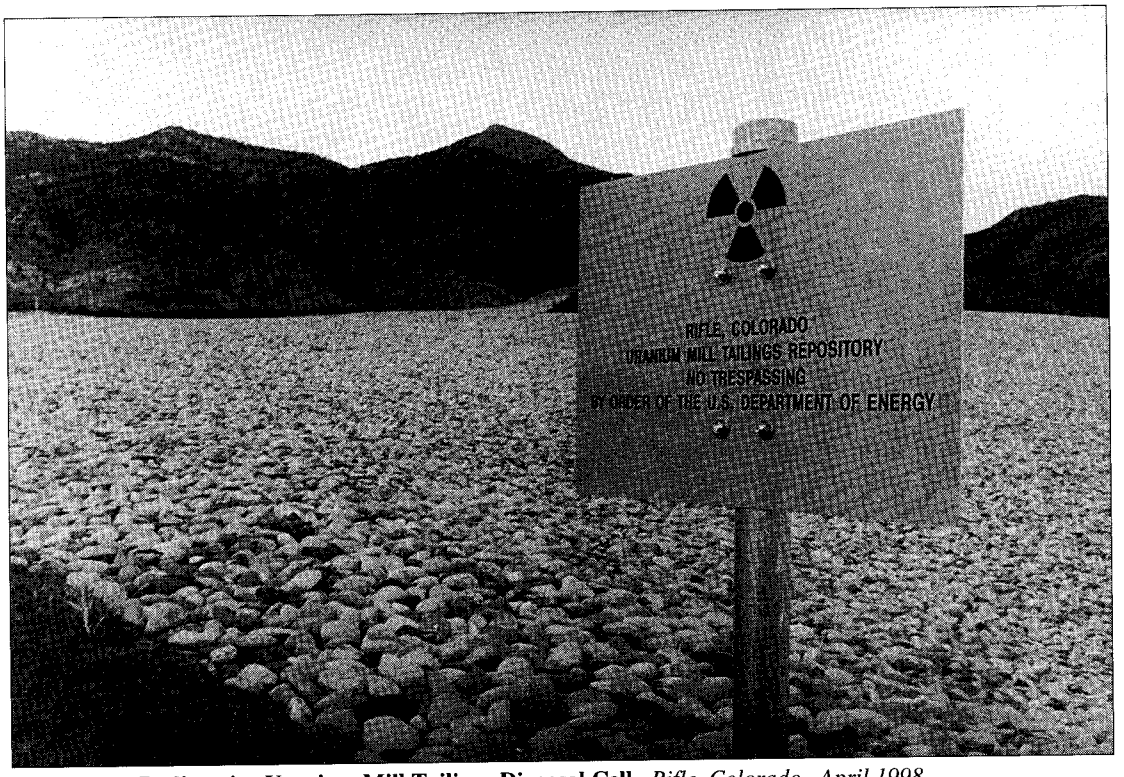
Uncertainties

- Long-term stewardship costs are based upon planned, near-term, cleanup funding levels. Changes in these funding levels could affect decisions regarding cleanup decisions and, consequently, the resulting end state and long-term stewardship activities.



Residential Development Towards the Rocky Flats Environmental Technology Site. More than 2 million people live within a 50-mile radius of the Rocky Flats Environmental Technology Site, visible in the upper center of this photo. This population is expected to increase by 30 percent within the next 20 years. Residential areas now border the northeastern edge of the site's Buffer Zone. Long-term stewardship requirements will include surveillance and maintenance of engineered caps, long-term monitoring of groundwater and surface water quality, and institutional controls to maintain land use restrictions. *Rocky Flats Environmental Technology Site, Colorado, September 1999.*

Rulison Marker identifying the site of the 1969 Rulison underground nuclear explosion. Project Rulison Underground Nuclear Test Explosion Marker. *Rulison, Garfield County, Colorado. June 1999.*



Estes Gulch Radioactive Uranium Mill Tailings Disposal Cell. *Rifle, Colorado. April 1998.*

Chapter 3

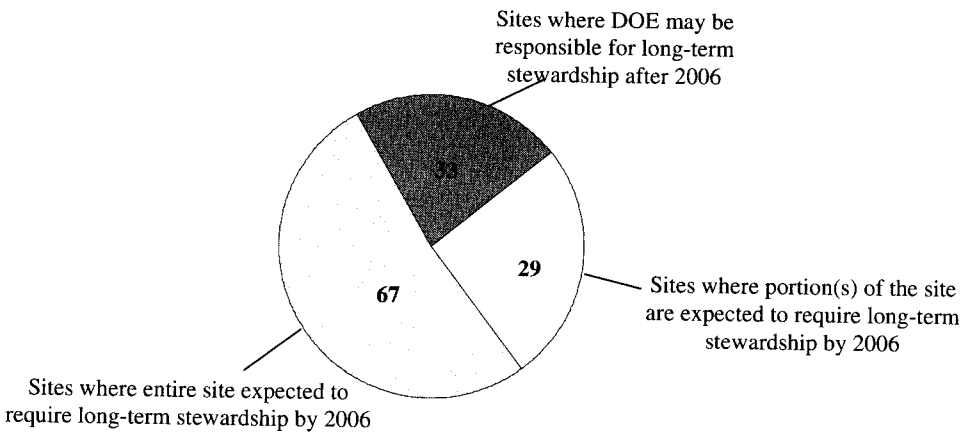
Results

CHAPTER 3: RESULTS

This chapter summarizes the results of an initial survey of DOE Field offices on their ongoing long-term stewardship activities and their projections for long-term stewardship in the future based on the scope and assumptions discussed in Chapter 2 and the Methodology in Appendix C. Although the primary focus is on the sites or portions of sites where long-term stewardship will be underway by 2006, this chapter also provides general information for the full universe of 129 sites where DOE expected to be responsible for conducting long-term stewardship (see Chapter 2.0, Exhibit 2-1).

The breakdown of the 129 sites expecting to require long-term stewardship is illustrated in Exhibit 3-1. The locations of the various sites are displayed in Exhibit 2-3 and listed in Table 2-1.

Exhibit 3-1. DOE Expects to Conduct Long-Term Stewardship at Up to 129 Sites

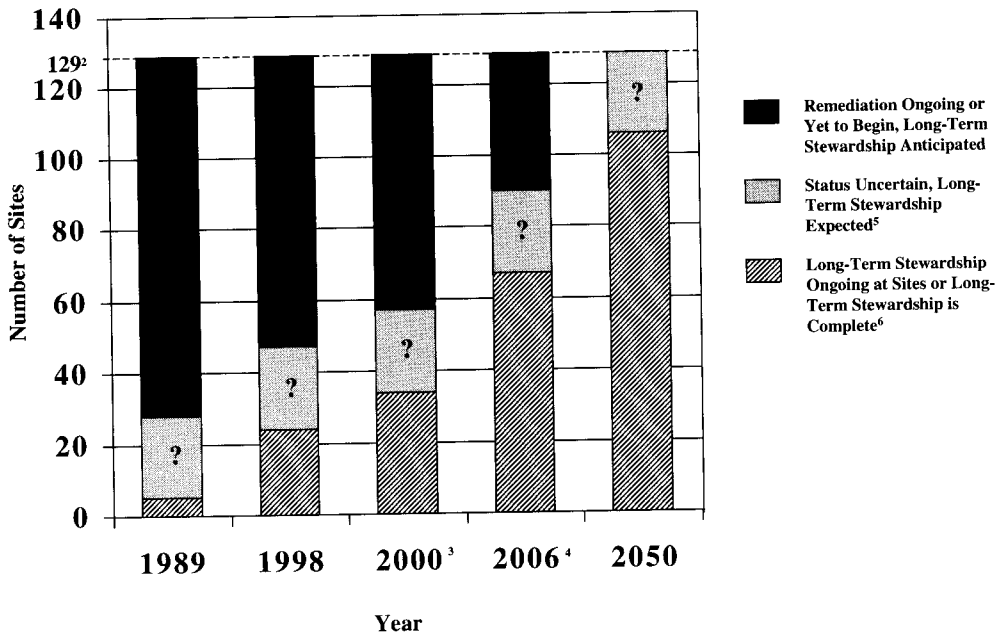


The results in this chapter are drawn from information provided by Field office staff, which was used to generate the site summaries presented in Volume II. This chapter is organized into the following six sections:

- Section 3.1 – DOE expects to perform long-term stewardship activities at 96 sites or portions of sites by 2006
- Section 3.2 – DOE may be responsible for long-term stewardship activities at 33 sites after 2006
- Section 3.3 – DOE's expected long-term stewardship activities
- Section 3.4 – Estimated long-term stewardship costs
- Section 3.5 – Land area requiring long-term stewardship
- Section 3.6 – Who will be involved in performing long-term stewardship?

From Cleanup to Stewardship - 1989 to 2050

The following exhibit illustrates DOE's progress as it completes cleanup at sites and transitions to long-term stewardship activities. The number of sites where DOE has completed cleanup and is performing long-term stewardship is expected to increase from 24 sites in 1998 to 67 sites in 2006.[1]



[1] This includes only those sites where all cleanup is completed. It excludes a number of sites where cleanup has been completed to levels allowing for unrestricted use, with only record keeping requirements remaining. It also excludes sites where long-term stewardship activities are being performed at portion(s) of the site, while remediation is ongoing at other parts of the site (see footnote 6 below).
[2] DOE has projected that it will eventually be responsible for long-term stewardship at 129 sites. Excluded from this exhibit are 48 sites where cleanup is expected to be completed to levels allowing for unrestricted use, except for record-keeping activities (see Exhibit 2-4 and Section 2.1.2).
[3] DOE is conducing site-wide long-term stewardship activities at 34 sites as of 2000 (see Section 3.1.1.).
[4] DOE is expecting to conduct long-term stewardship activities at 67 sites by 2006 (see Section 3.1.1).
[5] Of the 33 sites where DOE may be responsible for long-term stewardship activities, the extent and schedule of these activities are currently unknown for 21 sites (see Section 3.2).
[6] This category includes only those sites where all cleanup activities (e.g., cleanup, disposal, and stabilization) have been completed for the entire site. Sites where long-term stewardship activities are being performed at portion(s) of the site, while remediation is ongoing at other parts of the site, are categorized in this exhibit as "Remediation Ongoing or Yet to Begin, Long, Term Stewardship Anticipated."

3.1 DOE Expects to Perform Long-Term Stewardship Activities at Sites or Portions of 96 Sites by 2006

DOE expects to perform long-term stewardship activities at 96 sites or portions of sites by 2006. These sites include 67 sites where cleanup activities have already been completed (34 sites) or will be completed (33 sites) for the entire site by the end of 2006. At the remaining 29 sites, long-term stewardship activities are currently required or are expected to be required for portions of the sites. At these 29 sites, although remediation is expected to continue, significant cleanup has been completed at portions of the site. The 67 sites where remediation activities are either completed or will be completed, combined with the 29 sites where remediation has already been completed at portions of the site, represent progress toward the cleanup

goals DOE established in 1996 for many of its sites.[26]

Although cleanup activities at all sites will not be completed by 2006, the Department expects to complete cleanup activities for a significant proportion of the smaller sites and portions of the larger sites. In fact, at every site where DOE is performing cleanup work, some part of the cleanup will be completed by 2006.[27] This completed cleanup reflects the emphasis the Department places on completing remediation activities -- substantially reducing risks and reducing costs of maintaining safe conditions at the sites, both of which are goals of the Environmental Management program.

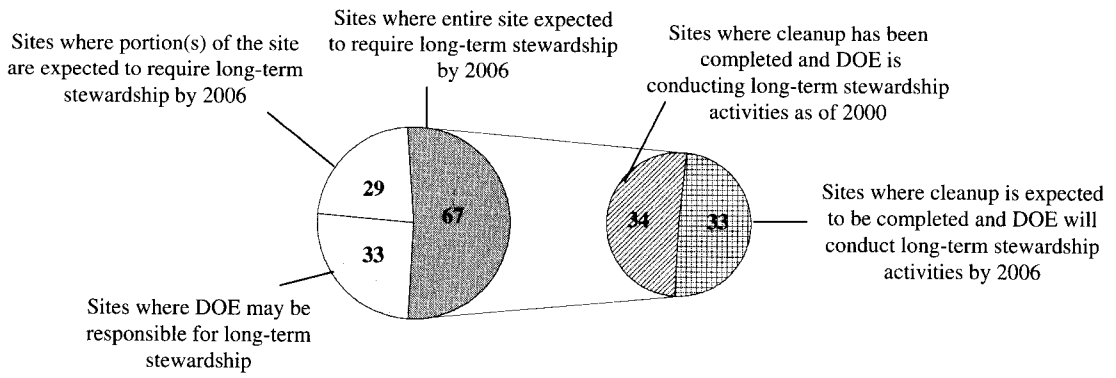
3.1.1 At 67 Sites, DOE Has Completed or Expects to Complete Cleanup and Expects to Conduct Site-Wide Long-Term Stewardship Activities by 2006

By the end of 2006, DOE expects to conduct long-term stewardship activities at 67 sites where all remediation is expected to be complete and where long-term stewardship activities will be required (see Exhibit 3-2 and Table 3-1). Of these 67 sites, all planned remediation activities have already been completed and DOE is currently conducting long-term stewardship activities at 34 sites (see Appendix D). Remediation work at an additional 33 sites is anticipated to be completed by 2006.

67 SITES

- 42 UMTRCA Titles I and II sites
- 11 Research and development; testing sites
- 4 Component manufacturing sites
- 4 Fossil energy research sites
- 2 Commercial research reactors sites
- 4 Other sites

Exhibit 3-2. 67 Sites Where DOE Is or Will Be Conducting Long-Term Stewardship Activities by 2006



The 67 sites are described below in terms of their past missions.

- More than half of the sites (42 of the 67) are former uranium mining, milling and refining sites and uranium mill tailings disposal cells located primarily in western States (mostly in Colorado, New Mexico, and Utah). Many of these sites were or will be remediated by DOE or another responsible party

[26] *Estimating the Cold War Mortgage: The 1995 Baseline Environmental Management Report*, DOE/EM-0232, March 1995 and *The 1996 Baseline Environmental Management Report*, DOE/EM-0290, June 1996.

[27] The DOE will continue to operate the WIPP for disposal of stored transuranic waste beyond 2006. Hence, the term, "cleanup work," in this case, does not include such waste management activities, which will continue after 2006 and require long-term stewardship after completion of disposal activities.

under UMTRCA Titles I and II. Cleanup of these uranium sites is now nearly complete, and the task of long-term stewardship will increasingly require dealing with different types of sites.

- In addition, DOE expects to complete cleanup and implement long-term stewardship activities at 11 research, development, and testing sites by the end of 2006. These sites include national laboratories (e.g., the Sandia and Lawrence Berkeley National Laboratories in California) and some former nuclear test sites (e.g., Amchitka Island, Salmon Site). Unlike most other sites within DOE's purview for long-term stewardship, the national laboratories are currently expected to have ongoing missions beyond environmental cleanup. These include missions in nuclear weapons stockpile stewardship, materials disposition, and nonproliferation support. Institutional controls are already be in place for ongoing operations in support of these missions. The long-term stewardship at those sites will be conducted by the landlord organization in accordance with the recently established (December 2000) internal policy regarding long-term stewardship responsibility (see Appendix I).

- Four of DOE's "manufacturing" sites are also expected to complete all planned remediation activities by 2006. These "manufacturing" sites include four component fabrication sites: The Kansas City Plant in Missouri, the Pantex Plant in Texas, the Miamisburg Environmental Management Project (Mound) in Ohio, and the Rocky Flats Environmental Technology Site in Colorado.

- Four of the sites used for fossil energy research are expected to complete remediation activities by 2006. They are the Naval Oil Shale Reserves Site in Colorado, the Hoe Creek Underground Coal Gasification Site, the Naval Petroleum Reserve No. 3 Landfill/Landfarm, and the Rock Springs Oil Shale Retort Site in Wyoming. These sites were used to investigate the process and environmental parameters of underground coal gasification technologies which resulted in residual petroleum hydrocarbon contamination. DOE will be responsible for surveillance and maintenance activities, as well as groundwater and surface vegetation monitoring at these four sites.

- Two sites (the Hallam and Piqua Nuclear Power Facilities) at which DOE is already conducting long-term stewardship activities are former commercial research reactor facilities. At these two sites, long-term stewardship activities include annual inspections and maintenance of the cocooned reactor containment structures.

- The four additional sites where DOE currently is performing long-term stewardship activities are a Nuclear Waste Policy Act (NWPA) site (Parkersburg), a nuclear fuel storage facility (Fort St. Vrain), a FUSRAP site (Bayo Canyon), and a former experimental laboratory and reactor site (Palos Forest (Site A/Plot M) Preserve).

A list of sites by cleanup completion year and site type (e.g., weapons fabrication and uranium mining, milling, and refining, etc.) is provided in Appendix D. Detailed descriptions of the long-term stewardship activities that are anticipated or are ongoing at the 67 sites are provided in Volume II.

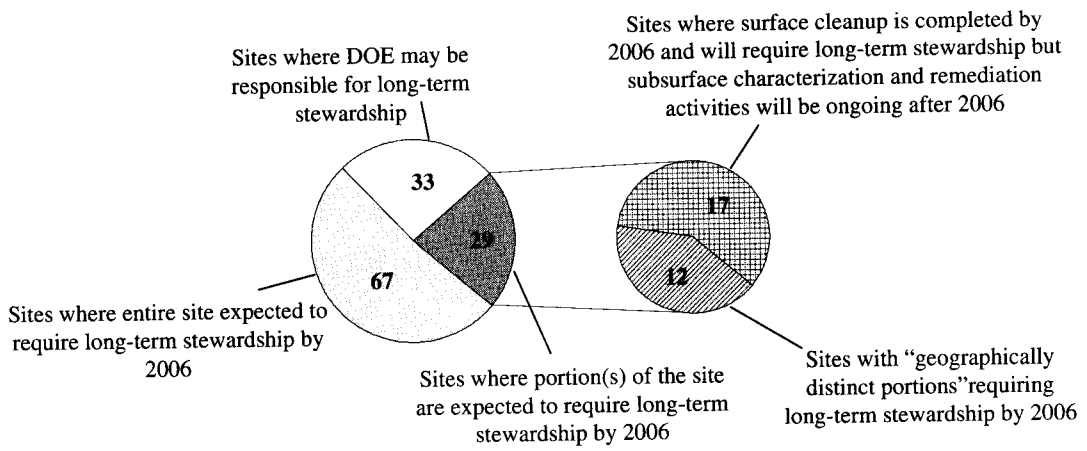
Table 3-1. At 67 Sites, DOE Has Completed or Expects to Complete Cleanup and Expects to Conduct Site-Wide Long-Term Stewardship Activities by 2006

For 34 Sites, Long-Term Stewardship Activities to Begin by the End of 2000			
State	**Site**	**State**	**Site**
CA	Sandia National Laboratories-CA	NM	Bluewater Site
CO	Bodo Canyon Cell		Lovelace Respiratory Research Institute
	Burro Canyon Disposal Cell	OH	Piqua Nuclear Power Facility
	Cheney Disposal Cell	OR	Lakeview Mill
	Estes Gulch Disposal Cell		Lakeview Site
	Fort St. Vrain	PA	Burrell Site
	Gunnison Disposal Cell		Canonsburg Site
	Maybell Mill Site	PR	Center for Energy and Environmental Research
	Naturita Site	SD	Edgemont Site
	Naval Oil Shale Reserves Site	TX	Falls City Site
ID	Lowman Site	UT	Mexican Hat Site
IL	Fermi National Accelerator Laboratory		Salt Lake City Mill
	Palos Forest (Site A/Plot M) Preserve		South Clive Disposal Cell
NE	Hallam Nuclear Power Facility	WA	(WNI) Sherwood Site
NJ	Princeton Plasma Physics Laboratory	WV	Parkersburg Site
NM	Ambrosia Lake Site	WY	Riverton Site
	Bayo Canyon		Spook Site
For 33 Sites, Long-Term Stewardship Activities to Begin by the End of 2006			
State	**Site**	**State**	**Site**
AK	Amchitka Island	TX	(Conoco) Conquista Site
CA	Lawrence Berkeley National Laboratory		(Exxon) Ray Point Site
	Stanford Linear Accelerator		Pantex Plant
CO	Grand Junction Mill 1	UT	(Atlas) Moab Mill
	Grand Junction Mill 2		Monticello Mill Site and Vicinity Properties
	Gunnison Mill	WY	(ANC) Gas Hills Site
	(HECLA) Durita Site		(Exxon) Highlands Site
	Rocky Flats Environmental Technology Site		Hoe Creek Underground Coal Gasification Site
	(UMETCO) Maybell Site 2		Naval Petroleum Reserve No. 3 Landfill/Landfarm
IL	Argonne National Laboratory East		(Pathfinder) Lucky Mc Site
MS	Salmon Site		(Pathfinder) Shirley Basin Site 2
MO	Kansas City Plant		(Petrotomics) Shirley Basin Site 1
	Weldon Spring Site		Rock Springs Oil Shale Retort Site
NM	Sandia National Laboratories - NM		(UMETCO) Gas Hills Site
	(SOHIO) LBAR Site		(Union Pacific) Bear Creek Site
OH	Miamisburg Environmental Management Project		(WNI) Split Rock Site
TX	(Chevron) Panna Maria Site		

3.1.2 DOE Expects to Perform Long-Term Stewardship Activities at Portions of 29 Sites by 2006

In addition to the 67 sites described in the previous section (where DOE has completed or expects to complete cleanup of the entire site by 2006), there are an additional 29 sites where DOE expects to complete cleanup at portions of the site by 2006. These include: 12 sites where geographically distinct portions of the site will be remediated and will require long-term stewardship; and 17 sites where only the surface will be remediated (and require long-term stewardship) but subsurface characterization and remediation activities will be ongoing (see Exhibit 3-3).

Exhibit 3-3. DOE Expects to Perform Long-Term Stewardship at Portions of 29 Sites by 2006



DOE expects to perform long-term stewardship activities at "geographically distinct portions" of 12 of the 29 sites by 2006

At 12 of the 29 sites, DOE expects to perform long-term stewardship activities at "geographically distinct portions" of the site by 2006. Table 3-2 provides a description of the portions of the sites where remediation activities are expected to be completed and where long-term stewardship activities will be required. The remediation challenges posed by the contaminants and environmental conditions at many other areas of these sites (e.g., high-level waste and transuranic waste issues, multiple types of waste and contaminants present) will require longer periods of time for completion of cleanup. At most of these sites, investigations are still underway to better understand the nature of the contamination and to identify the most appropriate remediation strategies for the sites or portions of sites. In some cases, negotiations are still ongoing with stakeholders and regulators to identify acceptable remediation strategies and, consequently, the resulting end state and subsequent long-term stewardship requirements have yet to be determined.

Table 3-2. DOE Anticipates Performing Long-Term Stewardship Activities at "Geographically Distinct Portions" of 12 Sites by 2006

State	*Site*	*Description of long-term stewardship activities, ongoing remediation, and site characterization*
California	Lawrence Livermore National Laboratory - Livermore Site	While cleanup activities at the Livermore Site are not expected to be complete by 2007, many key long-term stewardship operational components have already been initiated concurrent with the active, compliant cleanup program. Similarly, several administrative and institutional controls and surveillance/maintenance programs that currently exist will be maintained to support the overarching long-term stewardship goals of maintaining and operating required remediation systems and ensuring that selected remedies will remain protective of human health and the environment.
California	Lawrence Livermore National Laboratory - Site 300	While DOE does not expect to have assessed and completed all release sites and associated groundwater treatment systems at Site 300 until 2009, activities are currently being conducted at several completed release site(s) that are consistent and commensurate with the overall planned long-term stewardship goals for the site. Portions of the site that require long-term stewardship activities include areas with soil and groundwater contamination resulting from past operations and releases from spills, as well as closed waste treatment and land disposal facilities. By 2009, all release sites at Site 300 will have been assessed and completed and all groundwater treatment systems and other remedial actions will be in place and operational.
Idaho	Idaho National Engineering and Environmental Laboratory	Remediation is projected to be complete prior to 2006 at several small areas of the site. These areas will require monitoring and maintaining engineered units, enforcing institutional controls, and restricting access. The Ordnance Area is a large tract of 210,000 acres that will require access restrictions. Because the site is not scheduled to complete remediation until 2050, many areas will have ongoing remediation, such as waste consolidation.
Kentucky	Paducah Gaseous Diffusion Plant	At Paducah, there are several capped engineered units where long-term monitoring has already begun. Additionally, there is ongoing surface water monitoring. However, remediation of the entire site is not anticipated to be complete until 2010.
Nevada	Nevada Test Site	Remediation has been completed at 18 industrial sites at Nevada Test Site and 13 industrial areas at the Tonapah Test Range, such as capped landfills. Contaminant characterization (e.g., a comprehensive groundwater analysis) is ongoing at these and other areas of the Nevada Test Site. Other areas of the site are not scheduled to begin remediation until well after 2006. By 2017, all remedial activities at the Nevada Test Site will be completed and the entire site will require long-term stewardship.
New Mexico	Los Alamos National Laboratory	Of the 2,146 potential release sites identified at LANL, 719 were slated for further investigation or accelerated remediation. To date, DOE has proposed approximately 1,400 potential release sites to the New Mexico Environment Department for "No Further Action." Current long-term stewardship-related activities include: 1) planning for and implementing long-term stewardship activities, such as the long-term surveillance and monitoring efforts needed for the Material Disposal Areas that have covers as a proposed remedy; 2) site-wide monitoring of drinking water supplies; 3) active partnering with the regulatory authorities; and 4) monitoring sites where interim measures have been performed. Monitoring these sites will continue until such time as the final corrective measure investigations are completed, as well as inspections of the sites where remedial actions have been completed.
New York	Brookhaven National Laboratory*	Multiple landfills at the site are projected to be capped and to require long-term monitoring beginning in 2003. Long-term monitoring at the graphite research reactor is anticipated to begin in 2006.

Table 3-2. DOE Anticipates Performing Long-Term Stewardship Activities at "Geographically Distinct Portions" of 12 Sites by 2006

State	*Site*	*Description of long-term stewardship activities, ongoing remediation, and site characterization*
Ohio	Fernald Environmental Management Project	DOE will complete most of the planned remediation activities at the Fernald site by 2006. Many of these areas are subject to land use restrictions, such as the onsite disposal facility. Other areas will require periodic monitoring. The only areas with ongoing remediation beyond 2006 are the silos and wastewater treatment facility.
Ohio	Portsmouth Gaseous Diffusion Plant*	For management purposes, the site has been divided into quadrants. Within each of the site quadrants, some remediation activities will be completed by 2000 (primarily groundwater monitoring and pump and treat systems). However, remediation is expected to continue for other areas within each of these quadrants beyond 2006.
South Carolina	Savannah River Site	Long-term stewardship activities, such as institutional controls, maintenance of treatment systems, and groundwater monitoring, are forecasted to begin at several watershed portions of the site by 2006 (watershed portions include: Upper Three Runs, Lower Three Runs, Steel Creek, Pen Branch, Four Mile Branch, and the Savannah River and Floodplain Swamp). However, significant remediation work will be required beyond 2006 for these areas. Surveillance and maintenance activities are also forecasted to begin by 2006 at five facility portions (facilities that have been or will be deactivated by 2006 but for which final decisions have not been made on their decommissioning).
Tennessee	Oak Ridge Reservation	Long-term stewardship activities, such as monitoring of groundwater and surface water and maintaining engineered caps, will have begun at offsite locations, as well as the Bear Creek, Melton Valley, Bethel Valley, and East Fork Poplar Creek Watersheds, which are all located within the site boundary, by 2000. However, significant remediation activities, such as consolidating waste and capping disposal cells, are expected to continue beyond 2006 for these and other areas of the site.
Washington	Hanford Site	DOE anticipates it will be conducting many long-term stewardship activities by 2006, including the interim safe storage of multiple test reactors, groundwater monitoring, and maintaining engineered caps on disposal cells. Remediation for the entire site is not scheduled to be complete until 2048. Major ongoing remediation activities will include waste consolidation in the 23-acre Environmental Restoration Disposal Facility.

* The scope of remediation work has recently been updated at these sites.

DOE expects to have surface remediation complete at 17 of the 29 Sites by 2006, with ongoing subsurface characterization and remediation activities continuing after 2006 [28]

DOE has already completed surface remediation at 11 former mill tailings sites. However, groundwater has not been characterized enough to obtain NRC approval for selection of the subsurface remedy. Until a final remedy is selected, the subsurface of the site will not be subject to long-term stewardship. At six former nuclear test sites, DOE expects to complete surface remediation prior to 2006, but will continue subsurface characterization beyond 2006. Brief descriptions of each of these sites are provided in Table 3-3.

[28] In some cases, cleanup of the site's surface has been completed, but subsurface remediation (e.g., groundwater characterization and cleanup) has not yet been completed. In these cases, "cleanup" refers to the surface portion of a site rather than the whole site (see "cleanup" definition in Chapter 1). In this Report, completed surface remediation requiring long-term stewardship is identified separately from the long-term stewardship activities required for subsurface contamination.

Table 3-3. DOE Expects to Perform Long-Term Stewardship Activities at 17 Sites Where Surface Remediation is Expected to be Completed by 2006, but Subsurface Characterization Will Continue Beyond 2006

State	*Site*	*Description of long-term stewardship activities, ongoing remediation, and site characterization*
Arizona	Monument Valley Site	Surface remediation was completed in 1994, but groundwater characterization will continue beyond 2006. Groundwater long-term stewardship activities are anticipated to begin in 2013.
	Tuba City Site	Surface remediation was completed in 1990, but groundwater characterization will continue beyond 2006. Groundwater long-term stewardship activities are anticipated to begin in 2011.
Colorado	Durango Mill	Surface remediation was completed in 1990, but groundwater characterization will continue beyond 2006. Groundwater long-term stewardship activities are anticipated to begin in 2007.
	Naturita Mill	Surface remediation was completed in 1997, but groundwater characterization will continue beyond 2006. Groundwater long-term stewardship activities are anticipated to begin in 2009.
	Rifle (New) Mill	Surface remediation was completed in 1995, but groundwater characterization will continue beyond 2006. Groundwater long-term stewardship activities are anticipated to begin in 2008.
	Rifle (Old) Mill	Surface remediation was completed in 1995, but groundwater characterization will continue beyond 2006. Groundwater long-term stewardship activities are anticipated to begin in 2008.
	Rio Blanco	Soil remediation will be completed by 2006. However, subsurface characterization is expected to continue until 2009. Ongoing long-term stewardship activities include subsurface intrusion restrictions.
	Rulison	Soil remediation will be completed by 1998. However, subsurface characterization is expected to continue until 2010. Ongoing long-term stewardship activities include subsurface intrusion restrictions.
	Slick Rock (North Continent) Mill 1	Surface remediation was completed in 1996, but groundwater characterization will continue beyond 2006. Groundwater long-term stewardship activities are anticipated to begin in 2008.
	Slick Rock (Union Carbide) Mill 2	Surface remediation was completed in 1996, but groundwater characterization will continue beyond 2006. Groundwater long-term stewardship activities are anticipated to begin in 2008.
Florida	Pinellas STAR Center	Surface remediation was completed in 1999, but groundwater characterization will continue beyond 2006. Groundwater long-term stewardship activities are anticipated to begin in 2015.
Nevada	Central Nevada Test Area	Soil remediation will be completed by 2001. However, groundwater characterization is expected to continue until 2012. Ongoing long-term stewardship activities include subsurface intrusion restrictions.

Table 3-3. DOE Expects to Perform Long-Term Stewardship Activities at 17 Sites Where Surface Remediation is Expected to be Completed by 2006, but Subsurface Characterization Will Continue Beyond 2006

State	*Site*	*Description of long-term stewardship activities, ongoing remediation, and site characterization*
	Project Shoal	Soil remediation will be completed by 1998. However, groundwater characterization is expected to continue until 2009. Ongoing long-term stewardship activities include subsurface intrusion restrictions.
New Mexico	Gasbuggy Site	Soil remediation will be completed by 2006. However, subsurface characterization is expected to continue until 2014. Ongoing long-term stewardship activities include subsurface intrusion restrictions.
	Gnome-Coach	Soil remediation will be completed by 2005. However, groundwater characterization is expected to continue until 2012. Ongoing long-term stewardship activities include subsurface intrusion restrictions.
	Shiprock Site	Surface remediation was completed in 1996, but groundwater characterization will continue beyond 2006. Groundwater long-term stewardship activities are anticipated to begin in 2012.
Utah	Green River Site	Surface remediation was completed in 1998, but groundwater characterization will continue beyond 2006. Groundwater long-term stewardship activities are anticipated to begin in 2009.

3.2 DOE May Be Responsible for Long-Term Stewardship Activities at 33 Sites

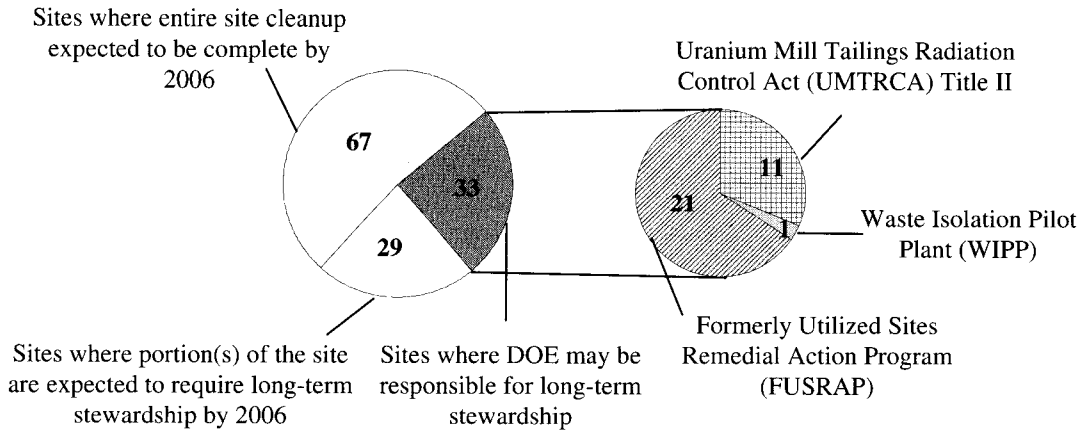
DOE has identified 33 sites where it may be responsible for performing long-term stewardship activities. This includes 11 UMTRCA Title II sites where DOE is not responsible for the cleanup but is responsible for long-term stewardship activities, and the Waste Isolation Pilot Plant (WIPP) which DOE is expected to continue operating (accepting transuranic waste for disposal) until after 2006. Additionally, there are 21 FUSRAP sites where the cleanup responsibility was transferred to the Corps in 1997 by the U. S. Congress. Generally, less detailed information is available for the types of long-term stewardship activities anticipated at these sites because decisions affecting their end states have not yet been made and, consequently, the long-term stewardship requirements remain uncertain. These sites are illustrated below in Exhibit 3-4.

- Eleven sites are expected to be transferred to DOE in accordance with UMTRCA Title II. These sites are currently privately owned, but DOE expects it will assume ownership of and responsibility for long-term stewardship at these sites some time after 2006, following completion of remediation activities (not expected to be complete by 2006). DOE is not responsible for completing remediation at these sites; remediation will be performed by the site owners, with partial reimbursement of costs by DOE.

11 SITES TO BE TRANSFERRED UNDER UMTRCA TITLE II

Colorado	(Cotter) Cañon City Site
	(UMETCO) Uravan Site
New Mexico	(Homestake) Grants Site
	(Quivira) Ambrosia Lake Site 2
	(UNC) Church Rock Site
Utah	(EFN) White Mesa Site
	(Plateau) Shootaring Canyon Site
	(Rio Algom) Lisbon Valley Site
	11e.(2) Disposal Site
Washington	(Dawn) Ford Site
Wyoming	(Kennecott) Sweetwater Site

Exhibit 3-4. 33 Sites Where DOE May Be Responsible for Long-Term Stewardship Activities



- The Waste Isolation Pilot Plant (WIPP) is a transuranic waste disposal site near Carlsbad, New Mexico. The anticipated closure date for WIPP is 2034, after the last shipment of waste has been received and emplaced. DOE expects that long-term stewardship activities at WIPP will begin in 2039, after the facility has been decontaminated and decommissioned.

- The Energy and Water Development Appropriations Act for Fiscal Year 1998 transferred responsibility for the administration and execution of FUSRAP from DOE to the Corps. The Department and the Corps signed a Memorandum of Understanding (MOU) in March 1999 identifying the roles and responsibilities for cleanup and post-closure care of FUSRAP sites. For the 21 sites assigned to the Corps for remediation, the MOU assigns responsibility to DOE for any required long-term stewardship. At these sites, long-term stewardship may be required subject to the Corps records of decision and completion of cleanup. DOE and the Corps have discussed a protocol that will include written approval of the cleanup by the appropriate Federal and State agencies and transfer of post-closure documents, including adequate and acceptable radiological surveys. These sites will be transferred to DOE for long-term stewardship, as appropriate, two years after the Corps completes remedial actions. However, because the cleanup decisions for these sites are not yet final, the level of long-term stewardship activities required for these sites, if any, is not yet known.

21 FUSRAP SITES TRANSFERRED TO THE U.S. ARMY CORPS OF ENGINEERS IN 1997 FOR CLEANUP

Connecticut	CE	New Jersey (cont.)	Wayne Site
Illinois	Madison	New York	Ashland Oil #1
Maryland	W.R. Grace and Company		Ashland Oil #2
Massachusetts	Shpack Landfill		Bliss and Laughlin Steel
Missouri	Latty Avenue Properties		Colonie
	St. Louis Airport Site		Linde Air Products
	St. Louis Airport Site Vicinity Properties		Niagara Falls Storage Site
	St. Louis Downtown Site		Seaway Industrial Park
New Jersey	DuPont & Company	Ohio	Luckey
	Maywood Chemical Works		Painesville
	Middlesex Sampling Plant		

3.3 DOE'S EXPECTED LONG-TERM STEWARDSHIP ACTIVITIES

Long-term stewardship activities will range in level of effort and complexity. This section identifies activities for the five media types where long-term stewardship is expected to be required: residually contaminated groundwater, residually contaminated soils, engineered units, contaminated facilities, and residually contaminated surface waters and sediments.

The types of long-term stewardship activities required at sites will relate directly to the types of residually contaminated media that will remain at the sites. These activities include institutional controls, such as maintaining deed restrictions and fences, and engineered controls, such as conducting monitoring and maintaining erosion control for caps. Many of these activities will be applied across an entire site (e.g., deed restrictions), while other activities will be specific to a given medium (e.g., monitoring and maintenance of a groundwater pump and treat system).

There are considerable differences in the way site personnel have defined and reported these activities. For example, some site personnel consider deed restriction and access controls as the same long-term stewardship activity, while others reported them as two distinct activities. Therefore, the intent of this section is not to provide a definite answer to questions such as "how many monitoring wells will DOE have?," but to indicate the general types of activities that will be required across the DOE complex so as to illustrate the nature and overall magnitude of the challenges ahead.

Detailed descriptions of the long-term stewardship activities required at each site are provided in the site summaries in Volume II. Table 3-4 provides a summary of the media that are subject to long-term stewardship at the129 sites where DOE expects to perform long-term stewardship activities.

Table 3-4. Summary of Media Requiring Long-Term Stewardship

State	*Site Name*	*Long-Term Stewardship Start Date*	*Media*				
			Facilities	*EU**	*Soil*	*GW**	*SW**
Alaska	Amchitka Island	2004			✓	✓	
Arizona	Monument Valley Site[a]	1994				✓	
	Tuba City Site	1990		✓		✓	
California	Lawrence Berkeley National Laboratory	2005			✓	✓	
	Lawrence Livermore National Laboratory - Livermore Site	1989			✓	✓	
	Lawrence Livermore National Laboratory - Site 300	1994		✓	✓	✓	✓
	Sandia National Laboratories - CA	1999		✓	✓	✓	
	Stanford Linear Accelerator	2004			✓	✓	
Colorado	Bodo Canyon Cell	1990		✓			
	Burro Canyon Disposal Cell	1998		✓			
	Cheney Disposal Cell	1994		✓			
	(Cotter) Cañon City Site	2020		✓		✓	
	Durango Mill[a]	1990				✓	
	Estes Gulch Disposal Cell	1997		✓			
	Fort St. Vrain	1999	✓				

Table 3-4. Summary of Media Requiring Long-Term Stewardship

State	Site Name	Long-Term Stewardship Start Date	Media				
			Facilities	EU*	Soil	GW*	SW*
	Grand Junction Mill 1	2001				✓	
	Grand Junction Mill 2[b]	2001				✓	✓
	Gunnison Disposal Cell	1995		✓			
	Gunnison Mill[a]	1994				✓	
Colorado	(HECLA) Durita Site	2001		✓			
	Maybell Mill Site	1999		✓		✓	
	Naturita Mill[a]	1997				✓	
	Naturita Site	1999		✓			
	Naval Oil Shale Reserves Site	2000				✓	
	Rifle (New) Mill[a]	1995				✓	
	Rifle (Old) Mill[a]	1995				✓	
	Rio Blanco[a,c]	2006			✓	✓	
	Rocky Flats Environmental Technology Site	2006	✓	✓	✓	✓	✓
	Rulison[a, c]	1998				✓	
	Slick Rock (North Continent) Mill 1[a]	1996				✓	
	Slick Rock (Union Carbide) Mill 2[a]	1996				✓	
	(UMETCO) Maybell Site 2	2001		✓		✓	
	(UMETCO) Uravan Site	2010		✓		✓	
Connecticut	CE[d]	Extent of long-term stewardship currently unknown					
Florida	Pinellas STAR Center[b]	2015				✓	
Idaho	Idaho National Engineering and Environmental Laboratory[e]	1964	✓	✓	✓	✓	
	Lowman Site	1994		✓			
Illinois	Argonne National Laboratory East	2001	✓	✓	✓	✓	✓
	Fermi National Accelerator Laboratory	1999		✓			
	Madison[d]	Extent of long-term stewardship currently unknown					
	Palos Forest (Site A/Plot M) Preserve	1997		✓		✓	
Iowa	Ames Laboratory	Long-term stewardship not expected beyond record-keeping activities					
Kentucky	Paducah Gaseous Diffusion Plant[e]	2000	✓	✓	✓	✓	✓
Maryland	W.R. Grace and Company[d]	Extent of long-term stewardship currently unknown					
Massachusetts	Shpack Landfill[d]	Extent of long-term stewardship currently unknown					
Mississippi	Salmon Site	2003				✓	
Missouri	Kansas City Plant	2005			✓	✓	✓
	Latty Avenue Properties[d]	Extent of long-term stewardship currently unknown					
	St. Louis Airport Site[d]	Extent of long-term stewardship currently unknown					

Table 3-4. Summary of Media Requiring Long-Term Stewardship

State	Site Name	Long-Term Stewardship Start Date	Media				
			Facilities	EU*	Soil	GW*	SW*
	St. Louis Airport Site Vicinity Properties[d]	Extent of long-term stewardship currently unknown					
	St. Louis Downtown Site[d]	Extent of long-term stewardship currently unknown					
	Weldon Spring Site	2003		✓		✓	
Nebraska	Hallam Nuclear Power Facility	1998	✓				
Nevada	Central Nevada Test Area[a]	2001		✓		✓	
	Nevada Test Site[f]	2009		✓	✓	✓	
	Project Shoal[a]	1998				✓	
New Jersey	DuPont & Company[d]	Extent of long-term stewardship currently unknown					
	Maywood Chemical Works[d]	Extent of long-term stewardship currently unknown					
	Middlesex Sampling Plant[d]	Extent of long-term stewardship currently unknown					
	Princeton Plasma Physics Laboratory	2000				✓	
	Wayne Site[d]	Extent of long-term stewardship currently unknown					
New Mexico	Ambrosia Lake Site	1998		✓			
	Bayo Canyon	1982			✓		
	Bluewater Site	1997		✓		✓	
	Gasbuggy Site[a,c]	2006			✓	✓	
	Gnome-Coach[a,c]	2005			✓	✓	
	(Homestake) Grants Site	2015		✓		✓	
	Los Alamos National Laboratory	1993	✓	✓	✓	✓	✓
	Lovelace Respiratory Research Institute	1994			✓	✓	
	(Quivira) Ambrosia Lake Site 2	2015		✓		✓	
	Sandia National Laboratories - NM	2000		✓	✓	✓	
	Shiprock Site	1996		✓		✓	
	(SOHIO) LBAR Site	2001		✓		✓	
	(UNC) Church Rock Site	2015		✓		✓	
	Waste Isolation Pilot Plant	2040		✓			
New York	Ashland Oil #1[d]	Extent of long-term stewardship currently unknown					
	Ashland Oil #2[d]	Extent of long-term stewardship currently unknown					
	Bliss and Laughlin Steel[d]	Extent of long-term stewardship currently unknown					
	Brookhaven National Laboratory[b,e]	2003	✓	✓	✓	✓	✓
	Colonie[d]	Extent of long-term stewardship currently unknown					
	Linde Air Products[d]	Extent of long-term stewardship currently unknown					
	Niagara Falls Storage Site[d]	Extent of long-term stewardship currently unknown					
	Seaway Industrial Park[d]	Extent of long-term stewardship currently unknown					
	West Valley Demonstration Project[g]	Long-term stewardship responsibility not determined					
Ohio	Fernald Environmental Management Project[e]	2006		✓	✓	✓	

Table 3-4. Summary of Media Requiring Long-Term Stewardship

State	*Site Name*	*Long-Term Stewardship Start Date*	*Media*				
			Facilities	*EU**	*Soil*	*GW**	*SW**
	Luckey[d]	Extent of long-term stewardship currently unknown					
	Miamisburg Environmental Management Project[e]	2000	✓		✓	✓	
	Painesville[d]	Extent of long-term stewardship currently unknown					
	Piqua Nuclear Power Facility	1998	✓				
	Portsmouth Gaseous Diffusion Plant[b,e]	2000	✓	✓		✓	✓
Oregon	Lakeview Mill	2000				✓	
	Lakeview Site	1995		✓			
Pennsylvania	Burrell Site	1994		✓		✓	
	Canonsburg Site	1996		✓		✓	
Puerto Rico	Center for Energy and Environmental Research	1970	✓				
South Carolina	Savannah River Site[e]	1996	✓	✓	✓	✓	
South Dakota	Edgemont Site	1996		✓			
Tennessee	Oak Ridge Reservation[e]	1997	✓	✓	✓	✓	✓
Texas	(Chevron) Panna Maria Site	2001		✓		✓	
	(Conoco) Conquista Site	2002		✓		✓	
	(Exxon) Ray Point Site	2001		✓			
	Falls City Site	1997		✓		✓	
	Pantex Plant	2003		✓	✓	✓	✓
Utah	(Atlas) Moab Mill[h]	2005				✓	✓
	(EFN) White Mesa Site	2025		✓			
	Green River Site	1998		✓		✓	
	Mexican Hat Site	1997		✓		✓	
	Monticello Mill Site and Vicinity Properties	2001		✓	✓	✓	
	(Plateau) Shootaring Canyon Site	2015		✓			
	(Rio Algom) Lisbon Valley Site	2010		✓		✓	
	Salt Lake City Mill	1989				✓	
	South Clive Disposal Cell	1997		✓			
	11e.(2) Disposal Site	Extent of long-term stewardship currently unknown					
Washington	(Dawn) Ford Site	2019		✓		✓	
	Hanford Site[e]	2000	✓	✓	✓	✓	
	(WNI) Sherwood Site	2000		✓		✓	
West Virginia	Parkersburg Site	1983		✓			
Wyoming	(ANC) Gas Hills Site	2001		✓		✓	
	(Exxon) Highlands Site	2002		✓		✓	
	Hoe Creek Underground Coal Gasification Site	2004				✓	

Table 3-4. Summary of Media Requiring Long-Term Stewardship

State	Site Name	Long-Term Stewardship Start Date	Media				
			Facilities	EU*	Soil	GW*	SW*
	(Kennecott) Sweetwater Site[i]	unknown				✓	
	Naval Petroleum Reserve No. 3 Landfill/Landfarm	2001		✓		✓	
	(Pathfinder) Lucky Mc Site	2005		✓		✓	
	(Pathfinder) Shirley Basin Site 2	2006		✓		✓	
	(Petrotomics) Shirley Basin Site 1	2002		✓		✓	
	Riverton Site[a]	1989				✓	
	Rock Springs Oil Shale Retort Site	2005				✓	
	Spook Site	1993		✓			
	(UMETCO) Gas Hills Site	2002		✓		✓	
	(Union Pacific) Bear Creek Site	2001		✓		✓	
	(WNI) Split Rock Site	2002		✓		✓	
TOTAL SITES	***131[29]***		***15***	***70***	***27***	***83***	***11***

* EU = engineered unit, GW = groundwater, and SW = surface water/sediments.

[a] Long-term stewardship activities for these sites are divided into two categories: the surface and the subsurface. The long-term stewardship start date reflects the surface remediation completion date. Subsurface characterization and remediation are ongoing. In some cases, the subsurface remedy is yet to be determined by regulators.
[b] The scope of remediation has changed since data were submitted to EM's IPABS-Information System as part of the Spring 2000 data call. Therefore, long-term stewardship start dates have been updated.
[c] As a result of nuclear explosion tests conducted on the site, underground supplies of natural gas were contaminated with radioactivity. This natural gas will require long-term stewardship indefinitely because remediation is technically infeasible.
[d] The extent of long-term stewardship activities at 21 FUSRAP sites is currently uncertain. The Army Corps of Engineers is responsible for cleanup of these sites, and the extent of DOE's long-term stewardship responsibilities, if any, will depend on final cleanup decisions that have yet to be made.
[e] The long-term stewardship start date for these sites represents when the first portion or an area began or will begin long-term stewardship activities. Many sites will not be entirely in long-term stewardship until well after 2006.
[f] The long-term stewardship start date represents when all soil sites are planned to have been remediated. However, significant remediation progress has been made at the site that currently requires some level of long-term stewardship activities.
[g] DOE's responsibility for long-term stewardship, if any, has not yet been determined. Negotiations with regulators (including determination of NEPA requirements) are still ongoing.
[h] The FY 2001 NDAA required DOE to prepare a plan for remediation of this site, including groundwater restoration, in accordance with UMTRCA Title I. Remedial action, including removal and permanent disposition of the tailings at a disposal site in Utah, will commence as soon as practicable after completion of the plan. The extent of long-term stewardship activities has yet to be determined.
[i] The long-term stewardship start date has yet to be determined.

3.4 ESTIMATED LONG-TERM STEWARDSHIP COSTS

This section summarizes the results of the cost information compiled from the individual sites identified in Sections 3.1 and 3.2. The information represents DOE's first comprehensive effort to compile cost estimates associated with current and expected long-term stewardship activities. Consequently, the cost data should

[29] In addition to 129 sites expected to require long-term stewardship by DOE, Ames Laboratory in Iowa and the West Valley Demonstration Project in New York are included for informational purposes only. Therefore, the total number of sites included in the table is 131.

be considered preliminary, order-of-magnitude estimates. Although some cost data reflects operational experience (particularly at DOE's Grand Junction Office), most of the data is based largely on projections (and current site-specific planning assumptions) -- rather than validated baselines -- of the known or anticipated scope of long-term stewardship activities at individual sites. Moreover, the projected scope and costs for long-term stewardship may be based on either known or anticipated cleanup end states. The accuracy and precision of these estimates are related directly to the certainty of the scope of the long-term stewardship requirements, and indirectly to the certainty regarding the cleanup end states.

The information used in developing the cost estimates presented in this Report varied greatly from site to site depending on the status of cleanup activities. Sites where cleanup has been completed or is nearing completion tend to have better defined scope, schedule, and cost for long-term stewardship than the sites where cleanup activities are expected to continue well into the future, particularly where the "end state" for the site has not been proposed, agreed to, or determined. There are also varying levels of understanding of the expected long-term stewardship activities at most sites. The level of understanding varies primarily because, to date, most sites do not have staff dedicated to identifying and defining the scope of long-term stewardship.

HOW SHOULD LONG-TERM STEWARDSHIP COST ESTIMATE DATA BE PRESENTED?

Summarizing cost estimate data for DOE's anticipated long-term stewardship activities requires consideration of how the information should be most accurately and clearly presented. First, costs are presented in thousands of constant 2000 dollars. Conducting the analyses and reporting costs in constant dollars allows "apples-to-apples" comparisons between different sites and also provides an indicator on how much long-term stewardship will cost in "today's dollars" (i.e., accounting for inflation and the "value of money"). The alternative (current dollars) would inaccurately cause the costs to appear to be increasing. Moreover, net present value for costs are not used because it could appear to make costs disappear after 30 years. Because the Department has indicated that it is committed to considering the long-term costs and consequences of its decisions, net present value could appear to undervalue these long-term costs.

Second, the use of life-cycle costs has been the normal method of presenting cost information since the Department's first baseline report in 1995. However, in the case of long-term stewardship costs, life-cycle information is not appropriate, and annual costs are used instead. Defining "life-cycle costs" for the long term is not meaningful in the same way that costs for projects with a predictable end point are calculated because there is no clear end point for long-term stewardship, in most cases.

Finally, although long-term stewardship will be required in perpetuity at many sites, for the purpose of this Report, costs are reflected only through 2070. Costs estimated out to 2070 should be viewed as an indicator for the "magnitude" of the projected long-term stewardship scope rather than a point where all long-term stewardship activities will end. Consequently, most analyses in this Report provide annual cost estimates over time rather than "life-cycle costs."

Long-term stewardship cost information can be grouped into the following three broad categories:

- *Sites where cleanup (including stabilization and disposal) is either completed or largely completed and long-term stewardship activities have been conducted:* At these sites, there is a great deal of confidence in the accuracy of the cost information for long-term stewardship activities (see Section 3.1.1). These sites include former uranium mining, milling, and refining sites, as well as uranium mill tailings disposal sites, managed by DOE's Grand Junction Office (through its Long-Term Surveillance and Maintenance Program); relatively small nuclear reactor sites (e.g., the Piqua Nuclear Power Facility in Ohio and the Hallam Nuclear Power Facility in Nebraska); and sites nearing project completion (e.g., the Weldon Spring Site in Missouri).

- *Sites where cleanup has been completed at portions of the site but cleanup is still continuing and expected to continue beyond 2006 for other areas of the site (see Section 3.1.2)*: This group includes various categories of sites, such as former uranium mining, milling, and refining sites; research, development, and testing sites; and other sites that supported the Department's past nuclear weapons

activities. The quality and availability of cost data for these sites varies greatly. For example, cost estimates for uranium mining, milling, and refining sites where DOE has not yet taken responsibility for long-term stewardship are likely to be comparable to costs of similar work where DOE has already gained operational experience. Hence, DOE's confidence in the cost estimate is high. For other sites, cost estimates are less precise because either end states are not yet defined or remediation decisions are still pending. Consequently, the scope of long-term stewardship activities required to generate cost estimates are yet to be defined. The accuracy of cost estimates should improve at these sites as cleanup nears completion (either for the entire site or portions of a site) and long-term stewardship plans are prepared. In many cases, cost estimates can be developed based on experience with similar activities conducted at other sites. For example, since the nature and extent of long-term stewardship activities are similar for capped landfills, the cost estimates for existing landfills can provide a useful basis for estimating costs at future landfills requiring similar long-term stewardship activities at other sites.

- *Sites where DOE may be responsible for long-term stewardship activities (see Section 3.2):* This category includes sites where the extent of long-term stewardship is currently unknown and, therefore, reliable cost estimates cannot be developed. At most of these sites, cleanup activities are still being conducted by an entity other than DOE – for example, the remediation of 21 FUSRAP sites is currently the responsibility of the U.S. Army Corps of Engineers.

The scope of this Report focuses primarily on the sites in the first two categories, particularly those sites or portions of sites where remediation is expected to be completed by 2006. For those sites or portions of sites where cleanup is not expected to be completed by 2006, DOE and its contractors will develop more detailed information on costs and technical requirements for long-term stewardship activities as DOE and regulators make decisions (in conjunction with Indian tribes, local governments and stakeholders) on cleanup, disposal, and stabilization.

In addition to the varying levels of information available on anticipated long-term stewardship activities and costs, the process used by sites to budget for long-term stewardship varies. Most sites have not established long-term stewardship as a specific project with distinct and discrete performance metrics. Some sites include long-term stewardship as part of the budget for each cleanup project. Some sites include certain long-term stewardship activities (e.g., records management and site security) as part of the overall infrastructure maintenance activities.

DOE staff are currently working to improve the methods for estimating long-term stewardship costs (i.e., developing guidance and cost models). They anticipate including long-term stewardship cost estimates in the FY 2003 budget formulation process, which will require that site personnel define the technical scope and schedules with enough detail to develop reliable cost estimates (e.g., in a long-term stewardship implementation plan).[30]

Site-specific cost information is provided in two appendices:

- Appendix E: Projected Long-Term Stewardship Costs for Sites: 2000, 2006, and 2050, which provides "snapshots" for the years indicated, and
- Appendix F: Projected Annual Average Long-Term Stewardship Costs for Sites: 2000-2010, 2031-2040, and 2061-2070, which provides average annual long-term stewardship costs for each site for each of the time intervals indicated.

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[30] See Memorandum for All Departmental Elements from Deputy Secretary T.J. Glauthier regarding "Long-term Stewardship Transition to Site Landlord", December 15, 2000.

Although similar at first glance, each appendix provides different perspectives in analyzing the data. Appendix E provides the simplest summary of expected costs by providing a "snapshot" of the costs for each site for three critical years -- 2000, 2006, and 2050. However, this method of summarizing cost information could result in a misleading presentation of the site-specific cost information if changes in costs are expected to occur between the "snapshot" years (i.e., between 2000 and 2006 or between 2006 and 2050). For example, if a site initiates long-term stewardship activities after 2006 and completes long-term stewardship activities prior to 2050, the "snapshot" presented in Appendix E of 2006 and 2050 would fail to capture these costs; therefore, average costs, as provided in Appendix F, provides a better perspective. Volume II provides the available detailed cost estimates and the scope of long-term stewardship for each site.[31]

DOE spends a relatively small portion of its current Environmental Management budget on long-term stewardship. To date, DOE's primary focus has been on the "cleanup" of sites – managing wastes and materials until disposition, deactivating/decommissioning unneeded facilities, facility surveillance and maintenance, and other activities to stabilize and close sites. However, as DOE completes cleanup and begins performing long-term stewardship activities at an increased number of sites and portions of sites, the total budget for performing long-term stewardship activities will also increase (although the annual cost will still remain small compared to the current annual cost for cleanup). DOE's preliminary, order-of-magnitude cost estimate indicates that from 2000 to 2070, DOE will spend a total of approximately $5.5 billion on long-term stewardship activities. For comparison, DOE estimates that high-level waste cleanup costs are anticipated to be more than $50 billion for the same time period. Although the budget for performing long-term stewardship activities will increase over time, at least in the near-term, the budget increase is primarily due to the number of sites performing activities. Some of the most challenging remediation tasks (e.g., remediating the contamination in high-level radioactive waste tanks and reprocessing canyons) will not be completed until well beyond 2006 and will ultimately require long-term stewardship activities, for which the costs are not yet known.

The highest projected long-term stewardship costs over time are associated with DOE's major sites, such as the Hanford Site, Oak Ridge Reservation, and the Savannah River Site.[32] At these sites, DOE still has complex contamination and remediation challenges ahead, such as co-mingled contaminants in groundwater plumes, unknown extent of subsurface contamination and other technically challenging problems, such as long-term surveillance and maintenance of high-level waste tanks. While it is clear that long-term stewardship will be required at these sites because of existing disposal cells and some other known conditions (e.g., groundwater contamination that will be monitored and contained rather than remediated), the specific activities and associated costs to manage additional activities in the future remain uncertain. Therefore, the estimates for future long-term stewardship costs may be underestimated.

Exhibit 3-5 shows an estimated long-term stewardship cost profile for the period between 2000 and 2070. Between 2004 and 2010, the projected cost increase is primarily due to more sites beginning long-term stewardship activities. Many sites under the DOE Grand Junction Office's management responsibility are expected to begin long-term stewardship activities at this time, along with larger sites, such as the Rocky

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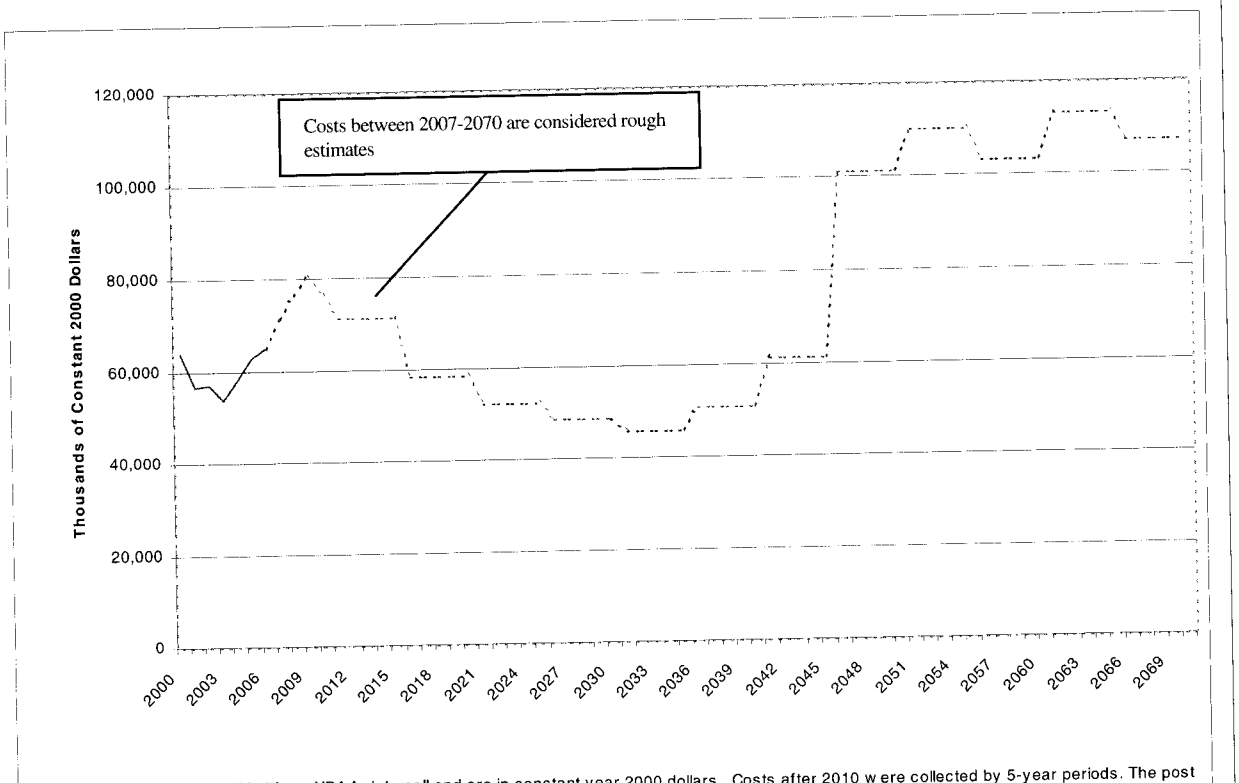
[31] Currently, for sites where DOE is not responsible for cleanup, but may be responsible for long-term stewardship activities, there is no basis for providing any costs estimates. Therefore, no cost estimates are provided for 21 FUSRAP sites where the U.S. Army Corps of Engineers is managing cleanup and one UMTRCA Title II site (the 11e.(2) Disposal Site in Utah) where a private company is managing operations.

[32] Long-term stewardship cost estimates for the Savannah River Site in South Carolina do not include any activities scheduled to begin after 2006. At this time, these activities are not well known and, therefore, reasonably reliable cost estimates were not available to be included in this Report. Hence, post-2006 cost estimates provided in this section are likely to underestimate the Department's long-term cost obligations.

Flats Environmental Technology Site. Between 2010 and 2035, long-term stewardship costs are expected to decrease as monitoring programs and pump and treat systems decrease or end. When all remediation activities are completed (between 2045 and 2050) at two major sites (the Hanford Site and the Idaho National Engineering and Environmental Laboratory (INEEL)), the costs are expected to increase sharply as major site activities, such as maintenance and monitoring of high-level waste tanks become long-term stewardship activities.

Exhibit 3-5. Estimated Annual Long-Term Stewardship Costs



* Cost data were provided from NDAA data call and are in constant year 2000 dollars. Costs after 2010 were collected by 5-year periods. The post 2010 costs shown in this exhibit reflect annual averages for each five year period (2011-2015, 2016-2020, ... , 2066-2070).

Costs after FY 2010 were collected by five-year periods and, therefore, the post FY 2010 costs shown in this exhibit reflect annual averages for each five-year period (2011-2015, 2016-2020...2066-2070).

- Between 2010 and 2035, long-term stewardship costs decrease at many sites as monitoring programs and pump and treat systems decrease or end.
- After 2050, long-term stewardship costs are expected to remain relatively constant. However, some fluctuations are expected for sites anticipating possible equipment repair or replacement (e.g., monitoring wells).
- Long-term stewardship cost estimates for the Savannah River Site do not include any activities scheduled to begin after 2006. At this time, these activities are not well known and cost estimates are not included in this Report. Therefore, post-2006 cost estimates provided in this section are likely to be an underestimate for the Department's long-term cost obligations.
- The extent of long-term stewardship for the 21 FUSRAP sites transferred to the Corps and two UMTRCA Title II sites are currently unknown. Therefore, cost data for these sites were not included in the estimates above.

3.4.1 Near Term Long-Term Stewardship Costs

According to the information compiled from Field offices, the Department currently spends approximately $64 million per year (as of FY 2000) for long-term stewardship activities at sites (or portions of sites) where cleanup, stabilization, or disposal activities have been completed. This total estimated cost was derived from individual cost estimates provided by 58 individual geographic sites, including 34 sites where all cleanup work has been completed, 12 sites where portions of the site have been cleaned up but where additional cleanup work is occurring elsewhere at the site, and 12 sites where all surface cleanup has been completed but where additional subsurface work remains to be done. Table 3-5 summarizes the expected number of sites requiring long-term stewardship and the anticipated annual long-term stewardship and cleanup costs for 2000, 2006, and 2050.

Table 3-5. Long-Term Stewardship Cost Highlights

Year	*2000*	*2006*	*2050*
Expected Number of Sites Requiring Long-Term Stewardship	58 sites • 34 entirely complete • 12 "geographically distinct" portions where long-term stewardship is being conducted • 12 sites where surface cleanup is complete, but subsurface characterization/remediation is ongoing	96 sites • 67 sites entirely complete • 12 "geographically distinct" portions complete • 17 sites where surface cleanup is complete by 2006, but site subsurface characterization is ongoing	129 sites
Projected Annual Long-Term Stewardship Cost[33]	$64 Million	$65 Million[34]	$101 Million[35]
Projected Annual Environmental Management Cost[36]	$6 Billion	$6 Billion	$150 Million[37]

[33] Costs for the 21 FUSRAP sites transferred to the Corps in 1997 were not included in the cost estimates because the extent of long-term stewardship is currently unknown.

[34] While a number of sites do show cost increases between 2000 and 2006, this increase in cost is offset by cost decreases at some sites during this period. These expected decreases in long-term stewardship cost can be attributed to many one-time administrative costs associated with initiations of long-term stewardship activities, as well as termination of groundwater pump and treat activities at some sites.

[35] Long-term stewardship cost estimates for the Savannah River Site in South Carolina do not include any activities scheduled to begin after 2006. At this time, these activities are not well known and cost estimates are not included in this Report. Therefore, post-2006 cost estimates provided in this section are likely to underestimate the Department's long-term cost obligations.

[36] Cleanup cost data taken from the U.S. Department of Energy Office of Environmental Management's "Status Report on Paths to Closure," DOE/EM-0526, March 2000. Environmental Management costs displayed in this table do not include the long-term stewardship costs.

[37] Environmental Management costs in 2050 consist primarily of high-level waste treatment, field programs (e.g., program support), and landlord responsibilities (e.g., maintaining roads).

This current annual estimate is significantly greater than the approximately $2.8 million budgeted by DOE's Grand Junction Office for long-term stewardship activities at 37 sites (see the text box *Long-Term Surveillance and Maintenance by the Grand Junction Office*). Hence, it is clear that, although DOE's Grand Junction Office performs much of the explicitly identified long-term stewardship activities at sites where cleanup and closure has been completed, a significant amount of long-term stewardship activities is occurring at others sites.

This estimate of current expenditures could either understate or overstate the costs required for long-term stewardship activities following cleanup. The estimate could be understated because many long-term stewardship activities are being performed as part of overall site maintenance work (e.g., site security and groundwater monitoring), now categorized at some sites as "overhead" activities instead of long-term stewardship activities. On the other hand, the estimate may overstate the cost required (not the amount spent) for long-term stewardship in that significant opportunities remain to perform the work more efficiently. For example, some sites may be performing extensive groundwater monitoring at a level that was originally required for site characterization. However, the number of wells monitored and samples analyzed may be reduced for long-term stewardship purposes if initial monitoring has been sufficient to characterize and model the behavior of groundwater contaminant movement, thereby allowing future monitoring to be conducted with fewer wells.

LONG-TERM SURVEILLANCE AND MAINTENANCE BY THE GRAND JUNCTION OFFICE

Long-term stewardship is not a new issue for the Department. For example, Field staff at the Department's Grand Junction Office (GJO) have been conducting long-term stewardship activities for several years. Originally established during World War II to support uranium mining and assaying, GJO supports the uranium mill tailings remediation program, for which surface cleanup was completed in 1996. GJO manages the long-term surveillance and maintenance program to maintain the physical (e.g., disposal cell cap) and institutional controls (e.g., deed restrictions, fencing and warning signs) that were put in place as each uranium milling site completed surface remediation activities -- and in a few cases, subsurface remediation activities (e.g., groundwater remediation). GJO performs these long-term stewardship activities under the regulatory control of the NRC. Although GJO's long-term stewardship efforts have primarily focused on closed uranium mill tailings sites, GJO has been taking on more responsibility for other types of sites, such as the Pinellas STAR Center in Florida. GJO is currently conducting long-term stewardship activities at 26 sites located primarily in the western U.S.

One of the lessons learned from GJO's experience is the importance of developing a long-term stewardship plan as a baseline for operations. GJO operations also provide a useful source of field-validated costs for long-term stewardship activities.

DOE's estimated annual cost for long-term stewardship in 2006 is approximately $65 million. This total annual cost estimate was derived from individual estimates provided for 96 individual geographic sites, including 67 sites where all EM work has been completed, 12 sites where portions of the site have been cleaned up but where additional cleanup work is occurring elsewhere at the site, and 17 sites where all surface cleanup has been completed but where additional subsurface work remains to be done. During this same time period, as a comparison, the budget target for EM is expected to remain at $6 billion per year.

Although this annual estimate for long-term stewardship in 2006 is only slightly higher than the 2000 estimated annual cost, it reflects significant changes within individual costs for long-term stewardship. The lack of a significant overall increase in the estimated annual cost results from substantial cost reductions occurring at several sites, while new long-term stewardship costs are added as a result of the completion of cleanup at 38 additional sites. There are two general reasons why costs for long-term stewardship at some sites are expected to decrease substantially during this period: (1) in some cases, groundwater pump and treat work is characterized as long-term stewardship and is expected to end prior to 2006; and (2) one-time administrative activities (e.g., establishing record-keeping management systems) are expected to be completed prior to 2006 at several sites. Because of these cost reductions at some sites, the net increase in long-term stewardship costs between 2000 and 2006 will be relatively small despite an increase in the

number of sites conducting long-term stewardship activities.

The key issue in estimating costs is establishing the activities required for which costs will be incurred. At this time, reliable information on the scope of long-term stewardship activities is limited, even for the near-term cost estimates, much less the out-year estimates. Significant costs are currently being incurred due to activities such as groundwater pump and treat operations, which in many cases are associated with cleanup rather than long-term stewardship goals. In addition, the costs associated with DOE's Grand Junction Office and other smaller sites already conducting long-term stewardship can be clearly assigned to a variety of functions, including: 1) monitoring and maintaining facilities, engineered caps, and in-situ barriers; 2) access controls and restrictions; 3) routine monitoring and maintenance (i.e., well replacement); and 4) record-keeping and reporting. However, future cost drivers remain unclear because of the preliminary nature of the data received, and because of the uncertain nature of long-term stewardship activities at some of DOE's largest, most complex sites.

3.4.2 Out-Year Long-Term Stewardship Costs

Although the primary focus of this Report is on sites and portions of sites where cleanup, stabilization, and disposal activities are expected to be completed by 2006 (as directed in the FY 2000 NDAA), some out-year activities and preliminary estimated costs are also included, where such information was available for the sites. However, as with other cost estimates for long periods of time in the future, the out-year estimates contained in this Report are somewhat speculative and certainly incomplete in many cases.

Based on out-year estimates submitted by Field offices, the estimated annual cost for long-term stewardship in 2050 is approximately $100 million. This cost estimate is based on available cost estimates for 129 sites where DOE is expected to be responsible for long-term stewardship. For several sites (e.g., Savannah River Site post-2006 activities and FUSRAP sites currently managed by the U.S. Army Corps of Engineers) no reasonably reliable cost estimates were available. During this same time period, the budget target for EM is expected to remain at $150 million per year -- primarily for high-level waste treatment, field programs (e.g., program support), and landlord responsibilities (e.g., maintaining roads).

Although this out-year estimate of $100 million is somewhat speculative and incomplete, the Department believes that it is likely accurate to an order-of-magnitude range (i.e., it is not likely to be $10 million or $1 billion per year). Although $100 million annually for long-term stewardship is substantially less than the $6 billion currently spent annually on the EM program, it is still a significant cost, particularly when it is expected to be required for a very long period of time. In some cases, cleanup agreements require long-term stewardship in perpetuity. Hence, any amount multiplied by perpetuity equals an infinite sum. The Department is, therefore, seeking to reduce these annual costs further.

Four general factors are expected to affect long-term stewardship costs are: (1) the "end state" selected for cleanup, which is dependent on expected land use, and the technical and economic feasibility of cleanup, (2) standards that must be achieved for the selected land use and end state, (3) the remedial technology selected to achieve the end state and standards, and (4) the scope of activities determined to be appropriate for long-term stewardship (e.g., extent and frequency of monitoring, frequency of remedy replacement, monitoring of health, worker pensions, extent of record-keeping, etc.). Of these factors, the Department has primary control over #3 (technologies used) and #4 (long-term stewardship activities). The Department is seeking to reduce long-term costs through investments in science and technology that could result in more reliable and less costly cleanup and long-term stewardship technologies (e.g., groundwater monitoring). Without such investments in better science and technologies, there is little hope for reducing the long-term costs.

3.5 LAND AREA REQUIRING LONG-TERM STEWARDSHIP

Another way to measure the extent of the Department's long-term stewardship responsibility is to estimate the amount of land (versus the number of sites or portions of sites) likely to require use or access restrictions because of hazards associated with residual surface or subsurface contamination. Long-term stewardship of land is required for a number of reasons, including: (1) conservation of natural resources; (2) protection as a safety or security buffer for ongoing operations; (3) contamination of groundwater (often during extended and uncertain pump and treat operations or where monitored natural attenuation is occurring); (4) maintenance of engineered units (e.g., closed disposal cells and capped landfills); and (5) contamination of soil that remains on the surface or the accessible subsurface.[38] This section only discusses the amount of land anticipated to require long-term stewardship activities at the 129 sites where DOE expects to perform long-term stewardship.[39, 40]

DOE LAND HOLDINGS

From the Manhattan Project to the present, DOE and its predecessor agencies acquired sizeable tracts of land to build and operate infrastructures needed to support nuclear weapons production activities, manage the resulting wastes and materials, and provide buffer space to maintain security and protect the public. Land area acquired by DOE for the nuclear weapons complex grew to approximately 2.54 million acres of land – an area approximately the size of the States of Rhode Island and Delaware combined. DOE still retains nearly all of this land. Most of the land held by DOE today is clean (approximately 79 percent) and has never been contaminated. In fact, one paradox of the Cold War is, because of the exclusion of commercial development for security and state reasons, many DOE sites are ecologically pristine, harboring native vegetation, and endangered species.

The land area requiring long-term stewardship largely depends on the extent of soil contamination and the spatial extent of groundwater contamination, but also includes surface areas for engineered units, even though engineered units comprise a relatively small area. Land area requiring long-term stewardship is not merely the sum of different areas of contamination. In some cases, areas can overlap with one another (e.g., surface contamination overlapping a groundwater plume); therefore, contaminated areas should be evaluated in three-dimensional space. Traditional land conservation areas and safety/security buffers are not considered as land requiring long-term stewardship and, therefore, are outside the scope of this Report. Instead, this Report to Congress focuses on lands with use restrictions resulting from residual contamination. For more detail on the methodology for determining land area requiring long-term stewardship, see Appendix C, Section 7.

To develop the estimates provided in this section, DOE used information in addition to the initial survey of Field offices, which served as the primary information source for this Report. These other sources included

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[38] DOE has contributed to the conservation of ecological systems both purposely and inadvertently. In many cases, vast tracts of land have been restricted from development for security reasons and, paradoxically, are ecologically rich and diverse. Many areas have become habitat for endangered species amidst profound radioactive contamination. More recently, the Department has deliberately sought to protect a number of tracts of land (e.g., the Rock Creek Preserve at the Rocky Flats Environmental Technology Site, and the Arid Lands Ecology Area and the Wahluke Slope section of the Hanford Site). These areas of the Hanford Site were designated as a national monument by President Clinton under the Antiquities Act in June 2000.

[39] This section focuses mainly on land in terms of surface soil contamination. In some cases, it does include discussion of land areas where contaminated groundwater is the only driver for long-term stewardship activities. However, comprehensive data were not available at the time of this Report to allow an estimate of the amount of land that will be affected by the extent of contaminated groundwater plumes.

[40] The land area represented by the 129 sites included in this analysis accounts for approximately 2.1 million of the 2.54 million acres under DOE responsibility. The extent of long-term stewardship is yet to be determined for the 21 FUSRAP sites transferred to the Corps for remediation; therefore, the land area analysis does not include these sites.

site-specific Environmental Impact Statements and land use reports. The specific methodology and data sources used to develop the estimate in this discussion is provided in Appendix C - Methodology.

Of the 2.54 million acres under DOE's responsibility, DOE expects to perform long-term stewardship activities at approximately 0.54 million acres which is approximately 21 percent of the total land under DOE responsibility.[41] Depending on the nature of the remaining hazards, long-term stewardship will include activities such as monitoring, record-keeping, and land use restrictions.

DOE estimates that just over 2.0 million out of the total 2.54 million acres (approximately 79 percent of the land under its responsibility) is "clean" and not contaminated by radioactive or hazardous chemical releases.[42] Most of the 2.0 million acres were never contaminated. However, some of the 2.0 million acres were contaminated lands that have been cleaned up to levels appropriate for residential use. Of the 2.0 million acres of uncontaminated land, DOE will eventually release some of the land for other uses, and some will be retained by DOE as buffer zones or to support other missions. A small percentage of currently contaminated land may be cleaned up to levels accepted for unrestricted use. However, given the nature of contamination and, in some cases, technological restraints, the vast majority of contaminated lands will require some form of long-term stewardship.

Exhibits 3-6 and 3-7 show the number of acres where DOE expects to perform long-term stewardship over time in relation to the current total DOE land holdings.

- In 2000, the number of acres where DOE is performing long-term stewardship activities is approximately 10 percent of the total acres, or 263,000 acres. More specifically, at almost half (263,000 acres) of all contaminated lands (0.54 million acres or 539,000 acres), DOE has completed cleanup activities and is conducting long-term stewardship activities.

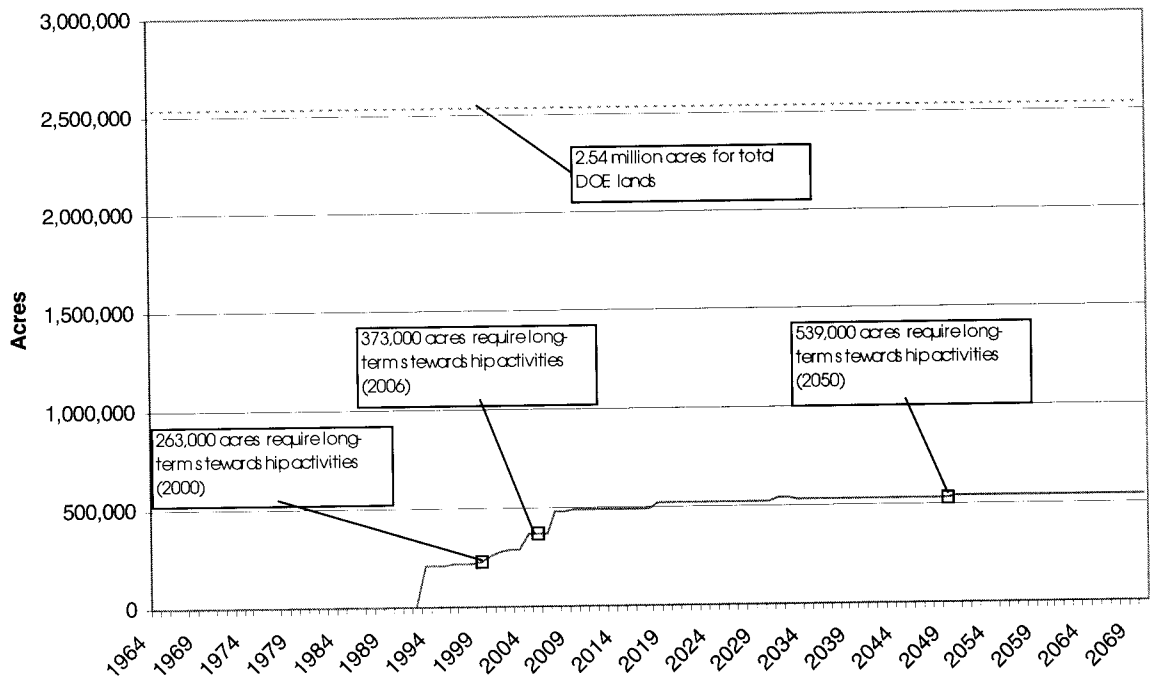
- By 2006, DOE expects to cleanup and conduct long-term stewardship activities at almost 70 percent (373,000 acres) of all contaminated lands (0.54 million acres or 539,000 acres).

- Between 2006 and 2050, DOE anticipates performing long-term stewardship activities at several additional sites and portions of sites. By 2050, DOE anticipates that all contaminated lands (0.54 million acres or 539,000 acres) will be cleaned up and will require long-term stewardship activities.

[41] Approximately 210,000 acres are associated with a 1940s bombing and artillery range within what is now the Idaho Engineering and Environmental National Laboratory.

[42] For the purpose of this Report, this estimate includes approximately 195,000 acres designated as a national monument at the Hanford site in June 2000.

Exhibit 3-6. DOE Expects to Perform Long-Term Stewardship at More than 21 Percent of DOE's Current Land Holdings

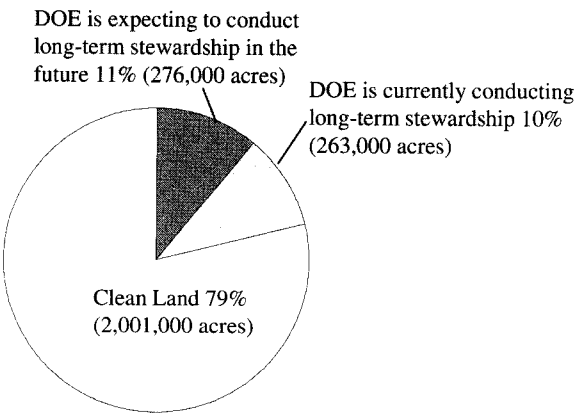


- As previously discussed, portions were partly defined to follow long-term stewardship boundaries, but this was not the case for all defined portions. In cases where defined portions are significantly larger than the area of residual contamination, acreage was based upon the area defined by media contamination. For the Hanford Site, acreage was changed for the defined portions (Wahluke Slope, Arid Land Ecology Reserve, and the Riverlands) to show the extent of media contamination. The combined, total long-term stewardship acreage for the three portions is assumed to be 510 acres.
- Idaho National Engineering and Environmental Laboratory's (INEEL) Ordnance Area is the single largest contiguous area subject to long-term stewardship, covering nearly 210,000 acres.
- Because the NDAA Conference Report only requested information on sites or portions of sites where remediation activities are complete and long-term stewardship begins by 2006, some sites with large land holdings and ongoing remediation were not required to provide all of their forecasted long-term stewardship acreage. For three of these sites (INEEL, the Savannah River Site, and the Nevada Test Site), the NDAA Data Call significantly underestimated life-cycle long-term stewardship acreage. Therefore, additional data sources were used to estimate long-term stewardship acreage.
  - For calendar year 2017, 23,000 acres were inserted for the Nevada Test Site (NTS) to fully account for surface plutonium contamination [if regulatory limits are 1000 picocuries per gram (PiCu/g)] not captured in this Report to Congress.[1] Note that inclusion of 23,000 acres is only for estimating purposes. NTS and the Air Force have not yet reached agreement on a cleanup level.
  - For calendar year 2030, 21,000 acres were inserted for the Savannah River Site to fully account for the contaminated right of way, industrial use, and ponds not captured in the NDAA Data Call.[2]
  - For calendar year 2050, 10,000 acres were inserted for INEEL to account for planned environmentally controlled areas not captured in this Report to Congress.[3]
- Information outside of the NDAA Conference Report request was used to create long-term stewardship acreage estimates for large sites scheduled to close well after 2006 (Idaho National Engineering and Environmental Laboratory, Nevada Test Site, and the Savannah River Site).
- The extent of land that will require long-term stewardship at the 21 FUSRAP sites that were transferred to the Corps is currently unknown. Therefore, the acreage of these sites were not included in the above acreage estimates.

[1] "Cost/Risk/Benefits Analysis of Alternative Clean-up Requirements for Plutonium Contaminated Soils on and Near the Nevada Test Site." DOE/NV-399, May 1995.
[2] Data for the Savannah River Site are based on the assumption that five percent of the site acreage is developed and will require access restrictions.
[3] *The Idaho National Engineering and Environmental Laboratory Land Use Plan* (1996).

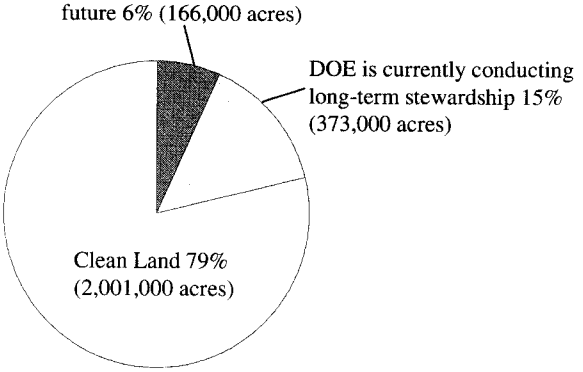
Exhibit 3-7. Comparing Long-Term Stewardship Acreage Over Time

2000



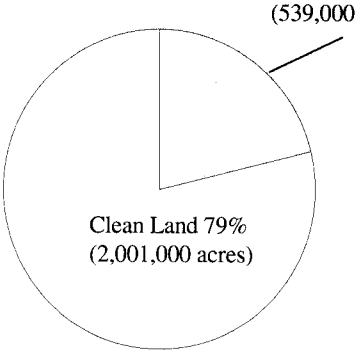
- Nearly 21% of DOE land is contaminated and falls into one of two categories: (1) contaminated land with ongoing remediation (scheduled for long-term stewardship), or (2) land currently subject to long-term stewardship.
- As of 2000, 34 sites have completed remediation and are subject to long-term stewardship, covering approximately 263,000 acres (10%).
- Roughly 79% of all DOE land is clean. Most of this land has always been uncontaminated, while some has been remediated for unrestricted use.
- The largest single area subject to long-term stewardship is the Ordnance Area at the Idaho National Engineering and Environmental Laboratory, which accounts for nearly 210,000 acres.

2006



- By 2006, 96 of the 129 sites are expected to be conducting long-term stewardship activities, covering approximately 373,000 acres (15%).
- Twenty-nine of the 96 sites will only be conducting long-term stewardship activities at portions of the site where remediation has been completed. Seventeen of these sites will have surface remediation completed but will have ongoing subsurface characterization.
- Contaminated lands scheduled to eventually require long-term stewardship will continue to be remediated at many of the larger sites.

Post 2050



- By 2050, 129 sites may be subject to long-term stewardship, covering approximately 539,000 acres (21%).
- Idaho National Engineering and Environmental Laboratory and Hanford are the last two sites scheduled to complete site-wide remediation (2050 and 2046 respectively).
- The overall acreage subject to long-term stewardship is expected to remain relatively constant between 2050 and 2070. Only small sites and small portions of larger sites, which represent a small percentage of overall DOE long-term stewardship acreage, are scheduled to complete long-term stewardship commitments during this period.

3.6 WHO WILL BE INVOLVED IN PERFORMING LONG-TERM STEWARDSHIP?

To gain get a better understanding of the level of involvement of various entities in performing long-term stewardship activities, DOE analyzed four types of site involvement.

- **Owner** - Entity who owns the deed to the property. In some instances, the owner leases the property to someone else, known as a landlord.
- **Landlord** - Entity responsible for activities that involve the physical operation and maintenance of installations. Specific tasks vary but generally include providing utilities, maintenance, and general infrastructure for the entire installation.
- **Steward** - Individuals or groups responsible for performing and/or ensuring that the required long-term stewardship activities take place.
- **Funding Organization** - Agency which provides financial support for stewardship activities.

As illustrated in Table 3-6, DOE is frequently not the owner or landlord of the property where it is or will be conducting long-term stewardship activities. In fact, at 64 sites where DOE is (or will be) performing long-term stewardship activities, DOE is working with other entities (e.g., Federal non-DOE, State, local, and private) to ensure that the necessary activities take place. At these sites, DOE works with the entities to coordinate long-term stewardship activities, such as surveillance and maintenance of facilities, monitoring of groundwater, and enforcing institutional controls. At the Pinellas STAR Center in Florida, for example, DOE is responsible for funding the long-term stewardship activities, but site ownership has already been transferred to a private entity.

Local governments traditionally conduct and enforce land use planning, land use restrictions (e.g., zoning) and certain types of record-keeping (e.g., deed registration), regardless of whether land is owned by Federal or private entities.

However, at 57 sites, DOE is the steward, funding organization, owner, and landlord. Currently, the responsibility for long-term stewardship resides with a variety of DOE offices, depending on the site and the situation. The exception is 11 sites (e.g., the Maxey Flats Disposal Site), where DOE has been responsible for at least some of the cleanup costs but does not expect to have any long-term stewardship responsibility.[43] For most of the larger sites, where long-term stewardship and cleanup activities are occurring concurrently (e.g., the Hanford and Savannah River Sites), long-term stewardship activities are considered part of the overall infrastructure and maintenance duties of their managing DOE operations office. For a number of sites, where cleanup has been completed, DOE conducts and funds a variety of long-term stewardship activities. For example, DOE is responsible for all aspects of long-term stewardship activities, including funding, for the UMTRCA Title II sites (e.g., (Homestake) Grants Site). However, the private owner of the site must make a one-time payment to the U.S. Treasury, in accordance with NRC rules, that pays for long-term stewardship activities at the site.

The distribution of responsibilities for performing long-term stewardship activities will change over time as property is transferred to and from DOE. In some instances, DOE can transfer property available for restricted use to other Federal or non-Federal entities. These property transfers often occur when neighboring communities want to use the land for economic redevelopment, and the risks associated with residual hazards are consistent with the anticipated redevelopment. DOE may retain responsibility for portions of long-term stewardship activities, impose management or use restrictions on the transferred property (stated in the land transfer documents), and/or oversee any restrictions or limits that are imposed.

[43] Long-term stewardship responsibilities for the West Valley Demonstration Project are yet to be determined.

Table 3-6. Long-Term Stewardship Responsibility

State	Site Name	Responsibility			
		Steward	Funding Organi-zation	Owner	Landlord
Alaska	Amchitka Island	DOE	DOE	Federal Non-DOE	Federal Non-DOE
Arizona	Monument Valley Site[a]	DOE	DOE	Tribe	N/A
	Tuba City Site[a]	DOE	DOE	Tribe	N/A
California	Energy Technology Engineering Center[b]	Private	Private	Private	Private
	General Atomics[b]	Private	Private	Private	Private
	General Electric Vallecitos Nuclear Center[b]	Private	Private	Private	Private
	Laboratory for Energy-Related Health Research Site[b]	UC/State	UC/State	UC/State	UC/State
	Lawrence Berkeley National Laboratory	DOE	DOE	State	DOE
	Lawrence Livermore National Laboratory - Livermore Site	DOE	DOE	DOE	DOE
	Lawrence Livermore National Laboratory - Site 300	DOE	DOE	DOE	DOE
	Sandia National Laboratories - CA	DOE	DOE	DOE	DOE
	Stanford Linear Accelerator	DOE	DOE	Private	DOE
Colorado	Bodo Canyon Cell[a]	DOE	DOE	DOE	N/A
	Burro Canyon Disposal Cell[a]	DOE	DOE	DOE	N/A
	Cheney Disposal Cell[a]	DOE	DOE	DOE	N/A
	(Cotter) Cañon City Site[a, d]	DOE	DOE	DOE	N/A
	Durango Mill[a]	DOE	DOE	State	N/A
	Estes Gulch Disposal Cell[a]	DOE	DOE	DOE	N/A
	Fort St. Vrain	DOE	DOE	DOE	DOE
	Grand Junction Mill [a]	DOE	DOE	Other	N/A
	Grand Junction Mill 2[a]	DOE	DOE	DOE	N/A
	Gunnison Disposal Cell[a]	DOE	DOE	DOE	N/A
	Gunnison Mill[a]	DOE	DOE	Other	N/A
	(HECLA) Durita Site[a, b]	DOE	DOE	Private	N/A
	Maybell Mill Site[a]	DOE	DOE	DOE	N/A
	Naturita Mill[a]	DOE	DOE	Private/ Other	N/A
	Naturita Site[a]	DOE	DOE	DOE	N/A
	Naval Oil Shale Reserves Site	DOE	DOE	DOE	Federal Non-DOE
	Rifle (New) Mill[a]	DOE	DOE	Other	N/A[c]
	Rifle (Old) Mill[a]	DOE	DOE	Other	N/A[c]

Table 3-6. Long-Term Stewardship Responsibility

State	Site Name	Responsibility			
		Steward	*Funding Organi-zation*	*Owner*	*Landlord*
	Rio Blanco	Federal Non-DOE	DOE	Federal Non-DOE	Federal Non-DOE
	Rocky Flats Environmental Technology Site	Other	DOE	DOE	DOE
	Rulison	Other	DOE	Private	Private
	Slick Rock (North Continent) Mill 1[a]	DOE	DOE	Private	N/A
	Slick Rock (Union Carbide) Mill 2[a]	DOE	DOE	Private	N/A
	(UMETCO) Maybell Site 2[a, d]	DOE	DOE	Private	N/A
	(UMETCO) Uravan Site[a,d]	DOE	DOE	DOE	N/A
Connecticut	CE[e]	Yet to be determined			
Florida	Pinellas STAR Center	Private	DOE	Other	DOE
Idaho	Idaho National Engineering and Environmental Laboratory	DOE	DOE	DOE	DOE
	Lowman Site	DOE	DOE	DOE	DOE
Illinois	Argonne National Laboratory East	DOE	DOE	DOE	DOE
	Fermi National Accelerator Laboratory	DOE	DOE	DOE	DOE
	Madison[e]	Yet to be determined			
	Palos Forest (Site A/Plot M) Preserve	DOE	DOE	Other	DOE
Iowa	Ames Laboratory	No activities beyond record-keeping expected			
Kentucky	Maxey Flats Disposal Site[b]	State	State	State	State
	Paducah Gaseous Diffusion Plant	DOE	DOE	DOE	DOE
Maryland	W.R. Grace and Company[e]	Yet to be determined			
Massachusetts	Shpack Landfill[e]	Yet to be determined			
Mississippi	Salmon Site	Other	DOE	State	State
Missouri	Kansas City Plant	DOE	DOE	DOE	DOE
	Latty Avenue Properties[e]	Yet to be determined			
	St. Louis Airport Site[e]	Yet to be determined			
	St. Louis Airport Site Vicinity Properties[e]	Yet to be determined			
	St. Louis Downtown Site[e]	Yet to be determined			
	Weldon Spring Site	DOE	DOE	DOE	DOE
	Westlake Disposal Site[b]	Yet to be determined			
Nebraska	Hallam Nuclear Power Facility	DOE	DOE	Other	DOE
Nevada	Central Nevada Test Area	Federal Non-DOE	DOE	Federal Non-DOE	Federal Non-DOE
	Nevada Test Site	DOE	DOE	Federal Non-DOE	DOE
	Project Shoal	Federal Non-DOE	DOE	Federal Non-DOE	Federal Non-DOE

Table 3-6. Long-Term Stewardship Responsibility

State	Site Name	Responsibility			
		Steward	Funding Organi-zation	Owner	Landlord
New Jersey	DuPont & Company[e]	Yet to be determined			
	Maywood Chemical Works[e]	Yet to be determined			
	Middlesex Sampling Plant[e]	Yet to be determined			
	Princeton Plasma Physics Laboratory	DOE	DOE	Other	DOE
	Wayne Site[e]	Yet to be determined			
New Mexico	Ambrosia Lake Site	DOE	DOE	DOE	N/A
	Bayo Canyon	DOE	DOE	Private	DOE
	Bluewater Site[d]	DOE	DOE	DOE	N/A
	Gasbuggy Site	Federal Non-DOE	DOE	Federal Non-DOE	Federal Non-DOE
	Gnome-Coach	Federal Non-DOE	DOE	Federal Non-DOE	Federal Non-DOE
	(Homestake) Grants Site[a,d]	DOE	Private	Private	N/A
	Los Alamos National Laboratory	DOE	DOE	DOE	DOE
	Lovelace Respiratory Research Institute	DOE	DOE	DOE	DOE
	(Quivira) Ambrosia Lake Site 2[a, d]	DOE	Private	Private	N/A
	Sandia National Laboratories - NM	DOE	DOE	DOE	DOE
	Shiprock Site	DOE	DOE	Other	N/A
	(SOHIO) LBAR Site[a, d]	DOE	DOE	Private	N/A
	South Valley Superfund Site[b]	Private	Private	Private	Private
	(UNC) Church Rock Site[b]	DOE	Private	Private	N/A
	Waste Isolation Pilot Plant	DOE	DOE	DOE	DOE
New York	Ashland Oil #1[e]	Yet to be determined			
	Ashland Oil #2[e]	Yet to be determined			
	Bliss and Laughlin Steel[e]	Yet to be determined			
	Brookhaven National Laboratory	DOE	DOE	DOE	DOE
	Colonie[e]	Yet to be determined			
	Linde Air Products[e]	Yet to be determined			
	Niagara Falls Storage Site[e]	Yet to be determined			
	Seaway Industrial Park[e]	Yet to be determined			
	West Valley Demonstration Project[b, 44]	TBD	State	State	TBD
Ohio	Ashtabula Environmental Management Project[b]	Private	DOE/Private	Private	Private
	Battelle Columbus-King Avenue[b]	Private	DOE/Private	Private	Private

[44] The funding is 90 percent DOE, 10 percent State. The steward and the landlord have yet to be determined due to the ongoing negotiations. However, the State of New York is the current owner of the site.

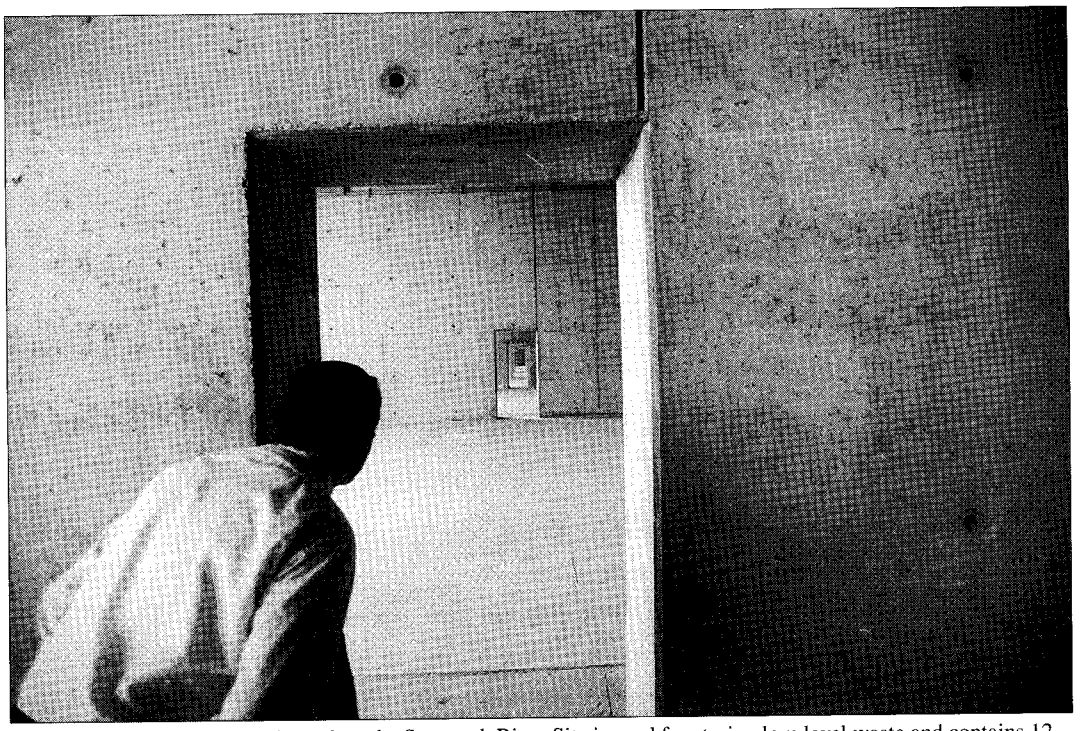
Table 3-6. Long-Term Stewardship Responsibility

State	Site Name	Responsibility			
		Steward	Funding Organi-zation	Owner	Landlord
	Battelle Columbus-West Jefferson[b]	Private	DOE/Private	Private	Private
	Fernald Environmental Management Project	DOE	DOE	DOE	DOE
	Luckey[e]	Yet to be determined			
	Miamisburg Environmental Management Project	DOE	DOE	Private	Private
	Painesville[e]	Yet to be determined			
	Piqua Nuclear Power Facility	DOE	DOE	DOE	DOE
	Portsmouth Gaseous Diffusion Plant	DOE	DOE	DOE	DOE
Oregon	Lakeview Mill[a]	DOE	DOE	Private	N/A
	Lakeview Site[a]	DOE	DOE	DOE	N/A
Pennsylvania	Burrell Site[a]	DOE	DOE	DOE	N/A
	Canonsburg Site[a]	DOE	DOE	DOE	N/A
Puerto Rico	Center for Energy and Environmental Research	DOE	DOE	Private	DOE
South Carolina	Savannah River Site	DOE	DOE	DOE	DOE
South Dakota	Edgemont Site[a,d]	DOE	DOE	DOE	N/A
Tennessee	Oak Ridge Reservation	DOE	DOE	DOE	DOE
Texas	(Chevron) Panna Maria Site[a,d]	DOE	DOE	Private	N/A
	(Conoco) Conquista Site[a,d]	DOE	DOE	Private	N/A
	(Exxon) Ray Point Site[a,d]	DOE	DOE	Private	N/A
	Falls City Site[a]	DOE	DOE	DOE	N/A
	Pantex Plant	DOE	DOE	DOE	DOE
Utah	(Atlas) Moab Mill[a, d, f]	DOE	Other	Other	N/A
	(EFN) White Mesa Site[a,d]	DOE	Private	Private	N/A
	Green River Site[a]	DOE	DOE	DOE	N/A
	Mexican Hat Site[a]	DOE	DOE	Other	N/A
	Monticello Mill Site and Vicinity Properties[a]	DOE	DOE	DOE/Other	N/A
	(Plateau) Shootaring Canyon Site[a,d]	DOE	Private	Private	N/A
	(Rio Algom) Lisbon Valley Site[a,d]	DOE	Private	Private	N/A
	Salt Lake City Mill[a]	DOE	DOE	Other	N/A
	South Clive Disposal Cell[a]	DOE	DOE	DOE	N/A
	11e.(2) Disposal Site	Yet to be determined			
Washington	(Dawn) Ford Site[a,d]	DOE	Private	Private	N/A
	Hanford Site	DOE	DOE	DOE	DOE
	(WNI) Sherwood Site[a,d]	DOE	DOE	Other	N/A

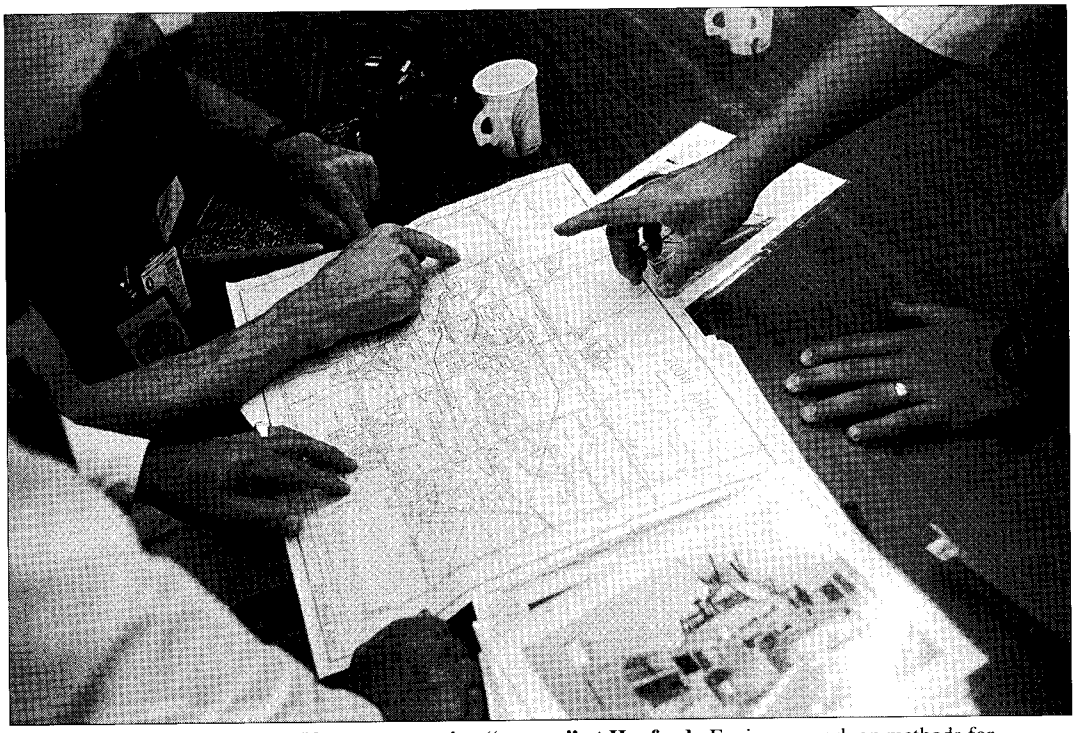
Table 3-6. Long-Term Stewardship Responsibility

State	Site Name	Responsibility			
		Steward	Funding Organi-zation	Owner	Landlord
West Virginia	Parkersburg Site	DOE	DOE	DOE	DOE
Wyoming	(ANC) Gas Hills Site[a,d]	DOE	DOE	Private	N/A
	(Exxon) Highlands Site[a,d]	DOE	DOE	Private	N/A
	Hoe Creek Underground Coal Gasification Site	DOE	DOE	Federal Non-DOE	DOE
	(Kennecott) Sweetwater Site[a,d]	DOE	Private	Private	N/A
	Naval Petroleum Reserve No. 3 Landfill/Landfarm	DOE	DOE	DOE	DOE
	(Pathfinder) Lucky Mc Site[a,d]	DOE	DOE	DOE	N/A
	(Pathfinder) Shirley Basin Site 2[a,d]	DOE	DOE	DOE	N/A
	(Petrotomics) Shirley Basin Site 1[a,d]	DOE	DOE	DOE	N/A
	Riverton Site[a]	DOE	DOE	Private	N/A
	Rock Springs Oil Shale Retort Site	DOE	DOE	Private	DOE
	Spook Site[a]	DOE	DOE	DOE	N/A
	(UMETCO) Gas Hills Site[a,d]	DOE	DOE	DOE	N/A
	(Union Pacific) Bear Creek Site[a,d]	DOE	DOE	DOE	N/A
	(WNI) Split Rock Site[a,d]	DOE	DOE	DOE	N/A

[a] For UMTRCA Title I and II sites, the Long-Term Surveillance and Maintenance (LTSM) program is the only ongoing program at these sites; therefore, activities which would otherwise be considered "landlord" responsibilities fall under the auspices of the LTSM program. In addition to specific long-term stewardship activities, the LTSM program will be responsible for maintaining roads, maintenance planning/management, and other basic responsibilities, as needed.
[b] At these sites, a non-DOE entity is responsible for long-term stewardship. However, in some cases, funding, remediation, and long-term stewardship responsibilities for DOE and all other responsible parties are still undetermined.
[c] The United States has title to the land and DOE has administrative jurisdiction.
[d] With the exception of the Edgemont Site and the Bluewater Site, all UMTRCA Title II sites are privately owned. Reclamation activities at these sites are funded by the owner with some reimbursement provided by DOE. The landlord at the Title II sites is the private owner. The steward is not yet known for all of these sites because the extent of long-term stewardship is yet to be determined. However, it is assumed that these sites will eventually be transferred to DOE, at which time DOE will become the steward.
[e] The extent of long-term stewardship activities at 21 FUSRAP sites is currently unknown. Although some of these sites may be cleaned up to unrestricted use and may only require record-keeping activities, for the purpose this Report, all 21 sites are categorized along with 11 additional sites where DOE may be responsible for long-term stewardship activities (see Section 3.2).
[f] Currently, the Trustee is the funding organization and owner. The Trustee will relinquish all responsibility, including funding, to DOE within one year of enactment of the NDAA for FY 2001.



Low-Level Waste Vault. This vault at the Savannah River Site is used for storing low-level waste and contains 12 large cells, each 55 feet long, 150 feet wide, and 30 feet high. This vault replaces the previous waste management practice of burying low-level waste in shallow engineered trenches. Workers began storing waste in this vault in September 1994. Once it is full, it will be covered with clay, gravel, and a geotextile cap. These vaults will require environmental monitoring, institutional controls, and long-term surveillance and maintenance in perpetuity. E Area Vault, Solid Waste Management Division. *Savannah River Site, South Carolina, January 1994.*



Planning for cleanup at the T Plant reprocessing "canyon" at Hanford. Engineers work on methods for decontaminating and eventually dismantling the world's oldest plutonium-separation plant. In the meantime, the facilities at the T Plant are being used to decontaminate equipment with high-activity contamination. *Hanford Site, Washington. July 11, 1994.*

Chapter 4

Next Steps

CHAPTER 4: NEXT STEPS

DOE needs to transition from a current mission of active cleanup and stabilization to one of its future missions -- that of long-term care of and monitoring at residually contaminated sites. Throughout this shift, the goal of DOE will remain the same – to protect human health and the environment. This chapter discusses several areas where next steps can be taken to provide a clear path forward for implementing long-term stewardship at DOE sites and establishing the long-term stewardship program. It does not presume to provide the answers or specific recommendations, but rather to raise issues that will need to be addressed in the near-term, as well as concepts that will need to be considered for future long-term stewardship success. Regardless of the next steps taken, it is clear that all discussions and planning activities need to involve close interaction with local officials and land use planners, State regulators, Tribal governments, other Federal agencies, and stakeholders. To be successful, the Department will need to rely on support and active participation from all of these entities to enforce site long-term stewardship controls. Therefore, frequent and early communication regarding all aspects of long-term stewardship planning and implementation will be essential.

In five-to-ten years, ongoing cleanup work at most of the sites will be completed and will likely be succeeded by a long-term stewardship program. At the larger sites, where cleanup is not anticipated to be complete for many years, the transition from remediation to long-term stewardship may be equally significant, but less noticeable, because it will be reflected by the number of portions of sites at which cleanup is complete and long-term stewardship can begin. A reliable and cost-effective long-term stewardship program will undertake whatever work is required to protect human health and the environment after cleanup, stabilization, or disposal is complete (e.g., monitoring, surveillance, maintenance, repair of remedies, performance evaluation, and information management). In addition, the long-term stewardship program will verify that land use and institutional controls are operating effectively to ensure that the land is used or conserved in a safe manner.

DOE is already performing long-term stewardship at many sites and portions of sites where remediation activities are complete. The DOE Grand Junction Long-Term Surveillance and Maintenance Program currently maintains caps, fences, and signs and performs required groundwater and other monitoring (e.g., groundwater and facilities) for 26 sites. At sites where remediation activities are complete for portions of the site, long-term stewardship activities are typically performed as part of ongoing site surveillance and monitoring, facility infrastructure maintenance, or other site-wide functions (except for long-term stewardship activities performed by the Grand Junction Office). However, these sites do not have a program specifically designated to address/perform long-term stewardship as a discrete function. For now, this approach is working to maintain protection of human health and the environment.

At a number of sites, including nine sites now under the National Nuclear Security Administration for nuclear weapons activities (e.g. Los Alamos National Laboratory, Sandia National Laboratories, Lawrence Livermore National Laboratory, and Pantex) and several sites where scientific research will continue, as well as a few large sites (e.g., the Hanford Site, Idaho National Engineering and Environmental Laboratory, and Savannah River Site) where long-term DOE missions will continue for decades, the complete long-term stewardship requirements will depend on the final site cleanup, the contamination present when the missions are complete, and other related factors.

More long-term stewardship information is available for those sites that are closer to completing remediation activities than for other sites. For sites where long-term stewardship activities are not expected to be initiated in the near future (i.e., in the next five years), a delay in planning may be appropriate. Cleanup decisions are still pending and, in many cases, the technical remediation challenges will prolong cleanup activities for years to come. In this case, delaying site-wide long-term stewardship decisions and activities until the end state is better defined will allow site personnel to benefit from lessons learned from other sites and will allow

them to evaluate decisions to make sure that the long-term stewardship implications of those decisions are understood.

However, there are 96 sites or portions of sites where cleanup activities will be complete or partially complete (portions complete) by 2006 and where DOE expects to perform long-term stewardship. There is a clear need now to identify critical activities and the means for transitioning these sites into a long-term stewardship program. Mechanisms are needed to facilitate a seamless transition from the cleanup phase to long-term stewardship and to put in place templates that will ensure a consistent approach to critical activities such as record-keeping and data management. Lessons learned from long-term stewardship at early participation sites will help lay the groundwork for a seamless long-term stewardship program capable of managing the expanding workload as the Department's larger sites complete cleanup.

DOE's focus will need to move from identifying and implementing active remedies to identifying ways to provide cost-effective, adequate protection in the long term. This must be accomplished while seeking to identify science and technologies that can ultimately reduce DOE's costs and liabilities and allow for a wider range of uses at the sites.

4.1 Roles and Responsibilities for Long-Term Stewardship

The roles and responsibilities for organizations involved with long-term stewardship are still being defined. Even so, it is clear that DOE needs to continue building on this initial framework to identify roles and responsibilities for Field personnel, their contractors, local governments, land users, community planners, Tribal governments, and other interested parties. Currently, many long-term stewardship planning activities are being conducted by personnel who are responsible for a variety of environmental activities at the sites, only one of which is long-term stewardship. As a consequence, it is not clear that there is a consistent approach to evaluating pending decisions to identify potential impacts on the Department's long-term liabilities, or for identifying common long-term stewardship issues and needs that occur at multiple sites. Identifying a person/office responsible for ensuring a smooth transition from cleanup to closure and stewardship would help ensure that critical activities (e.g., defining the end state) are identified and addressed by the staff most knowledgeable about anticipated long-term stewardship needs.

As DOE learns more about long-term stewardship requirements and their costs, it improves its ability to avoid or minimize these costs. Clearly, long-term stewardship reflects an inability to fully remediate, at a reasonable cost, all contamination occurring as a result of operations usually occurring years ago. Comparable operations are now underway or are being designed or constructed (e.g., vitrification facilities and pit production and inspection facilities). It is not yet clear whether those facilities are being constructed and operated in a way that will minimize or avoid the eventual long-term stewardship requirements. For example, machinery that processes radioactive materials was often built and operated inside a building that was not constructed to allow for the removal or decontamination of the machinery. These structural limitations have made decontamination difficult, or in some cases impossible, resulting in long-term stewardship requirements and the attendant long-term cost obligations. To ensure that long-term stewardship obligations are avoided to the extent possible, DOE will develop the necessary technical engineering and obtain the institutional authority to design and construct stewardship-compatible facilities. Developing these capabilities is particularly important because the ability of long-term stewardship to prevent human exposure or environmental damage remains uncertain. In cases where solutions to a problem remain elusive, prevention is the most prudent course of action.

Recently (December 2000), DOE established policy stating that the landlord organizations at sites with a continuing non-EM mission (e.g., DOE's Office of Defense Programs at the Nevada Test Site) will take responsibility for long-term stewardship after EM activities are completed (see Appendix I for more details).

These organizations are responsible for:

- working with cleanup program personnel to understand the technical scope and activities that will be required at the site to prevent unallowable releases and maintain acceptable levels of risk;
- identifying long-term science and technology needs such that those risks can ultimately be reduced;
- ensuring that all planned remediation activities are complete and that remediation goals have been met (or that the long-term remediation systems are constructed and operating as intended);
- verifying that documentation pertinent to cleanup and long-term stewardship is readily accessible;
- making sure that the site meets a set list of "acceptance criteria" ensuring environmental compliance commitments with regulators (e.g., have all unused monitoring wells been properly deactivated and closed?);
- coordinating with local, State, and Tribal governments regarding implementation of the long-term stewardship plans and future use of the sites;
- developing, implementing, and overseeing institutional controls; and
- maintaining long-term stewardship operating baselines so that accurate estimates of scope, schedule, and cost would be readily available for planning and budget purposes.

4.2 Planning for Long-Term Stewardship

As cleanup is completed and sites are "closed," some Field staff are working to plan and document site cleanup activities such that the information needed for long-term stewardship will be available. In other cases this planning and documentation is not occurring. Limitations to more effective planning include the current lack of specific long-term stewardship guidance and the focus on accelerating cleanup activities rather than on long-term stewardship. This planning may be aided by development of guidance and policy that provide, for example, templates on the types of information that will be needed for long-term stewardship and to identify the components of a long-term stewardship plan. The long-term stewardship requirements at sites under the responsibility of the Grand Junction Office are clearly documented in site-specific Long-Term Stewardship Plans. At other sites, long-term stewardship activities may be included as part of site-wide management plans, unit-specific records of decision, or other remedial action documents.

From a national planning perspective, there is a clear need for such plans to be able to adequately detail the scope of activities anticipated in order to develop reliable costs and schedules. Long-term stewardship planning will also provide opportunities to identify issues or policies that could substantially improve the long-term stewardship program through risk and cost reduction.

From the local perspective, such planning efforts are critical to communicate the Department's understanding of the hazards that remain at the sites, the importance of instituting and maintaining controls (either engineered or administrative controls), the specific activities that will be required to maintain protectiveness from the hazards that remain onsite, the potential impacts of failure, and a clear delineation of the roles and responsibilities for implementing these activities. In addition, detailed planning will allow site personnel to begin to recognize opportunities for cost savings (by understanding the overall scope of work ahead) through, for example, identification and disposition of excess property.

One means for capturing this information is to develop long-term stewardship plans that provide a consistent approach to documenting the required information. However, the information may also be presented in other documents, such as a specific section of the site-wide baselines and environmental compliance documents required by the Department's environmental regulators (NRC, EPA, States).

The information in this Report is also the first step in helping the Department establish the ability to plan for natural hazards, such as floods and fires, that could exacerbate efforts to provide reliable long-term stewardship. Moreover, the Department may wish to examine the risk of long-term stewardship controls

failing, not only from natural hazards, but also from the failure of remedies, so that it can create a response capability and a contingency plan.

4.3 Building Long-Term Stewardship Elements into Life-Cycle Planning

At sites where long-term stewardship is not anticipated for several years, the possibility exists for site personnel to evaluate all pending and future remediation decisions for opportunities to reduce the future long-term stewardship responsibilities or to make decisions that could eliminate the need for long-term stewardship altogether. This in no way means that decisions already made need to be revisited -- rather site personnel are encouraged to begin considering long-term stewardship costs and other implications (i.e., will there need to be an onsite presence to maintain long-term stewardship activities?) in their overall life-cycle planning efforts. While long-term stewardship will not always have an "end," like most traditional projects, there is still a need to identify ways of reducing life-cycle costs and opportunities for reducing the Department's long-term responsibilities.

These concepts also apply further up the "pipeline" as new facilities are proposed and constructed for new missions. Long-term stewardship needs to be considered in all aspects of new missions or projects to ensure that decisions are made to reduce or completely eliminate new long-term stewardship obligations. Consideration of long-term stewardship is important because it is not clear that long-term stewardship will work over the long periods of time it is likely to be required. Incorporating long-term stewardship prevention into project life-cycle planning is, therefore, an important activity.

4.4 Summary

This Report to Congress provides the first comprehensive projection of the Department's long-term stewardship obligations, activities, and costs. As such, this Report marks a milestone toward building a reliable and cost-effective long-term stewardship program at the Department. The Department now has a stronger factual foundation from which to analyze long-term stewardship needs and activities. For example, information on projected long-term stewardship costs can help future decision-makers avoid creating unnecessary long-term liabilities, or inappropriately postpone actions with short-term cleanup decisions. A recent National Research Council report also noted the benefits of incorporating long-term stewardship costs into today's decisions. These cost data can also help prevent excessive cleanup being conducted that will nonetheless require the same amount of long-term stewardship as a less expensive remedy, despite the additional cost and effort. In short, planning for long-term stewardship will help to improve near-term cleanup decisions and ensure that DOE fulfills its existing cleanup commitments.

Although this Report may be the Department's first comprehensive report on long-term stewardship, it is far from the last word. The Department expects to: (1) continue conducting long-term stewardship activities at sites where they have already begun, and learning from that experience; (2) develop policies, related/other guidance, and staff training programs to ensure effective long-term stewardship planning and implementation; (3) develop long-term stewardship plans for sites that have not yet begun long-term stewardship activities; (4) ensure meaningful public participation; and (5) form better connections between agencies and staff involved in related activities at different sites and agencies to ensure effective integration across sites.

Much of the future long-term stewardship work may not be identified currently in the budget as "long-term stewardship." The Department intends to seek to better integrate this work as part of its overall effort to accelerate completion of cleanup and to close sites in a way that allows them to be used for appropriate purposes.

Appendices

APPENDIX A: RELATIONSHIP TO OTHER INITIATIVES

The analysis in this Report is directly related to several other DOE initiatives that have shaped the evolution of the Environmental Management (EM) program. The 1995 and 1996 *Baseline Environmental Management Reports* provided the first comprehensive scope and cost estimates for the cleanup of the nuclear weapons complex. These reports clearly identified that most of the contaminated areas at DOE sites will not be remediated to "green fields" or unrestricted use and that almost all DOE sites would require long-term surveillance and monitoring far into the future.

The initial cost estimates developed in the *Baseline Environmental Management Reports* showed that the costs were $230 billion and cleanup was scheduled to take 75 years. This effort was deemed by members of Congress as too expensive and requiring too long a timetable. One response to this realization was a DOE restructuring of how EM accounted for cleanup progress by focusing on discrete tasks that could be managed towards clear endpoints. This restructuring resulted in the *Accelerating Cleanup: Paths to Closure* reports, which identified strategies to reduce the schedule and costs associated with the previous estimates by accelerating site cleanup and closure and improving productivity. The 1998 and 2000 *Accelerating Cleanup: Paths to Closure* reports identified strategies to reduce the schedule and costs associated with the baseline reports by accelerating site cleanup and closure and improving productivity and integration in the Environmental Management program. The Department acknowledged the need for more comprehensive site end state and long-term stewardship plans.

In 1999, the Department released its first Report on long-term stewardship, entitled *From Cleanup to Stewardship: A Companion Report to Accelerating Cleanup: Paths to Closure* and *Background Information to Support the Scoping Process Required for the 1998 PEIS Settlement Study*, also referred to as the "Background Report." The *Background Report* presented the first national summary of the nature and extent of DOE's long-term stewardship needs and examined some of the issues, challenges, and barriers associated with the transition from cleanup to stewardship.

THE MAJOR FINDINGS OF THE *BACKGROUND REPORT* INCLUDE:

- Most of the sites in DOE's cleanup program will require long-term stewardship;
- Long-term stewardship will be necessary wherever cleanup efforts do not achieve conditions that allow for unrestricted use;
- Cleanup to unrestricted use cannot always be achieved for several reasons, including technical and economic infeasibility;
- Long-term stewardship will involve a variety of activities, including both engineered and administrative controls;
- DOE is already performing long-term stewardship at a number of sites; and
- More research and analysis is needed to fully understand the nature of the challenge ahead.

The analysis being conducted for this Report to Congress builds on the analysis presented in the *Background Report* by providing a more precise description of the overall site end states and the associated long-term stewardship costs and activities. Because the *Background Report* was based on data collected for purposes other than identifying long-term stewardship needs and responsibilities, many holes were left in the Department's understanding of the specific stewardship responsibilities at many sites. This analysis attempts to refine that understanding and to develop a baseline estimate for the cost, scope, and schedule of long-term stewardship activities at each site.

A second, related long-term stewardship study is currently being conducted by DOE pursuant to a December 1998 lawsuit settlement agreement.[45] That resulting report, *The Draft Long-Term Stewardship Study,*

[45] Natural Resources Defense Council et al. v. Richardson et al., Civ. No.97-936 (SS) (D.D.C.), Dec. 12, 1998.

addresses national, programmatic, and cross-cutting issues related to long-term stewardship, such as options for financing, legal requirements, and program structure. The *Draft Long-Term Stewardship Study* addresses two specific goals:

- Analyze the national issues that DOE needs to address in planning for and conducting long-term stewardship activities.
- Promote information exchange on long-term stewardship issues among DOE, other Federal agencies, Tribal nations, State and local governments, and private citizens.

The issues addressed in *The Draft Long-Term Stewardship Study* were identified through a public scoping process that was consistent with the processes mandated in the National Environmental Policy Act (NEPA) regulations. Although the lawsuit settlement did not identify the issues that DOE should address, it did mandate that DOE follow the NEPA public scoping procedures. Unlike the analysis conducted for this Report, *The Draft Long-Term Stewardship Study* does not address site-specific issues or contain site- or portion-specific long-term stewardship data. *The Draft Long-Term Stewardship Study* is expected to be completed in late 2000.

KEY CHALLENGES DISCUSSED IN THE *DRAFT LONG-TERM STEWARDSHIP STUDY*

- Incorporating long-term stewardship considerations into cleanup decisions;
- Ensuring the continued effectiveness of long-term stewardship if property ownership changes;
- Ensuring open access to information about residual hazards;
- Ensuring reliable and sufficient funding;
- Maintaining continued partnerships with State, local, and Tribal governments;
- Developing mechanisms to promote the sustainability of long-term stewardship; and
- Building the concept of "stewardship prevention" into the planning processes for new missions and facilities.

Relationship Between the Background Document, the *Draft Study*, and the *National Defense Authorization Act (NDAA) Report to Congress*

The Background Document *(From Cleanup to Stewardship)* provides background information for the long-term stewardship study scoping process required by the PEIS Settlement Agreement. The Background Document provides an overall summary of the nature and extent of current and anticipated long-term stewardship needs at all DOE sites. The Background Document also summarizes available information about the number and location of sites that will likely require long-term stewardship by DOE; the type of long-term stewardship activities likely to be required; and DOE sites at which long-term stewardship activities are currently being conducted. DOE used this information to identify sites where contaminated facilities, water, soil, and/or engineered units would likely remain after cleanup is complete and to estimate the scope of long-term stewardship activities needed.

DOE prepared the *Draft Study,* pursuant to the terms of the Settlement Agreement, to meet the commitment made in the Background Document and to respond to insights provided by the public during a recently completed public scoping process. The *Draft Study* does not analyze site-specific issues -- rather, it analyzes the national issues that DOE needs to address in planning for and conducting long-term stewardship activities. The *Draft Study* promotes exchange of long-term stewardship information between DOE and non-DOE agencies and organizations, including Tribal nations, State and local governments, and private citizens. The *Draft Study* will inform future DOE site and national programmatic decision makers affected by long-term stewardship issues.

This Report, the *National Defense Authorization Act (NDAA) Report to Congress*, will be the third important building block for developing DOE's long-term stewardship program. While the *Draft Study* and Background

Document address long-term stewardship issues on a broad, complex-wide scale, this *Report to Congress* addresses DOE's long-term stewardship requirements on a more site-specific, detailed scale. As the title implies, this Report was requested in a Congressional report accompanying the National Defense Authorization Act for Fiscal Year 2000. This *Report to Congress*:

- Identifies sites or portions of sites where environmental restoration, waste disposal, and facility stabilization are projected to be complete by 2006 without unrestricted land use.

- Includes sufficient detail to undertake the necessary management and stewardship responsibilities, including cost, scope, and schedule.

APPENDIX B: LIST OF SITES INCLUDED IN VOLUME II OF THIS REPORT[46]

Table B-1. List of Sites and Portions of Sites by State

State	*Site*	*Portion*
Alaska	Amchitka Island[a]	Surface
		Subsurface
Arizona	Monument Valley Site[a]	Surface
		Subsurface
	Tuba City Site[a]	Surface
		Subsurface
California	Energy Technology Engineering Center	Unknown[b]
	General Atomics	Unknown[b]
	General Electric Vallecitos Nuclear Center	Unknown[b]
	Laboratory for Energy Related Health Research	Unknown[b]
	Lawrence Berkeley National Laboratory	Old Town
		Building 51/64 VOC Plume
		Building 71 Freon/VOC Plume
		Building 75 Tritium Plume
		Building 88 Area
	Lawrence Livermore National Laboratory - Livermore Site	Building 292 Area
		Building 331 Area
		Building 419/511
		Treatment Facility F/406
		Treatment Facility 5475
		Treatment Facility A
		Treatment Facility B
		Treatment Facility C
		Treatment Facility D
		Treatment Facility E
		Treatment Facility G
		Treatment Facility 518
	Lawrence Livermore National Laboratory - Site 300	OU #7 Building 832
		OU #8 Rest of Site
		OU #1 GSA
		OU #2 Building 834

[46] Includes 96 sites where DOE expects to perform long-term stewardship activities by 2006, and 33 sites where DOE will or may be responsible for long-term stewardship after 2006. Additionally, 11 sites where a non-DOE entity is responsible for long-term stewardship are listed, as well as the Ames Laboratory in Iowa. Therefore, the total number of sites listed and included in Volume II of this Report is 141.

Table B-1. List of Sites and Portions of Sites by State

State	*Site*	*Portion*
California	Lawrence Livermore National Laboratory - Site 300	OU #3 Pit 6
		OU #4 Building 815
		OU #5 Building 850 - Pits 3&5
		OU #6 Building 854
	Sandia National Laboratories - CA	Fuel Oil Spill
		Groundwater
		Navy Landfill
	Stanford Linear Accelerator	Site-wide Portion
Colorado	Bodo Canyon Cell	Site-wide Portion
	Burro Canyon Disposal Cell	Site-wide Portion
	Cheney Disposal Cell (*Grand Junction Disposal Site*)[c]	Site-wide Portion
	(Cotter) Cañon City Site	Unknown[b]
	Durango Mill[a]	Surface
		Subsurface
	Estes Gulch Disposal Cell	Site-wide Portion
	Fort St. Vrain	Site-wide Portion
	Grand Junction Mill 1	Site-wide Portion
	Grand Junction Mill 2	Site-wide Portion
	Gunnison Disposal Cell	Site-wide Portion
	Gunnison Mill[a]	Surface
		Subsurface
	(HECLA) Durita Site	Site-wide Portion
	Maybell Mill Site	Site-wide Portion
	Naturita Mill[a]	Surface
		Subsurface
	Naturita Site	Site-wide Portion
	Naval Oil Shale Reserves Site	Site-wide Portion
	Rifle (New) Mill[a]	Surface
		Subsurface
	Rifle (Old) Mill[a]	Surface
		Subsurface
	Rio Blanco[a]	Surface
		Subsurface
	Rocky Flats Environmental Technology Site	Site-wide Portion
	Rulison[a]	Surface
		Subsurface

Table B-1. List of Sites and Portions of Sites by State

State	*Site*	*Portion*
Colorado	Slick Rock (North Continent) Mill 1[a]	Surface
		Subsurface
	Slick Rock (Union Carbide) Mill 2[a]	Surface
		Subsurface
	(UMETCO) Maybell Site 2	Site-wide Portion
	(UMETCO) Uravan Site	Unknown[b]
Connecticut	CE	Unknown[b]
Florida	Pinellas STAR Center (*Pinellas Plant*)[a,c]	4.5 Acre Site
		Building 100
		Northeast Site
		Wastewater Neutralization Area/Building 200 Area
Idaho	Idaho National Engineering and Environmental Laboratory	ARA Soils
		Argonne West
		BORAX Area
		CFA
		EBR-1
		INTEC Sites
		Ordnance Area
		Other TAN Soils
		Pad A
		PBF Soils
		SL-1 Burial Ground
		TAN Building 616
		TAN Soils
		TAN Tanks
		TRA Ponds
		TRA Subsurface Soils
	Lowman Site	Site-wide Portion
Illinois	Argonne National Laboratory East	300 Area
		800 Area
		CP-5
		Rest of Site
	Fermi National Accelerator Laboratory	Site-wide Portion
	Madison	Unknown[b]
	Palos Forest (Site A/Plot M) Preserve (*Site A/Plot M*)[c]	Site-wide Portion
Iowa	Ames Laboratory	Clean Closure

Table B-1. List of Sites and Portions of Sites by State

State	*Site*	*Portion*
Kentucky	Maxey Flats Disposal Site	Unknown[b]
	Paducah Gaseous Diffusion Plant	Site-wide Portion
Maryland	W.R. Grace and Company	Unknown[b]
Massachusetts	Shpack Landfill	Unknown[b]
Mississippi	Salmon Site[a]	Surface
		Subsurface
Missouri	Kansas City Plant	Site-wide Portion
	Latty Avenue Properties	Unknown[b]
	St. Louis Airport Site	Unknown[b]
	St. Louis Airport Site Vicinity Properties	Unknown[b]
	St. Louis Downtown Site	Unknown[b]
	Weldon Spring Site	Chemical Plant
		Quarry Groundwater
	Westlake Disposal Site	Unknown[b]
Nebraska	Hallam Nuclear Power Facility	Site-wide Portion
Nevada	Central Nevada Test Area[a]	Surface
		Subsurface
	Nevada Test Site	Area 3 RWMS
		Area 5 RWMS
		Industrial Sites
		Soils
		UGTA
	Project Shoal[a]	Surface
		Subsurface
New Jersey	DuPont & Company	Unknown[b]
	Maywood Chemical Works	Unknown[b]
	Middlesex Sampling Plant	Unknown[b]
	Princeton Plasma Physics Laboratory	Site-wide Portion
	Wayne Site	Unknown[b]
New Mexico	Ambrosia Lake Site	Site-wide Portion
	Bayo Canyon	Site-wide Portion
	Bluewater Site (*Arco Bluewater*)[c]	Site-wide Portion
	Gasbuggy Site[a]	Surface
		Subsurface
	Gnome-Coach[a]	Surface
		Subsurface
	(Homestake) Grants Site	Unknown[b]

Table B-1. List of Sites and Portions of Sites by State

State	*Site*	*Portion*
New Mexico	Los Alamos National Laboratory	Site-wide Portion
	Lovelace Respiratory Research Institute (*Inhalation Toxicology Research Institute*)[c]	Diesel Spill Site
		Hot Ponds
		Sewage Lagoon Site
	(Quivira) Ambrosia Lake Site 2	Unknown[b]
	Sandia National Laboratories - NM	CAM Unit
		Chemical Waste Landfill
		Groundwater
		MLLW Landfill
		Signed & Fenced Soil
		Signed Soils
	Shiprock Site[a]	Surface
		Subsurface
	(SOHIO) LBAR Site	Site-wide Portion
	South Valley Superfund Site	Unknown[b]
	(UNC) Church Rock Site	Unknown[b]
	Waste Isolation Pilot Plant	Unknown[b]
New York	Ashland Oil #1	Unknown[b]
	Ashland Oil #2	Unknown[b]
	Bliss and Laughlin Steel	Unknown[b]
	Brookhaven National Laboratory	BGRR/HFBR D&D
		Former HWMF
		Groundwater
		Landfills
		Other Radiated Soils
		Peconic River
		Rest of Site
	Colonie	Unknown[b]
	Linde Air Products	Unknown[b]
	Niagara Falls Storage Site	Unknown[b]
	Seaway Industrial Park	Unknown[b]
	West Valley Demonstration Project	Unknown[b]
Ohio	Ashtabula Environmental Management Project (*RMI Titanium Company Site*)[c]	Unknown [b]
	Battelle Columbus - King Avenue	Unknown[b]
	Battelle Columbus - West Jefferson	Unknown[b]
	Fernald Environmental Management Project	Site-wide Portion
	Luckey	Unknown[b]

Table B-1. List of Sites and Portions of Sites by State

State	*Site*	*Portion*
Ohio	Miamisburg Environmental Management Project (*Mound*)[c]	Site-wide Portion
	Painesville	Unknown[b]
	Piqua Nuclear Power Facility	Site-wide Portion
	Portsmouth Gaseous Diffusion Plant	Quadrant I
		Quadrant II
		Quadrant III
		Quadrant IV
Oregon	Lakeview Mill	Site-wide Portion
	Lakeview Site	Site-wide Portion
Pennsylvania	Burrell Site	Site-wide Portion
	Canonsburg Site	Site-wide Portion
Puerto Rico	Center for Energy and Environmental Research	Site-wide Portion
South Carolina	Savannah River Site	247-F Naval Fuel Manufacturing Facility
		D Area Heavy Water Facilities
		F Tank Area
		Four Mile Branch Watershed
		Heavy Water Component Test Reactor
		Lower Three Runs Watershed
		M Area Fuel/Target Manufacturing Facilities
		Pen Branch Watershed
		Savannah River & Floodplain Swamp Watershed
		Steel Creek Watershed
		Upper Three Runs Watershed
South Dakota	Edgemont Site	Site-wide Portion
Tennessee	Oak Ridge Reservation	Bear Creek Watershed
		Bethel Valley Watershed
		E. Tennessee Tech. Watershed
		Melton Valley Watershed
		Offsite
		Upper E. Fork Poplar Creek Watershed
Texas	(Chevron) Panna Maria Site	Site-wide Portion
	(Conoco) Conquista Site	Site-wide Portion
	(Exxon) Ray Point Site	Site-wide Portion
	Falls City Site	Site-wide Portion
	Pantex Plant	Risk Reduction Std 2
		Risk Reduction Std 3

Table B-1. List of Sites and Portions of Sites by State

State	*Site*	*Portion*
Utah	(Atlas) Moab Mill	Site-wide Portion
	(EFN) White Mesa Site	Unknown[b]
	Green River Site[a]	Surface
		Subsurface
	Mexican Hat Site	Site-wide Portion
	Monticello Mill Site and Vicinity Properties	Disposal Site
		Groundwater
		Supplemental Standards Areas
	(Plateau) Shootaring Canyon Site	Unknown[b]
	(Rio Algom) Lisbon Valley Site	Unknown[b]
	Salt Lake City Mill	Site-wide Portion
	South Clive Disposal Cell	Site-wide Portion
	11e.(2) Disposal Site	Unknown[b]
Washington	(Dawn) Ford Site	Unknown[b]
	Hanford Site	100 B/C Area
		100 D Area
		100 F Area
		100 H Area
		100 K Area
		100 N Area
		100 Other Area
		1100 Area
		200 Area North
		200 Area PO1-1 GW
		300 Area
		Arid Land Ecology
		ERDF Cell
		Riverland
		Wahluke Slope
	(WNI) Sherwood Site	Site-wide Portion
West Virginia	Parkersburg Site (*Amax*)[c]	Site-wide Portion
Wyoming	(ANC) Gas Hills Site	Site-wide Portion
	(Exxon) Highlands Site	Site-wide Portion
	Hoe Creek Underground Coal Gasification Site	Site-wide Portion
	(Kennecott) Sweetwater Site	Unknown[b]
	Naval Petroleum Reserve No. 3 Landfill/Landfarm	Site-wide Portion
	(Pathfinder) Lucky Mc Site	Site-wide Portion

Table B-1. List of Sites and Portions of Sites by State

State	*Site*	*Portion*
Wyoming	(Pathfinder) Shirley Basin Site 2	Site-wide Portion
	(Petrotomics) Shirley Basin Site 1	Site-wide Portion
	Riverton Site	Site-wide Portion
	Rock Springs Oil Shale Retort Site	Site-wide Portion
	Spook Site	Site-wide Portion
	(UMETCO) Gas Hills Site	Site-wide Portion
	(Union Pacific) Bear Creek Site	Site-wide Portion
	(WNI) Split Rock Site	Site-wide Portion

[a] For remediation of sites, DOE distinguishes the surface from the subsurface activity. The long-term stewardship start date reflects the completion of surface remediation. However, characterization of the subsurface contamination will continue well beyond 2006.
[b] For these sites, it has yet to be determined what portion, if any, will require long-term stewardship activities by DOE.
[c] In some cases, sites are known by alternate names which are italicized in parentheses.

Table B-2. List of Sites and Portions of Sites by DOE Office

DOE Office	*Site*	*Portion*
Albuquerque	Kansas City Plant	Site-wide Portion
	Los Alamos National Laboratory	Site-wide Portion
	Lovelace Respiratory Research Institute (*Inhalation Toxicology Research Institute*) [c]	Diesel Spill Site
		Hot Ponds
		Sewage Lagoon Site
	Pantex Plant	Risk Reduction Std 2
		Risk Reduction Std 3
	Sandia National Laboratories - CA	Fuel Oil Spill
		Groundwater
		Navy Landfill
	Sandia National Laboratories - NM	CAM Unit
		Chemical Waste Landfill
		Groundwater
		MLLW Landfill
		Signed & Fenced Soil
		Signed Soils
	South Valley Superfund Site	Unknown[b]
Carlsbad	Waste Isolation Pilot Plant	Unknown[b]
Chicago	Ames Laboratory	Clean Closure
	Argonne National Laboratory East	300 Area
		800 Area
		CP-5
		Rest of Site
	Brookhaven National Laboratory	BGRR/HFBR D&D
		Former HWMF
		Groundwater
		Landfills
		Other Rad Soils
		Peconic River
		Rest of Site
	Fermi National Accelerator Laboratory	Site-wide Portion
	Princeton Plasma Physics Laboratory	Site-wide Portion
Fossil Energy	Hoe Creek Underground Coal Gasification Site	Site-wide Portion
	Naval Oil Shale Reserves Site	Site-wide Portion
	Naval Petroleum Reserve No. 3 Landfill/Landfarm	Site-wide Portion
	Rock Springs Oil Shale Retort Site	Site-wide Portion
Grand Junction	Ambrosia Lake Site	Site-wide Portion
	(ANC) Gas Hills Site	Site-wide Portion

Table B-2. List of Sites and Portions of Sites by DOE Office

DOE Office	*Site*	*Portion*
Grand Junction	(Atlas) Moab Mill	Site-wide Portion
	Bluewater Site (*Arco Bluewater*)[c]	Site-wide Portion
	Bodo Canyon Cell	Site-wide Portion
	Burrell Site	Site-wide Portion
	Burro Canyon Disposal Cell	Site-wide Portion
	Canonsburg Site	Site-wide Portion
	Cheney Disposal Cell (*Grand Junction Disposal Site*)[c]	Site-wide Portion
	(Chevron) Panna Maria Site	Site-wide Portion
	(Conoco) Conquista Site	Site-wide Portion
	(Cotter) Cañon City Site	Unknown[b]
	(Dawn) Ford Site	Unknown[b]
	Durango Mill [a]	Surface
		Subsurface
	Edgemont Site	Site-wide Portion
	(EFN) White Mesa Site	Unknown[b]
	Estes Gulch Disposal Cell	Site-wide Portion
	(Exxon) Highlands Site	Site-wide Portion
	(Exxon) Ray Point Site	Site-wide Portion
	Falls City Site	Site-wide Portion
	Grand Junction Mill 1	Site-wide Portion
	Grand Junction Mill 2	Site-wide Portion
	Green River Site [a]	Surface
		Subsurface
	Gunnison Disposal Cell	Site-wide Portion
	Gunnison Mill [a]	Surface
		Subsurface
	Hallam Nuclear Power Facility	Site-wide Portion
	(HECLA) Durita Site	Site-wide Portion
	(Homestake) Grants Site	Unknown[b]
	(Kennecott) Sweetwater Site	Unknown[b]
	Lakeview Mill	Site-wide Portion
	Lakeview Site	Site-wide Portion
	Lowman Site	Site-wide Portion
	Maybell Mill Site	Site-wide Portion
	Mexican Hat Site	Site-wide Portion
	Monticello Mill Site and Vicinity Properties	Disposal Site
		Groundwater
		Supplemental Standards Areas

Table B-2. List of Sites and Portions of Sites by DOE Office

DOE Office	*Site*	*Portion*
Grand Junction	Monument Valley Site[a]	Surface
		Subsurface
	Naturita Mill[a]	Surface
		Subsurface
	Naturita Site	Site-wide Portion
	Palos Forest (Site A/Plot M) Preserve (*Site A/Plot M*) [c]	Site-wide Portion
	Parkersburg Site (*Amax*)[c]	Site-wide Portion
	(Pathfinder) Lucky Mc Site	Site-wide Portion
	(Pathfinder) Shirley Basin Site 2	Site-wide Portion
	(Petrotomics) Shirley Basin Site 1	Site-wide Portion
	Pinellas STAR Center (*Pinellas Plant*)[a,c]	4.5 Acre Site
		Building 100
		Northeast Site
		Wastewater Neutralization Area/Building 200 Area
	Piqua Nuclear Power Facility	Site-wide Portion
	(Plateau) Shootaring Canyon Site	Unknown[b]
	(Quivira) Ambrosia Lake Site 2	Unknown[b]
	Rifle (New) Mill[a]	Surface
		Subsurface
	Rifle (Old) Mill[a]	Surface
		Subsurface
	(Rio Algom) Lisbon Valley Site	Unknown[b]
	Riverton Site	Site-wide Portion
	Salt Lake City Mill	Site-wide Portion
	Shiprock Site[a]	Surface
		Subsurface
	Slick Rock (North Continent) Mill 1[a]	Surface
		Subsurface
	Slick Rock (Union Carbide) Mill 2[a]	Surface
		Subsurface
	(SOHIO) LBAR Site	Site-wide Portion
	South Clive Disposal Cell	Site-wide Portion
	Spook Site	Site-wide Portion
	Tuba City Site[a]	Surface
		Subsurface
	(UMETCO) Gas Hills Site	Site-wide Portion
	(UMETCO) Maybell Site 2	Site-wide Portion

Table B-2. List of Sites and Portions of Sites by DOE Office

DOE Office	*Site*	*Portion*
Grand Junction	(UMETCO) Uravan Site	Unknown[b] Portion
	(UNC) Church Rock Site	Unknown[b] Portion
	(Union Pacific) Bear Creek Site	Site-wide Portion
	Weldon Spring Site	Chemical Plant
		Quarry Groundwater
	(WNI) Sherwood Site	Site-wide Portion
	(WNI) Split Rock Site	Site-wide Portion
	11e.(2) Disposal Site[d]	Unknown[b]
Idaho	Fort St. Vrain	Site-wide Portion
	Idaho National Engineering and Environmental Laboratory	ARA Soils
		Argonne West
		BORAX Area
		CFA
		EBR-1
		INTEC Sites
		Ordnance Area
		Other TAN Soils
		Pad A
		PBF Soils
		SL-1 Burial Ground
		TAN Building 616
		TAN Soils
		TAN Tanks
		TRA Ponds
		TRA Subsurface Soils
Nevada	Amchitka Island [a]	Surface
		Subsurface
	Central Nevada Test Area [a]	Surface
		Subsurface
	Gasbuggy Site [a]	Surface
		Subsurface
	Gnome-Coach [a]	Surface
		Subsurface
	Nevada Test Site	Area 3 RWMS
		Area 5 RWMS
		Industrial Sites
		Soils
		UGTA

Table B-2. List of Sites and Portions of Sites by DOE Office

DOE Office	*Site*	*Portion*
Nevada	Project Shoal [a]	Surface
		Subsurface
	Rio Blanco [a]	Surface
		Subsurface
	Rulison [a]	Surface
		Subsurface
	Salmon Site [a]	Surface
		Subsurface
Oakland	Energy Technology Engineering Center	Unknown [b]
	General Atomics	Unknown [b]
	General Electric Vallecitos Nuclear Center	Unknown [b]
	Laboratory for Energy Related Health Research	Unknown [b]
	Lawrence Berkeley National Laboratory	Old Town
		Building 51/64VOC Plume
		Building 71 Freon/VOC Plume
		Building 75 Tritium Plume
		Building 88 Area
	Lawrence Livermore National Laboratory - Livermore Site	Building 292 Area
		Building 331 Area
		Building 419/511
		Treatment Facility F/406
		Treatment Facility 5475
		Treatment Facility A
		Treatment Facility B
		Treatment Facility C
		Treatment Facility D
		Treatment Facility E
		Treatment Facility G
		Treatment Facility 518
	Lawrence Livermore National Laboratory - Site 300	OU #7 Building 832
		OU #8 Site
		OU #1 GSA
		OU #2 Building 834
		OU #3 Pit 6
		OU #4 Building 815
		OU #5 Building 850 - Pits 3 & 5
		OU #6 Building 854
	Stanford Linear Accelerator	Site-wide Portion

Table B-2. List of Sites and Portions of Sites by DOE Office

DOE Office	*Site*	*Portion*
Oak Ridge	Bayo Canyon	Site-wide Portion
	Center for Energy and Environmental Research	Site-wide Portion
	Maxey Flats Disposal Site	Unknown [b]
	Oak Ridge Reservation	Bear Creek Watershed
		Bethel Valley Watershed
		E. Tenn. Tech. Watershed
		Melton Valley Watershed
		Offsite
		Upper E. Fork Poplar Creek Watershed
	Paducah Gaseous Diffusion Plant	Site-wide Portion
	Portsmouth Gaseous Diffusion Plant	Quadrant I
		Quadrant II
		Quadrant III
		Quadrant IV
	Westlake Disposal Site	Unknown [b]
Ohio	Ashtabula Environmental Management Project (*RMI Titanium Company Site*)[c]	Unknown [b]
	Battelle Columbus - King Avenue	Unknown [b]
	Battelle Columbus - West Jefferson	Unknown [b]
	Fernald Environmental Management Project	Site-wide Portion
	Miamisburg Environmental Management Project (*Mound*) [c]	Site-wide Portion
	West Valley Demonstration Project, New York	Unknown [b]
Rocky Flats	Rocky Flats Environmental Technology Site	Site-wide Portion
Richland	Hanford Site	100 B/C Area
		100 D Area
		100 F Area
		100 H Area
		100 K Area
		100 N Area
		100 Other Area
		1100 Area
		200 Area North
		200 Area PO1-1 GW
		300 Area
		Arid Land Ecology
		ERDF Cell
		Riverland
		Wahluke Slope

Table B-2. List of Sites and Portions of Sites by DOE Office

DOE Office	*Site*	*Portion*
Savannah River	Savannah River Site	247-F Naval Fuel Manufacturing Facility
		D Area Heavy Water Facilities
		F Tank Area
		Four Mile Branch Watershed
		Heavy Water Component Test Reactor
		Lower Three Runs Watershed
		M Area Fuel/Target Manufacturing Facilities
		Pen Branch Watershed
		Steel Creek Watershed
		Savannah River & Floodplain Swamp Watershed
		Upper Three Runs Watershed
FUSRAP Sites[e]	Ashland Oil #1	Unknown[b]
	Ashland Oil #2	Unknown[b]
	Bliss and Laughlin Steel	Unknown[b]
	CE	Unknown[b]
	Colonie	Unknown[b]
	DuPont & Company	Unknown[b]
	Latty Avenue Properties	Unknown[b]
	Linde Air Products	Unknown[b]
	Luckey	Unknown[b]
	Madison	Unknown[b]
	Maywood Chemical Works	Unknown[b]
	Middlesex Sampling Plant	Unknown[b]
	Niagara Falls Storage Site	Unknown[b]
	Painesville	Unknown[b]
	St. Louis Airport Site	Unknown[b]
	St. Louis Airport Site Vicinity Properties	Unknown[b]
	St. Louis Downtown Site	Unknown[b]
	Seaway Industrial Park	Unknown[b]
	Shpack Landfill	Unknown[b]
	W.R. Grace and Company	Unknown[b]
	Wayne Site	Unknown[b]

[a] For the remediation of the sites, the Department distinguishes the surface from the subsurface activity. The long-term stewardship start date reflects the completion of surface remediation. However, characterization of the subsurface contamination will continue well beyond 2006.
[b] For these sites, it has yet to be determined what portion, if any, will require long-term stewardship activities by DOE.
[c] In some cases, sites are known by alternate names which are italicized in parentheses.

[d] The operations office has yet to be determined, but will most likely be the Grand Junction Office.
[e] Cleanup responsibility for these 21 FUSRAP sites has been assigned to the U.S. Army Corps of Engineers (Corps). The Department and the Corps signed a Memorandum of Understanding (MOU) in March 1999 which assigns responsibility to DOE for any required long-term stewardship activities. However, the cleanup decisions for these sites are not yet final and, therefore, the level of long-term stewardship required for these sites, if any, is not yet known.

Table B-3. List of Sites and Portions of Sites by Site Name

Site	*Portion*
Ambrosia Lake Site	Site-wide Portion
Amchitka Island[a]	Surface
	Subsurface
Ames Laboratory	Clean Closure
(ANC) Gas Hills Site	Site-wide Portion
Argonne National Laboratory East	300 Area
	800 Area
	CP-5
	Rest of Site
Ashland Oil #1	Unknown[b]
Ashland Oil #2	Unknown[b]
Ashtabula Environmental Management Project (*RMI Titanium Company Site*)[c]	Unknown[b]
(Atlas) Moab Mill	Site-wide Portion
Battelle Columbus - King Avenue	Unknown[b]
Battelle Columbus - West Jefferson	Unknown[b]
Bayo Canyon	Site-wide Portion
Bliss and Laughlin Steel	Unknown[b]
Bluewater Site (*Arco Bluewater*)[c]	Site-wide Portion
Bodo Canyon Cell	Site-wide Portion
Brookhaven National Laboratory	BGRR/HFBR D&D
	Former HWMF
	Groundwater
	Landfills
	Other Radiated Soils
	Peconic River
	Rest of Site
Burrell Site	Site-wide Portion
Burro Canyon Disposal Cell	Site-wide Portion
Canonsburg Site	Site-wide Portion
CE	Unknown[b]
Center for Energy and Environmental Research	Site-wide Portion
Central Nevada Test Area[a]	Surface
	Subsurface
Cheney Disposal Cell (*Grand Junction Disposal Site*)[c]	Site-wide Portion
(Chevron) Panna Maria Site	Site-wide Portion
Colonie	Unknown[b]
(Conoco) Conquista Site	Site-wide Portion

Table B-3. List of Sites and Portions of Sites by Site Name

Site	*Portion*
(Cotter) Cañon City Site	Unknown[b]
(Dawn) Ford Site	Unknown[b]
DuPont & Company	Unknown[b]
Durango Mill[a]	Surface
	Subsurface
Edgemont Site	Site-wide Portion
(EFN) White Mesa Site	Unknown[b]
Energy Technology Engineering Center	Unknown[b]
Estes Gulch Disposal Cell	Site-wide Portion
(Exxon) Highlands Site	Site-wide Portion
(Exxon) Ray Point Site	Site-wide Portion
Falls City Site	Site-wide Portion
Fermi National Accelerator Laboratory	Site-wide Portion
Fernald Environmental Management Project	Site-wide Portion
Fort St. Vrain	Site-wide Portion
Gasbuggy Site[a]	Surface
	Subsurface
General Atomics	Unknown[b]
General Electric Vallecitos Nuclear Center	Unknown[b]
Gnome-Coach[a]	Surface
	Subsurface
Grand Junction Mill 1	Site-wide Portion
Grand Junction Mill 2	Site-wide Portion
Green River Site[a]	Surface
	Subsurface
Gunnison Disposal Cell	Site-wide Portion
Gunnison Mill[a]	Surface
	Subsurface
Hallam Nuclear Power Facility	Site-wide Portion
Hanford Site	100 B/C Area
	100 D Area
	100 F Area
	100 H Area
	100 K Area
	100 N Area
	100 Other Area
	1100 Area

Table B-3. List of Sites and Portions of Sites by Site Name

Site	*Portion*
	200 Area North
	200 Area PO1-1 GW
	300 Area
	Arid Land Ecology
	ERDF Cell
	Riverland
	Wahluke Slope
(HECLA) Durita Site	Site-wide Portion
Hoe Creek Underground Coal Gasification Site	Site-wide Portion
(Homestake) Grants Site	Unknown[b]
Idaho National Engineering and Environmental Laboratory	ARA Soils
	Argonne West
	BORAX Area
	CFA
	EBR-1
	INTEC Sites
	Ordnance Area
	Other TAN Soils
	Pad A
	PBF Soils
	SL-1 Burial Ground
	TAN Building 616
	TAN Soils
	TAN Tanks
	TRA Ponds
	TRA Subsurface Soils
Kansas City Plant	Site-wide Portion
(Kennecott) Sweetwater Site	Unknown[b]
Laboratory for Energy Related Health Research	Unknown[b]
Lakeview Mill	Site-wide Portion
Lakeview Site	Site-wide Portion
Latty Avenue Properties	Unknown[b]
Lawrence Berkeley National Laboratory	Old Town
	Building 51/64 VOC Plume
	Building 71 Freon/VOC Plume
	Building 75 Tritium Plume
	Building 88 Area

Table B-3. List of Sites and Portions of Sites by Site Name

Site	*Portion*
Lawrence Livermore National Laboratory - Livermore Site	Building 292 Area
	Building 331 Area
	Building 419/511
	Treatment Facility F/406
	Treatment Facility 5475
	Treatment Facility A
	Treatment Facility B
	Treatment Facility C
	Treatment Facility D
	Treatment Facility E
	Treatment Facility G
	Treatment Facility 518
Lawrence Livermore National Laboratory - Site 300	OU #7 Building 832
	OU #8 Rest of Site
	OU #1 GSA
	OU #2 Building 834
	OU #3 Pit 6
	OU #4 Building 815
	OU #5 Building 850 - Pits 3&5
	OU #6 Building 854
Linde Air Products	Unknown[b]
Los Alamos National Laboratory	Site-wide Portion
Lovelace Respiratory Research Institute (*Inhalation Toxicology Research Institute*)[c]	Diesel Spill Site
	Hot Ponds
	Sewage Lagoon Site
Lowman Site	Site-wide Portion
Luckey	Unknown[b]
Madison	Unknown[b]
Maxey Flats Disposal Site	Unknown[b]
Maybell Mill Site	Site-wide Portion
Maywood Chemical Works	Unknown[b]
Mexican Hat Site	Site-wide Portion
Miamisburg Environmental Management Project (*Mound*) [c]	Site-wide Portion
Middlesex Sampling Plant	Unknown[b]
Monticello Mill Site and Vicinity Properties	Disposal Site
	Groundwater
	Supplemental Standards Areas

Table B-3. List of Sites and Portions of Sites by Site Name

Site	*Portion*
Monument Valley Site[a]	Surface
	Subsurface
Naturita Mill[a]	Surface
	Subsurface
Naturita Site	Site-wide Portion
Naval Oil Shale Reserves Site	Site-wide Portion
Naval Petroleum Reserve No. 3 Landfill/Landfarm	Site-wide Portion
Nevada Test Site	Area 3 RWMS
	Area 5 RWMS
	Industrial Sites
	Soils
	UGTA
Niagara Falls Storage Site	Unknown[b]
Oak Ridge Reservation	Bear Creek Watershed
	Bethel Valley Watershed
	E. Tennessee Tech. Watershed
	Melton Valley Watershed
	Offsite
	Upper E. Fork Poplar Creek Watershed
Paducah Gaseous Diffusion Plant	Site-wide Portion
Painesville	Unknown[b]
Palos Forest (Site A/Plot M) Preserve (*Site A/Plot M*) [c]	Site-wide Portion
Pantex Plant	Risk Reduction Std 2
	Risk Reduction Std 3
Parkersburg Site (*Amax*)[c]	Site-wide Portion
(Pathfinder) Lucky Mc Site	Site-wide Portion
(Pathfinder) Shirley Basin Site 2	Site-wide Portion
(Petrotomics) Shirley Basin Site 1	Site-wide Portion
Pinellas STAR Center (*Pinellas Plant*)[a,c]	4.5 Acre Site
	Building 100
	Northeast Site
	Wastewater Neutralization Area/Building 200 Area
Piqua Nuclear Power Facility	Site-wide Portion
(Plateau) Shootaring Canyon Site	Unknown[b]
Portsmouth Gaseous Diffusion Plant	Quadrant I
	Quadrant II
	Quadrant III

Table B-3. List of Sites and Portions of Sites by Site Name

Site	*Portion*
	Quadrant IV
Princeton Plasma Physics Laboratory	Site-wide Portion
Project Shoal [a]	Surface
	Subsurface
(Quivira) Ambrosia Lake Site 2	Unknown[b]
Rifle (New) Mill[a]	Surface
	Subsurface
Rifle (Old) Mill[a]	Surface
	Subsurface
(Rio Algom) Lisbon Valley Site	Unknown[b]
Rio Blanco[a]	Surface
	Subsurface
Riverton Site	Site-wide Portion
Rock Springs Oil Shale Retort Site	Site-wide Portion
Rocky Flats Environmental Technology Site	Site-wide Portion
Rulison[a]	Surface
	Subsurface
St. Louis Airport Site	Unknown[b]
St. Louis Airport Site Vicinity Properties	Unknown[b]
St. Louis Downtown Site	Unknown[b]
Salmon Site[a]	Surface
	Subsurface
Salt Lake City Mill	Site-wide Portion
Sandia National Laboratories - CA	Fuel Oil Spill
	Groundwater
	Navy Landfill
Sandia National Laboratories - NM	CAM Unit
	Chemical Waste Landfill
	Groundwater
	MLLW Landfill
	Signed & Fenced Soil
	Signed Soils
Savannah River Site	247-F Naval Fuel Manufacturing Facility
	D Area Heavy Water Facilities
	F Tank Area
	Four Mile Branch Watershed
	Heavy Water Component Test Reactor

Table B-3. List of Sites and Portions of Sites by Site Name

Site	*Portion*
	Lower Three Runs Watershed
	M Area Fuel/Target Manufacturing Facilities
	Pen Branch Watershed
	Savannah River & Floodplain Swamp Watershed
	Steel Creek Watershed
	Upper Three Runs Watershed
Seaway Industrial Park	Unknown[b]
Shiprock Site[a]	Surface
	Subsurface
Shpack Landfill	Unknown[b]
Slick Rock (North Continent) Mill 1[a]	Surface
	Subsurface
Slick Rock (Union Carbide) Mill 2[a]	Surface
	Subsurface
(SOHIO) LBAR Site	Site-wide Portion
South Clive Disposal Cell	Site-wide Portion
South Valley Superfund Site	Unknown[b]
Spook Site	Site-wide Portion
Stanford Linear Accelerator	Site-wide Portion
Tuba City Site[a]	Surface
	Subsurface
(UMETCO) Gas Hills Site	Site-wide Portion
(UMETCO) Maybell Site 2	Site-wide Portion
(UMETCO) Uravan Site	Unknown[b]
(UNC) Church Rock Site	Unknown[b]
(Union Pacific) Bear Creek Site	Site-wide Portion
W.R. Grace and Company	Unknown[b]
Waste Isolation Pilot Plant	Unknown[b]
Wayne Site	Unknown[b]
Weldon Spring Site	Chemical Plant
	Quarry Groundwater
West Valley Demonstration Project	Unknown[b]
Westlake Disposal Site	Unknown[b]
(WNI) Sherwood Site	Site-wide Portion
(WNI) Split Rock Site	Site-wide Portion
11e.(2) Disposal Site[d]	Unknown[b]

[a] For the remediation of the sites, the Department distinguishes the surface from the subsurface activity. The long-term stewardship start date reflects the completion of surface remediation. However, characterization of the subsurface contamination will continue

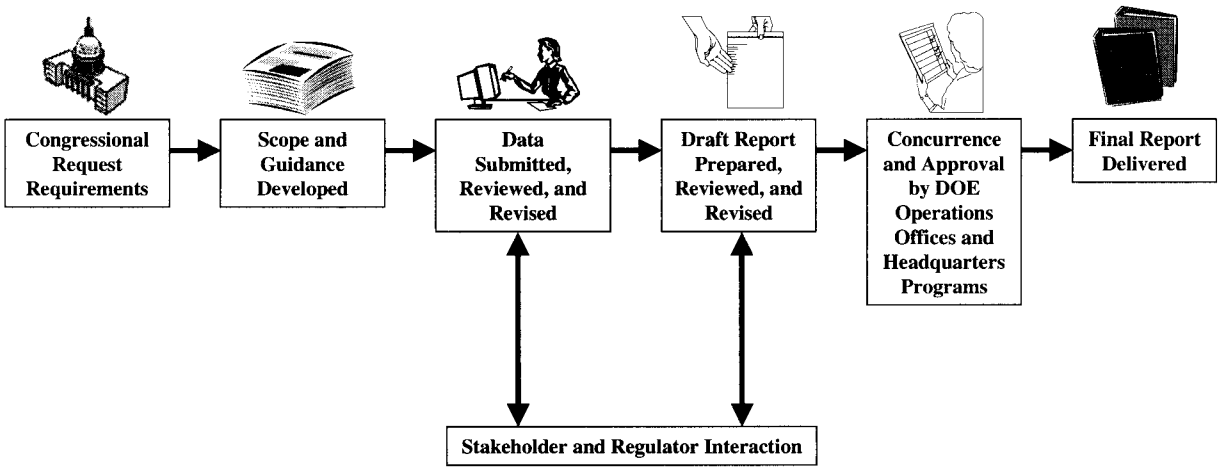
well beyond 2006.
[b] For these sites, it has yet to be determined what portion, if any, will require long-term stewardship activities by DOE.
[c] In some cases, sites are known by alternate names which are italicized in parentheses.
[d] The operations office has yet to be determined, but will most likely be the Grand Junction Office.

APPENDIX C: METHODOLOGY

1.0 PROCESS FOR DEVELOPING THE REPORT

This report is developed by compiling information from the DOE Field offices in response to a data call designed to meet the Congressional request. Each step in this methodology is described below and illustrated in Exhibit C-1.

Exhibit C-1. Methodology Process Overview



1.1 CONGRESSIONAL REQUEST REQUIREMENTS

The report accompanying the FY 2000 *National Defense Authorization Act* requested that the Department provide Congress with:

> *A report on existing and anticipated long-term environmental stewardship responsibilities for those Department of Energy sites or portions of sites for which environmental restoration, waste disposal, and facility stabilization is expected to be completed by the end of calendar year 2006. The report shall include a description of what sites, whole and geographically distinct locations, as well as specific disposal cells, contained contamination areas, and entombed contaminated facilities that cannot or are not anticipated to be cleaned up to standards allowing for unrestricted use. The report shall also identify the long-term stewardship responsibilities (for example, longer than 30 years) that would be required at each site, including soil and groundwater monitoring, record-keeping, and containment structure maintenance. In those cases where the Department has a reasonably reliable estimate of annual or long-term costs for stewardship activities, such costs shall be provided.*[47]

[47] *Fiscal Year 2000 National Defense Authorization Act Conference Report, Congressional Record*, August 5, 1999 (page H7855).

1.2 Developing the Scope and Guidance of the Report

In response to this request, DOE Headquarters and Field personnel worked closely to accomplish three tasks:

- Identify the potential list of sites and portions of sites within the scope of the analysis (Section 1.2.1);
- Obtain the necessary information needed to fulfill the NDAA requirements (Section 1.2.2); and
- Develop this Report, including the site summaries presented in Volume II (Section 1.4).

The scope of this Report was developed to respond to the preceding report language, as well as other drivers, as indicated below:

- Congress is increasingly aware that DOE's responsibilities will not be eliminated when "cleanup" is complete and is interested in understanding the estimated size of the remaining responsibilities.
- In order to support a credible long-term stewardship program, Congress has expressed a strong interest in learning as much as possible about "portions of sites" where cleanup and stabilization are currently complete or will be complete.
- During the past 10 years, Congress has appropriated substantial funding (nearly $60 billion) for DOE to conduct environmental management activities, and DOE needs to demonstrate the degree of success achieved by that funding.

Generally, the scope of this Report includes those sites where cleanup is currently managed by DOE, where DOE has a clear and planned responsibility for long-term stewardship after cleanup, and where the level of cleanup will result in residual contamination at levels greater than what is acceptable for unrestricted use. In accordance with the NDAA language, this includes all sites or portions of sites where long-term stewardship activities are anticipated by the end of calendar year 2006. This Report also identifies, to a lesser extent, those sites where long-term stewardship activities are anticipated, but where the long-term stewardship activities will not begin until after 2006. The scope reflects current policies, understandings, and information available at the time of development of this Report.

1.2.1 Identifying Sites within the Scope of the Report

The first task was to identify the list of sites within the scope of this Report. To accomplish this task, DOE staff identified those sites where cleanup is currently managed by DOE, where DOE has a clear and planned responsibility for long-term stewardship after cleanup, and where the level of cleanup will result in residual contamination at levels greater than what is acceptable for unrestricted use. The initial list of sites came from DOE's 1999 *Background Report* on long-term stewardship, which identified 144 sites where DOE could potentially have long-term stewardship responsibilities.[48]

DOE SITES ARE NOT ALL ALIKE

DOE sites vary significantly from one another not only in size, but also in terms of past missions and the resulting nature of residual contamination. For example, the Hanford Site covers 375,000 acres and had past missions including fuel and target fabrication, production reactor operations, chemical separations, and component fabrications. The Piqua Nuclear Power Facility is a small site (0.5 acre), which formerly contained a single thermal, organically-cooled and moderated, demonstration reactor.

DOE's project team then refined this list to determine the scope of sites to be covered by this Report, as described in the paragraphs below (see Exhibit C-2).

[48] *From Cleanup to Stewardship: A Companion Report to Accelerating Cleanup: Paths to Closure and Background Information to Support the Scoping Process Required for the 1998 PEIS Settlement Study,* U.S. Department of Energy, DOE/EM-0466, October 1999.

First, after discussions with site personnel, the project team combined the Argonne National Laboratory-West (ANL-W) site with the Idaho National Engineering and Environmental Laboratory, and combined the Oak Ridge Associated Universities (ORAU) with the Oak Ridge Reservation, thereby further reducing the number of sites by two (both ANL-W and ORAU are located within the boundaries of the larger site with which each was combined). The next step was to identify the sites where DOE expects to clean up to levels allowing for unrestricted use and, therefore, these sites are excluded from the scope of this Report. The list of these sites is included in Exhibit C-2. This consolidation and elimination reduced the number of sites identified in the *Background Report* by 36 to 108 sites.

Second, several sites were added to the report, including the Fort St. Vrain site, a privately-owned former nuclear reactor and current spent nuclear fuel storage installation. This site was included in the list of sites because DOE is responsible for monitoring the spent nuclear fuel stored at this site. The Westlake site, a privately-owned landfill, was included in this Report because DOE will be responsible for a percentage of site remediation costs as a liable third-party. An additional disposal site, 11e.(2) Disposal Site in Utah, was added. DOE anticipates future responsibility for this site because of disposal of 112.(2) wastes by DOE.

Third, because the scope of this analysis encompasses all DOE sites with potential long-term stewardship responsibilities, rather than just those managed by the Environmental Management (EM) program, DOE identified sites outside the scope of the EM program that fit the criteria established in the Congressional mandate. DOE identified four sites -- Naval Oil Shale Reserves Site, Naval Petroleum Reserve No. 3 Landfill/Landfarm, Rock Springs Oil Shale Retort Site, and the Hoe Creek Underground Coal Gasification Site -- managed by the Office of Fossil Energy where all planned remediation activities will be complete by the end of 2006, after which long-term stewardship activities are expected to be required. These sites were used by DOE to investigate the process and environmental parameters of underground coal gasification technologies and were included in this analysis.

Fourth, for the purpose of this analysis, DOE determined that five of the UMTRCA Title I sites described in the *Background Report* should be divided into two sites each, based on the fact that the uranium mill tailings sites and the disposal cells are geographically distinct. The sites were separated, and as a result, five sites were added to the scope. These sites include the Durango Mill, Grand Junction Mill 1, Gunnison Mill, Lakeview Mill, and the Naturita Mill sites

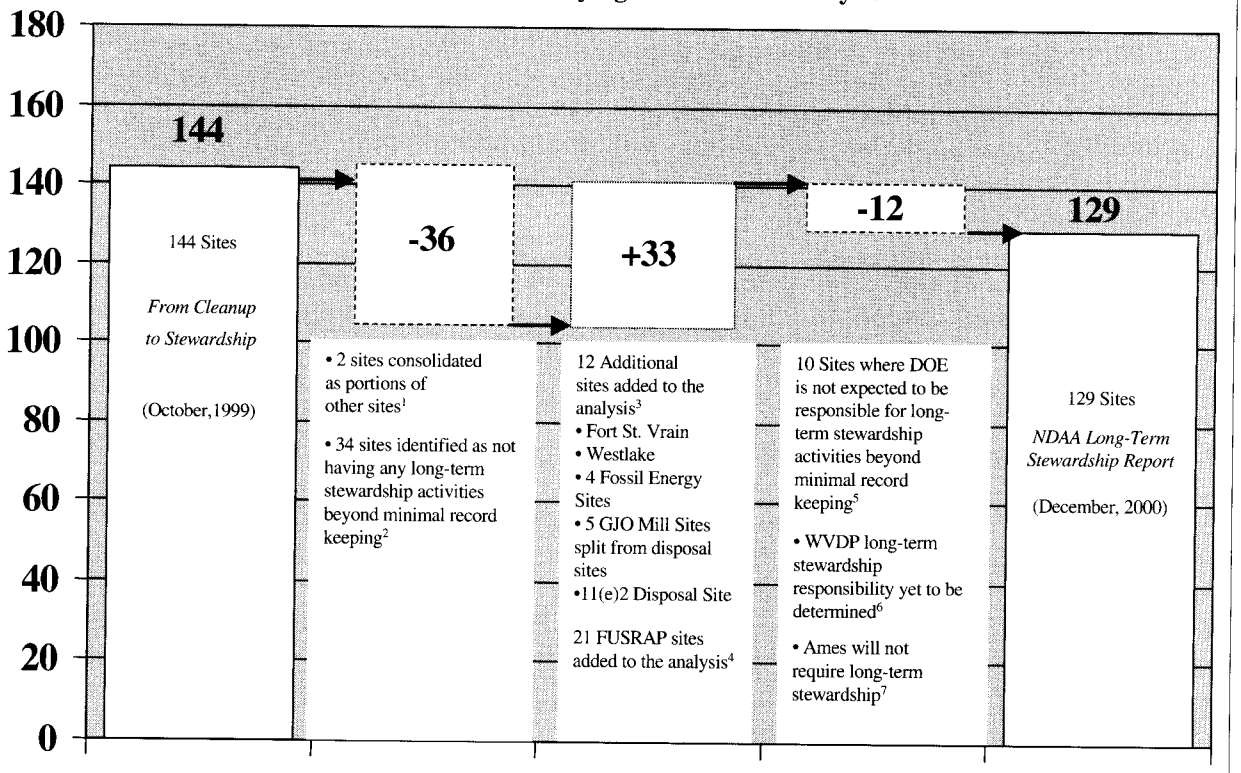
Finally, 21 FUSRAP sites transferred to the Corps for remediation in 1997 were also added to the Report. Although the extent of long-term stewardship, if any, is unknown at this time, for the purpose of this Report, DOE assumes it may be responsible for long-term stewardship activities. These sites are included in Volume I discussions as part of the number of sites expected to require long-term stewardship. However, given the uncertainty regarding the extent of long-term stewardship, cost and acreage data were not provided. The addition of the 33 sites mentioned above combined with the 108 sites from the *Background Report* brings the total number of sites included in this Report to 141.

However, of the 141 sites, DOE identified 12 sites that are not within the scope of this Report for various reasons. These sites include:

- Ten out of 12 sites are excluded because although some long-term stewardship activities may be required after cleanup at these 10 sites, based on legally binding documents agreed to by all parties, DOE is not expected to be responsible for long-term stewardship activities at these sites.

- Long-term stewardship responsibility for the West Valley Demonstration Project in New York is yet to be determined.

Exhibit C-2. Identifying Sites for this Analysis



[1] Argonne National Laboratory-West (included as part of INEEL) and Oak Ridge Associated Universities (included as part of ORR) are within the geographic boundaries of other identified sites. Thus, unlike the *Background Report*, these sites are not counted as separate geographic sites.

[2] Thirty-four sites were removed because the Department does not expect that the sites will require any long-term stewardship, beyond record-keeping activities for the completed cleanup: Acid/Pueblo Canyons, Alba Craft, Aliquippa Forge, Albany Research Center, Associate Aircraft, Baker and Williams Warehouses, Baker Brothers, B&T Metals, Chapman Valve, C.H. Scnoor, Chupadera Mesa, Elza Gate, General Motors, Geothermal Test Facility, Granite City Steel, Herring-Hall Marvin Safe Co., Holloman Air Force Base, Kauai Test Facility, Kellex/Pierpont, Middlesex Municipal Landfill, National Guard Armory, New Brunswick Site, Niagara Falls Storage Site Vicinity Properties, Oxnard Facility, Pagano Salvage Yard, Peak Oil PRP Participation, Project Chariot, Salton Sea Test Base, Separation Process Research Unit (SPRU), Seymour Speciality Wire, Shippingport, University of California, University of Chicago, and Ventron.

[3] The five uranium mill sites managed by the Grand Junction Office were split from their respective disposal sites because they represent geographically distinct sites. The Fort St. Vrain site was introduced by the Idaho Operations Office because the site will require DOE long-term stewardship activities where spent nuclear fuel is being stored. Similarly, four additional sites managed by the Office of Fossil Energy will require relatively limited long-term stewardship after cleanup. The Westlake Disposal Site in Missouri will also require long-term stewardship activities. The 11e.(2) Disposal Site will require long-term stewardship activities, however, the of long-term stewardship responsibility has yet to be determined.

[4] Twenty-one FUSRAP sites transferred to the Corps for remediation will be returned to DOE two years after the completion of cleanup. The extent of long-term stewardship for these sites, if any, is currently unknown. However, for the purpose of this Report, DOE assumes it may be responsible for long-term stewardship at all 21 sites: Combustion Engineering, CT; Madison, IL; W.R. Grace & Company, MD; Shpack Landfill, MS; Latty Avenue Properties, MO; St. Louis Airport Site and St. Louis Airport Vicinity Properties, MO; St. Louis Downtown Site, MO; DuPont & Company, NJ; Maywood Chemical Works, NJ; Middlesex Sampling Plant, NJ; Wayne Site, NJ; Ashland Oil #1 and #2, NY; Bliss and Laughlin Steel, NY; Colonie Site, NY; Linde Air Products, NY; Niagara Falls Storage Site, NY; Seaway Industrial Park, NY; Luckey, OH; and Painesvill, OH.

[5] The 10 sites where DOE is not expected to be responsible for long-term stewardship activities are Ashtabula Environmental Management Project, OH; South Valley Site, NM; Energy Technology Engineering Center, CA; General Atomics, CA; General Electric Vallecitos Nuclear Center, CA; Maxey Flats Disposal Site, KY; Battelle Columbus King Avenue and West Jefferson Sites, OH; Laboratory for Energy-Related Health Research, CA; and the Westlake Disposal Site, MO.

[6] Currently, the final determination of the extent of and responsibility for long-term stewardship at the West Valley Demonstration Project (WVDP) in New York is yet to be determined.

[7] Ames Laboratory in Iowa is not expected to require long-term stewardship.

The Ames Laboratory is not included because no long-term stewardship activities are anticipated after scheduled remediation is completed in 2006 (i.e., clean closure of the site).

Because DOE is not expected to have long-term stewardship responsibility for the 12 sites mentioned above, they were not considered to be within the scope of this Report. However, brief descriptions of these sites are included in Volume II because DOE was involved in the cleanup.

In summary, as a result of this methodology, DOE identified a total of 129 sites where the Department will have long-term stewardship responsibility and, consequently, are included in the analysis in Volume I of this Report. (See Table 2-1). Volume II of this Report includes 141 site summaries, but provides more detailed long-term stewardship information for the 129 sites where DOE anticipates long-term stewardship responsibility.

1.2.1.1 Portion(s) of a Site

After the number of sites were determined, it was necessary to identify portions within each site to fulfill the intent of the Congressional language. For some larger sites, multiple portions were identified to provide increased detail of the long-term stewardship activities.

For the purpose of this Report, a portion of a site is defined as

> *A geographically contiguous and distinct area for which cleanup, disposal, or stabilization has been completed or is expected to be completed by approximately the end of calendar year 2006 and where residual contamination remains. A portion may involve any or all of the following media: soil, groundwater, surface water/sediment, a facility, or an engineered unit. A portion can also be an aggregate of a number of facilities, soil sites, or engineered units that meet the following criteria: (1) all have similar contaminants; (2) they are closely located; and (3) all require similar long-term stewardship activities.*[49]

DOE Headquarters and Field staff worked closely and iteratively to identify the portions of sites that should be included as part of this analysis. In most cases, portions were based on site characteristics and the residual contamination expected within geographically distinct areas. Later in the process, the portion definition was refined to include a distinction between surface and subsurface. This distinction is particularly important for six of the former nuclear test sites: Rio Blanco and Rulison in Colorado, the Central Nevada Test Site and Project Shoal in Nevada, and Gasbuggy and Gnome-Coach in New Mexico. At these sites, surface remediation has been or will be completed well before the subsurface contamination characterization is complete. The surface and subsurface are each considered as a "portion." This distinction is also important for 11 former mill tailing sites and 1 component fabrication facility (Pinellas STAR Center in Florida). It is important to note, however, that some sites were not divided into portions based on their size and/or type of anticipated long-term stewardship activities.

The purpose of dividing sites into "portions," other than to comply with the explicit Congressional mandate, is to identify discrete subsets of sites that could be subject to distinct management attention. This interpretation was based partly on discussions with Congressional staff about the intent of the report language. Clearly, Congressional staff were interested in seeing evidence that DOE was actively considering how the sites would be managed after cleanup and making progress toward completion of cleanup. During

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[49] *Guidance for the Development of the FY 2000 National Defense Authorization Act (NDAA) Long-Term Stewardship Report*, January 24, 2000.

cleanup, sites are managed in units according to what makes sense to local site managers in order to accomplish local goals - generally to complete cleanup, disposal, or stabilization. However, after cleanup is complete, the "old" way of thinking about and managing the site (e.g., operable units, waste area groups) may no longer be the most appropriate for managing the long-term stewardship activities. Based on future uses of the site, managers may determine, for example, that portions of a site that are in close proximity to roads, rail lines, or other means of public access would have similar management needs that may differ from areas of a site that are more isolated. Even though the site may have been managed as a single operable unit for cleanup purposes, there may be a benefit to managing them as two "portions" for long-term stewardship -- one requiring more frequent inspections and monitoring to ensure that signs, fences, and other controls remain in place. Alternatively, DOE staff at some sites (e.g., Nevada Test Site) expect to continue non-EM missions long after the EM activities are completed at the sites, with no expectation for significant non-DOE use of the land. In theory, creating portions of the site based on the anticipated long-term stewardship activities could result in a new geographic division of sites that would better prepare the Department to manage the site after cleanup is completed.

In practice, dividing sites into portions for purposes of planning and managing expected long-term stewardship activities was neither easy nor straightforward. In some cases, site personnel could not provide information on expected land use after cleanup is completed. In most cases, no site personnel have been assigned responsibility for the post-cleanup management of portions of the site. Site personnel often provided information based on "areas" or other subsets of the site that may or may not be the basis for future organization of the site, but will likely be useful building blocks for any post-cleanup management scheme. The definition of "areas" and "portions" varied greatly among sites. Consequently, Volume I of this Report does not focus on this level of analysis. However, the site-specific summaries in Volume II provide detailed discussions of portions of sites, when applicable.

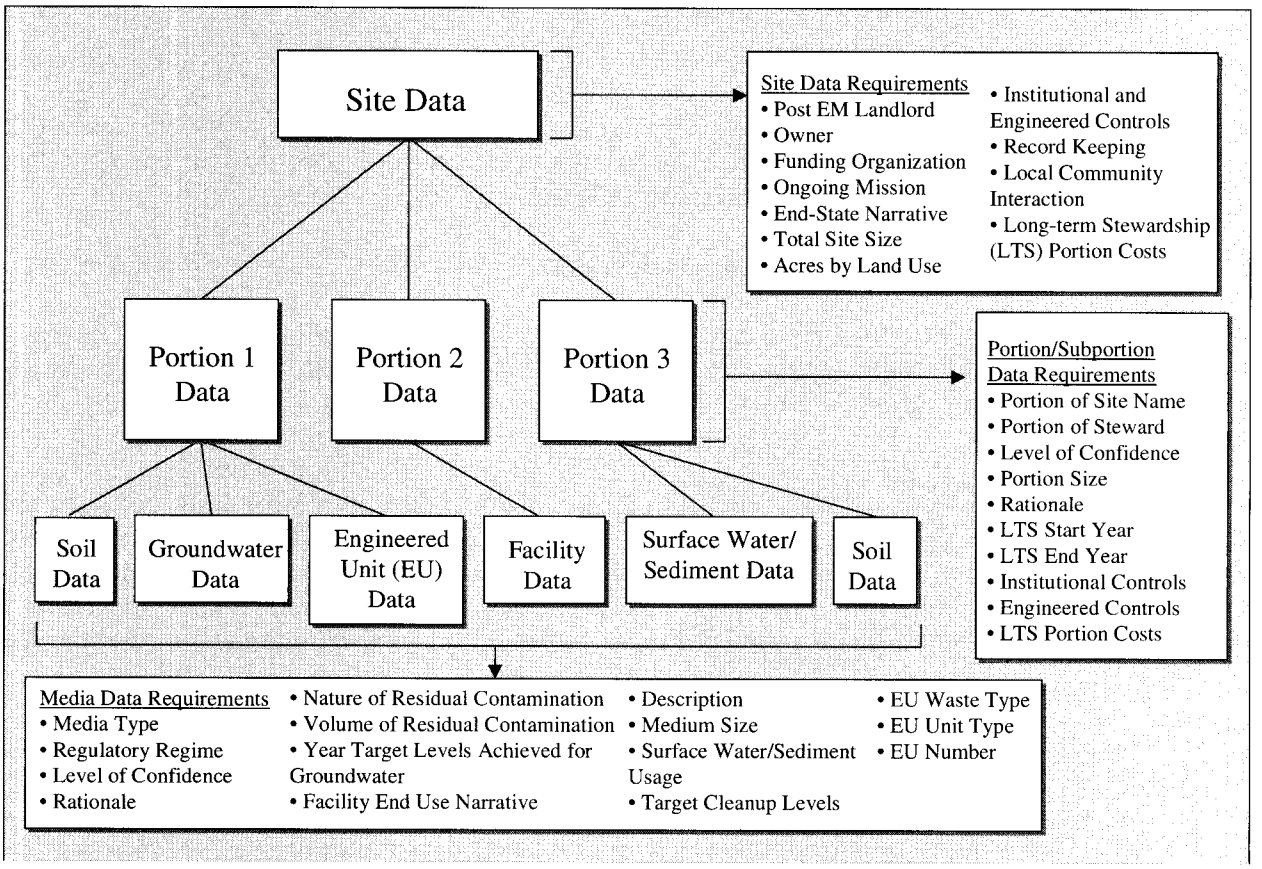
Because of the relative paucity and varying quality of information on some portions of sites, the DOE project team used supplemental information sources (e.g., Environmental Impact Statements, land use plans, etc.) to estimate the number of acres where residual contamination would remain and require long-term stewardship. See Section 7 of this Appendix and Chapter 3 of this Report for more details on this information and its compilation.

1.2.2 Developing the Guidance and Survey

After DOE identified the sites and portions of sites that would be included in the analysis, the project team began developing a survey tool for collecting information on those sites and portions of sites from DOE Field staff. First, DOE determined the discrete data elements needed to provide a complete picture of the Department's long-term stewardship requirements. The Department identified 36 data elements for collection at the site and portion levels. At the site level, general site information, including identifying the responsible parties, a summary of the site end-state, local community interactions, and long-term stewardship activities that are not associated with a specific portion was requested. At the portion level, portion-specific data elements were requested including a description of the portion, the portion size, start and end years for long-term stewardship, estimated costs, and the long-term stewardship activities associated with that portion. If no portions were identified for a given site, then the data to be collected at the portion level was applied to the entire site (i.e., for the purpose of the data collection effort, the sites were handled as a single geographic portion).

The project team also identified data elements on the environmental media where residual contamination would remain following planned remediation activities. Five media types were identified: soil, groundwater, engineered units (e.g., landfills) facilities, and surface water/sediments. The data elements and the data structure used in the survey are depicted in Exhibit C-3.

Exhibit C-3. Data Levels and Elements



To facilitate the data collection process (i.e., save time and money and improve communications), DOE staff developed an electronic tool so that Field personnel could submit their data directly into the database used for this analysis, developed a guidance document defining the data elements being requested, and developed a user's manual for the electronic tool. In addition, the project team established a hotline and a web-based question submittal process to address Field staff concerns or difficulties with the data tool on a real time basis. To ensure consistency in responses across sites, a comment response and tracking log was maintained.

1.3 Data Submitted, Reviewed, and Revised

Once DOE Field staff submitted draft data, the Headquarters project team initiated an extensive data quality assurance review process that relied heavily upon the assistance of Headquarters programs. The review comments generated by various Headquarters reviews were provided back to Field staff for update. The review by Headquarters programs were focused on programmatic and policy issues. In some cases, the review process consisted of several iterations until the data provided were corrected.

Stakeholder Involvement

As with most public participation activities, each Field office determines the level and type of appropriate public participation. However, Headquarters strongly encouraged each Field office to involve the public in the development of the information provided to respond to the Congressional request. The specific process for stakeholder involvement in the data collection effort varied on a site-by-site basis.

For example, in some cases Field office staff provided local stakeholders and other interested parties, such

as regulators and state representatives with copies of the draft NDAA data collection guidance document and copies of the draft site summaries in Volume II. Discussions with stakeholders regarding the NDAA data draft site summaries occurred during forums such as Site-Specific Advisory Board meetings. Governor Sunquist of Tennessee explicitly raised this issue with the Secretary and included it in the text of the agreement signed at the 1999 Summit in Denver by both the Governor and the Secretary, which requires that the Department share the information with the State and stakeholders before it is reported to Congress. Other States also requested the same level of involvement as Tennessee.

1.4 Draft Report Prepared, Reviewed, and Revised

DOE used the data submitted from Field staff to obtain the summary statistics and analysis presented in Volume I of this Report to Congress. Volume II of this Report to Congress consists solely of the site-specific summaries developed for each site. The site summaries presented in Volume II are listed alphabetically by State.

The site-specific long-term stewardship summaries for Volume II of the Report were developed using the data collected as a starting point. These summaries provide a clear description of the site and the anticipated site end-state, the cleanup activities that will be undertaken to achieve that end-state, and the resulting long-term stewardship costs and activities. The amount of detail included in the site-specific summaries generally depends on various factors including, but not limited to, site cleanup status, site mission, and the site ownership.

Once the initial site summaries were developed, DOE initiated a review process similar to that used for the data review process. DOE Field staff reviewed the site summaries and provided additional or clarifying data when necessary. This review was a valuable part of the site summary development process because it ensured that Field-submitted data were properly interpreted during the writing process. DOE Headquarters and Field staff worked collaboratively on developing and improving the site summaries.

Detailed sites summaries were provided for 96 sites where DOE expects to have clear long-term stewardship responsibility by 2006 and where significant long-term stewardship information is available. These sites represent the primary focus of the report. Additionally, brief site summaries were also developed for the 33 sites where DOE may have long-term stewardship responsibility, but the extent of long-term stewardship is yet to be determined. The 33 sites include the 11 UMTRCA Title II sites, 21 FUSRAP sites, and WIPP. Brief site summaries are also provided for the 11 sites where DOE is not expected to have long-term stewardship responsibilities after completing remediation as a liable party.[50] Although long-term stewardship is not expected, a brief site summary for the Ames Laboratory in Iowa was also included because remediation at the site is ongoing. Each site summary includes a site description and discussion of the site mission, past contamination and cleanup activities, accomplishments achieved at the site, site-specific long-term stewardship activities, long-term stewardship costs, and assumptions and uncertainties. Also, DOE used site maps supplied by Field staff to complement the discussions.

Stakeholder Involvement

As with the data submittal and review, each Field office determines the level and type of appropriate public participation for reviewing the draft report. As before, Headquarters strongly encouraged each Field office to involve the public in reviewing the Report. The specific process for stakeholder involvement in the data collection effort varied on a site-by-site basis.

[50] Long-term stewardship responsibility for the West Valley Demonstration Project is yet to be determined.

1.5 Concurrence and Approval by DOE Operations Offices and Headquarters Programs

After the draft Report was prepared, the document required a formal DOE concurrence process. Concurrence approval was received from each DOE Operations Office and each Headquarters Program. All comments were addressed and tracked in a database.

2.0 Assumptions and Data Limitations

A number of assumptions, data limitations, and uncertainties are associated with the data collected for this analysis. Programmatic assumptions and data limitations are discussed below. Site-specific assumptions are provided in the site-specific summaries in Volume II of this Report to Congress.

Scope

- Data provided for this Report are for planning purposes only and in no way preempt any ongoing or future regulatory or other decision-making processes.

- This Report is prepared based on the best available data to date (as of Spring - Summer 2000). In some cases, Field office staff do not know what the site end-state will be at the completion of cleanup and do not have a sufficiently clear estimate of the scope of long-term stewardship (i.e., the necessary long-term stewardship activities and expected costs) because site characterization has not been completed. As more characterization and final decisions are made, Field office staff will have more clearly defined long-term stewardship activities and cost estimates. Decisions about site end-state and cleanup assumptions will ultimately be made in accordance with the applicable statutes (i.e., RCRA, CERCLA, AEA), DOE Orders, and State and local requirements.

- Sites where DOE is identified as a potentially responsible party (PRP) and, therefore, participants in the cleanup, but where DOE is not expected to retain any long-term stewardship responsibilities, are not included in the summary results presented in Volume I of this Report to Congress (however, these sites are included in Volume II for informational purposes).

- This analysis includes any site or portion of a site that will require use restrictions as a result of residual contamination. This analysis does not include any sites or portions of a site where DOE Field staff and regulators determined there is no residual contamination or where contamination was remediated to levels that will allow for unrestricted use.

- An uncertain number of low-level radioactive waste sites under NWPA Section 151(b) and (c), which include low-level radioactive waste disposal sites and low-level radioactive waste sites at certain ore processing facilities, are excluded from this analysis because of the uncertainty regarding whether DOE will be responsible for long-term stewardship of these sites beyond those already identified as part of DOE's long-term stewardship responsibilities.

- The definition of what activities should be included in long-term stewardship differs from site to site.

- Changes in scientific understanding of the human health or environmental effects of residual contamination may result in changes to our regulatory standards, resulting in more or less stringent long-term stewardship activities in the future. Similarly, technology developments may enable additional contamination to be removed or change the nature of the long-term stewardship activities required.

- Long-term stewardship activities are linked to site cleanup and future use decisions. As these decisions

are finalized, the Department's long-term stewardship activities may change accordingly.

Schedule

- The long-term stewardship process is dynamic and the specific activities at a site will change over time in response to both site-specific and external factors. These factors include regulatory changes, technology developments, demographic shifts, and changes in the contamination due to attenuation or ongoing remediation.

Cost

- Long-term stewardship costs are based upon planned near-term cleanup funding levels. Changes in these funding levels could affect decisions regarding cleanup decisions and, consequently, the resulting end-state and long-term stewardship activities.

- Estimated long-term stewardship costs cover long-term stewardship activities through 2070 (DOE Environmental Management data sources currently track costs only to 2070), even though long-term stewardship activities may be required for a longer period, possibly in perpetuity.

- Cost estimates for activities occurring at sites where cleanup will be completed for the entire geographic site during the near-term time period (i.e., through 2006) are more accurate than the longer-range planning estimates for the out years (i.e., after 2006).

- For sites where cleanup of the entire site has not been completed and no long-term stewardship plan has been prepared, existing data are largely organized according to DOE project rather than by geographic area. Consequently, the information submitted by Field staff do not describe expected long-term stewardship costs and activities at the geographic portion level.

- Although costs for long-term stewardship at the site-specific level appear to be more comprehensive than in past reports, it is still difficult, if not impossible to draw comparisons of costs for long-term stewardship activities between sites. Sites include and report long-term stewardship activities in their budgets differently.

3.0 METHOD FOR IDENTIFYING ACRES LIKELY TO REQUIRE LONG-TERM STEWARDSHIP AT DOE SITES

The purpose of long-term stewardship is to protect human health and the environment from the hazards remaining at the sites. One way to measure the size of the Department's long-term stewardship responsibility is to estimate the amount of land likely to be affected because of residual surface or subsurface contamination. Depending on the nature of the remaining hazards, these lands will, at a minimum, be subject to monitoring, record-keeping requirements, and land use restrictions. This section discusses the amount of land affected at the 129 sites where DOE expects to perform long-term stewardship activities.

Approximately 539,000 acres (more than 21 percent) of the land is contaminated. To refine the estimated extent of residually contaminated lands and DOE's expected long-term stewardship requirements, the Headquarters' project team attempted to collect data at a level of detail not previously requested from Field staff. In addition to collecting the total acreage of the geographic sites, the Headquarters project team requested the Field staff to submit the number of acres for distinct portions of sites where cleanup activities are expected to be complete by 2006 and long-term stewardship has begun.

Because each DOE site is unique, portions were defined on a site-specific basis. The portions are not always

defined to be exact representations of the extent of residually contaminated areas, but rather may reflect land use controls in place for other reasons. For example:

- Buffer Zone: This land is clean, but the land has use or access restrictions similar to contaminated areas to reduce the risk of exposure to humans and the environment. Several sites are required to have buffer areas as a means of spatial separation between humans and areas of residual contamination.
- Wildlife Areas: Other sites have defined portions of sites based upon ecological management.
- Areas Surrounded by Contamination: Some sites have scattered areas ("islands") of contamination. The land in between these areas of contamination is often clean. However, for more efficient management purposes, the land is managed as a contiguous unit. The entire area is subject to land use control.

For the purpose of reporting lands currently subject to long-term stewardship and those expected to require long-term stewardship by 2006, the NDAA Data Call information provided a reasonable estimate of acreage. The NDAA Data Call information was used for portion acreage as a proxy for long-term stewardship acreage. As previously discussed, portions were partly defined to follow long-term stewardship boundaries and areas of residual contamination, but this was not always the case. The scope of the Report to Congress and the use of portion acreage limits the usefulness of acreage data for two type of sites:

- Sites where portions were much larger than the actual area of contamination (see above: buffer zone, wildlife areas, areas surrounded by contamination).
- Large sites not scheduled to complete cleanup activities until well after 2006.

Therefore, a number of key assumptions were made to compensate for the information shortcomings. To address portions that are much larger than the actual area of contamination, the surface areas of contaminated media were used. The surface area of contaminated media (soil, groundwater, surface water/sediment, engineered units, and facilities) was collected in the NDAA Data Call to provide a more exact reference to areas of residual contamination. This collection affected three portions at the Hanford Site, which are wildlife areas:

- The Wahluke Slope was assumed to be 518 acres of contaminated soil rather than 88,000 acres, which is an ecological management unit.
- The Arid Land Ecology Reserve was assumed to be two acres of soil contamination rather than the 76,000 acres, which is an ecological management unit.
- The Riverlands was assumed to be five acres of soil contamination rather than 8,600 acres, which is an ecological management unit.

Because the NDAA Data Call focused on sites or portions of sites to be complete by 2006, many large sites scheduled to have ongoing remediation well into the future were not adequately represented for long-term stewardship acreage. To compensate for the scope of the Report to Congress, assumptions were made for the Idaho Engineering and Environmental Laboratory, the Nevada Test Site, and the Savannah River Site. External data sources were required for this information. The assumptions used in the acreage assessments (Exhibits 3-7 and 3-8) are as follows:

- In 2018 (when the site remediation is scheduled to be complete), 23,000 acres were added for the Nevada Test Site to fully account for surface plutonium contamination (if regulatory limits are 40

PiCu/g) not captured in the Report to Congress.[51]

- In 2030 (when the site remediation is scheduled to be complete), 21,000 acres were inserted for the Savannah River Site to fully account for contaminated industrial areas, infrastructure, and ponds not captured in the Report to Congress.[52]
- In 2050 (when the site remediation is scheduled to be complete), 10,000 acres were inserted for the Idaho Engineering and Environmental Laboratory to account for planned, environmentally-controlled areas, not captured in the Report to Congress.[53]

Other key assumptions:

- The Idaho Engineering and Environmental Laboratory's Ordnance Area is the single largest contiguous area subject to long-term stewardship, covering nearly 210,000 acres. This portion is not entirely contaminated and contains "islands" of clean land. However, the area has not been fully characterized, and it is difficult to know the exact extent of contamination. Additionally, the entire area has access restrictions. Therefore, the entire 210,000 acres are considered to be subject to long-term stewardship activities.
- Amchitka Island is 74,000 acres. The area of contamination and associated use restrictions is considerably smaller than the size of the entire island. However, characterization of the island is not complete. Until spatial information can be updated, the Amchitka Island site will be treated as a 74,000 acres site subject to long-term stewardship.
- Acreage for the 21 FUSRAP sites transferred to the Corps in 1997 for remediation were not included in the land-use estimates because the extent of long-term stewardship is currently unknown.

[51] "Cost/Risk/Benefits Analysis of Alternative Clean-up Requirements for Plutonium Contaminated Soils on and Near the Nevada Test Site", DOE/NV-399, May 1995.

[52] Data for the Savannah River Site are based on the assumption that five percent of the site acreage is developed and will require access restrictions.

[53] "The Idaho National Engineering and Environmental Laboratory Land Use Plan," 1996.

APPENDIX D:SITE LISTS BY CLEANUP COMPLETION YEAR[54]

This appendix organizes the 129 sites (entire site or portion of a site) where DOE may have long-term stewardship responsibility into four tables based on remediation completion year.

Table D-1. Remediation of Entire Site Complete by End of 2000

State	*Site Name*	*Site Type**
California	Sandia National Laboratories-CA	Research, Development, & Testing
Colorado	Bodo Canyon Cell	Uranium Mining, Milling, & Refining
	Burro Canyon Disposal Cell	Uranium Mining, Milling, & Refining
	Cheney Disposal Cell	Uranium Mining, Milling, & Refining
	Estes Gulch Disposal Cell	Uranium Mining, Milling, & Refining
	Fort St. Vrain	Other
	Gunnison Disposal Cell	Uranium Mining, Milling, & Refining
	Maybell Mill Site	Uranium Mining, Milling, & Refining
	Naturita Site	Uranium Mining, Milling, & Refining
	Naval Oil Shale Reserves Site	Fossil Energy
Idaho	Lowman Site	Uranium Mining, Milling, & Refining
Illinois	Fermi National Accelerator Laboratory	Research, Development, & Testing
	Palos Forest (Site A/Plot M) Preserve	Other
Nebraska	Hallam Nuclear Power Facility	Other
New Jersey	Princeton Plasma Physics Laboratory	Research, Development, & Testing
New Mexico	Ambrosia Lake Site	Uranium Mining, Milling, & Refining
	Bayo Canyon	Other
	Bluewater Site	Uranium Mining, Milling, & Refining
	Lovelace Respiratory Research Institute	Research, Development, & Testing
Ohio	Piqua Nuclear Power Facility	Other
Oregon	Lakeview Mill	Uranium Mining, Milling, & Refining
	Lakeview Site	Uranium Mining, Milling, & Refining
Pennsylvania	Burrell Site	Uranium Mining, Milling, & Refining
	Canonsburg Site	Uranium Mining, Milling, & Refining
Puerto Rico	Center for Energy and Environmental Research	Research, Development, & Testing
South Dakota	Edgemont Site	Uranium Mining, Milling, & Refining
Texas	Falls City Site	Uranium Mining, Milling, & Refining
Utah	Mexican Hat Site	Uranium Mining, Milling, & Refining
	Salt Lake City Mill	Uranium Mining, Milling, & Refining

[54] In some cases, the cleanup of the site's surface has been completed, but subsurface remediation (e.g., groundwater characterization and cleanup) has not yet been completed. For the purpose of this Report, completed surface remediation requiring long-term stewardship is identified separately from the long-term stewardship required for subsurface contamination. The long-term stewardship activities for the entire site (i.e., both surface and subsurface) may be managed and budgeted as part of ongoing cleanup activities, rather than as distinct activities.

Table D-1. Remediation of Entire Site Complete by End of 2000

State	*Site Name*	*Site Type**
	South Clive Disposal Cell	Uranium Mining, Milling, & Refining
Washington	(WNI) Sherwood Site	Uranium Mining, Milling, & Refining
West Virginia	Parkersburg Site	Other
Wyoming	Riverton Site	Uranium Mining, Milling, & Refining
	Spook Site	Uranium Mining, Milling, & Refining
Subtotal of entire sites to have completed remediation by the end of 2000:		**34**

* Site Type is referenced from *Linking Legacies: Connecting the Cold War Nuclear Weapons Production Processes to Their Environmental Consequences*, DOE/EM #97-2392, January 1997.

Table D-2. Remediation of Entire Site Expected to be Complete by End of 2006

State	Site Name	Site Type*
Alaska	Amchitka Island	Research, Development, & Testing
California	Lawrence Berkeley National Laboratory	Research, Development, & Testing
	Stanford Linear Accelerator	Research, Development, & Testing
Colorado	Grand Junction Mill 1	Uranium Mining, Milling, & Refining
	Grand Junction Mill 2	Uranium Mining, Milling, & Refining
	Gunnison Mill	Uranium Mining, Milling, & Refining
	(HECLA) Durita Site	Uranium Mining, Milling, & Refining
	Rocky Flats Environmental Technology Site	Component Fabrication
	(UMETCO) Maybell Site 2	Uranium Mining, Milling, & Refining
Illinois	Argonne National Laboratory East	Research, Development, & Testing
Mississippi	Salmon Site	Research, Development, & Testing
Missouri	Kansas City Plant	Component Fabrication
	Weldon Spring Site	Uranium Mining, Milling, & Refining
New Mexico	(SOHIO) LBAR Site	Uranium Mining, Milling, & Refining
	Sandia National Laboratories - NM	Research, Development, & Testing/Weapons Operations
Ohio	Miamisburg Environmental Management Project	Component Fabrication
Texas	(Chevron) Panna Maria Site	Uranium Mining, Milling, & Refining
	(Conoco) Conquista Site	Uranium Mining, Milling, & Refining
	(Exxon) Ray Point Site	Uranium Mining, Milling, & Refining
	Pantex Plant	Component Fabrication/Weapons Operations
Utah	(Atlas) Moab Mill	Uranium Mining, Milling, & Refining
	Monticello Mill Site and Vicinity Properties	Uranium Mining, Milling, & Refining
Wyoming	(ANC) Gas Hills Site	Uranium Mining, Milling, & Refining
	(Exxon) Highlands Site	Uranium Mining, Milling, & Refining
	Hoe Creek Underground Coal Gasification Site	Fossil Energy
	Naval Petroleum Reserve No. 3 Landfill/Landfarm	Fossil Energy
	(Pathfinder) Lucky Mc Site	Uranium Mining, Milling, & Refining
	(Pathfinder) Shirley Basin Site 2	Uranium Mining, Milling, & Refining
	(Petrotomics) Shirley Basin Site 1	Uranium Mining, Milling, & Refining
	Rock Springs Oil Shale Retort Site	Fossil Energy
	(UMETCO) Gas Hills Site	Uranium Mining, Milling, & Refining
	(Union Pacific) Bear Creek Site	Uranium Mining, Milling, & Refining
	(WNI) Split Rock Site	Uranium Mining, Milling, & Refining
Subtotal of entire sites expected to have completed remediation by 2006:		**33**

* Site Type is referenced from *Linking Legacies: Connecting the Cold War Nuclear Weapons Production Processes to Their Environmental Consequences*, DOE/EM #97-2392, January 1997.

Table D-3. Remediation of Entire Site Expected to be Partially Complete (Portion(s) Complete) by End of 2006

State	*Site Name*	*Site Type**
Arizona	Monument Valley Site[a]	Uranium Mining, Milling, & Refining
	Tuba City Site[a]	Uranium Mining, Milling, & Refining
California	Lawrence Livermore National Laboratory - Livermore Site	Research, Development, & Testing
	Lawrence Livermore National Laboratory - Site 300	Research, Development, & Testing
New York	Brookhaven National Laboratory	Research, Development, & Testing
Colorado	Durango Mill[a]	Uranium Mining, Milling, & Refining
	Naturita Mill[a]	Uranium Mining, Milling, & Refining
	Rifle (New) Mill[a]	Uranium Mining, Milling, & Refining
	Rifle (Old) Mill[a]	Uranium Mining, Milling, & Refining
	Rio Blanco[a]	Research, Development, & Testing
	Rulison[a]	Research, Development, & Testing
	Slick Rock (North Continent) Mill 1[a]	Uranium Mining, Milling, & Refining
	Slick Rock (Union Carbide) Mill 2[a]	Uranium Mining, Milling, & Refining
Florida	Pinellas STAR Center[b]	Component Fabrication
Idaho	Idaho National Engineering and Environmental Laboratory	Chemical Separation
Kentucky	Paducah Gaseous Diffusion Plant	Isotope Separation
Nevada	Central Nevada Test Area[a]	Research, Development, & Testing
	Nevada Test Site[c]	Research, Development, & Testing
	Project Shoal[a]	Research, Development, & Testing
New Mexico	Gasbuggy Site[a]	Research, Development, & Testing
	Gnome-Coach[a]	Research, Development, & Testing
	Los Alamos National Laboratory	Research, Development, & Testing/Weapons Operations/Component Fabrication
	Shiprock Site[a]	Uranium Mining, Milling, & Refining
Ohio	Fernald Environmental Management Project	Uranium Mining, Milling, & Refining/Fuel & Target Fabrication
	Portsmouth Gaseous Diffusion Plant	Isotope Separation
South Carolina	Savannah River Site	Fuel & Target Fabrication (deactivation only)
Tennessee	Oak Ridge Reservation	Isotope Separation/Production Reactor Operations/Component Fabrication
Utah	Green River Site[a]	Uranium Mining, Milling, & Refining
Washington	Hanford Site	Fuel & Target Fabrication/Production Reactor Operations/Chemical Separations/Component Fabrication
Subtotal of entire sites expected to be partially complete by 2006:		**29**

* Site Type is referenced from *Linking Legacies: Connecting the Cold War Nuclear Weapons Production Processes to Their Environmental Consequences*, DOE/EM #97-2392, January 1997.

[a] For the remediation of sites, DOE distinguishes the surface from subsurface activity. The long-term stewardship start date reflects

the completion of surface remediation. However, characterization of subsurface contamination will continue well beyond 2006. Therefore, this site is considered to be partially complete by 2006.

[b] Surface cleanup activities were completed in 1999 to unrestricted use. No active long-term stewardship activities are being performed or planned for the surface other than record-keeping activities. However, groundwater remediation is ongoing and is anticipated to continue until 2014. Therefore, this site is considered to be partially complete by 2006.

[c] The indicated date reflects when all soil sites are planned to be remediated and long-term stewardship activities are expected to be performed for the soil sites. However, significant remediation progress has been made at the site that currently requires some level of long-term stewardship activities.

Table D-4. Sites Where DOE May Be Responsible for Long-Term Stewardship, if Long-Term Stewardship is Required*

State	*Site Name*	*Site Type***
Colorado	(Cotter) Cañon City Site	Uranium Mining, Milling, & Refining/Fuel & Target Fabrication
	(UMETCO) Uravan Site	Uranium Mining, Milling, & Refining/Fuel & Target Fabrication
Connecticut	CE	FUSRAP
Illinois	Madison	FUSRAP
Maryland	W.R. Grace and Company	FUSRAP
Massachusetts	Shpack Landfill	FUSRAP
Missouri	Latty Avenue Properties	FUSRAP
	St. Louis Airport Site	FUSRAP
	St. Louis Airport Site Vicinity Properties	FUSRAP
	St. Louis Downtown Site	FUSRAP
New Jersey	DuPont & Company	FUSRAP
	Maywood Chemical Works	FUSRAP
	Middlesex Sampling Plant	FUSRAP
	Wayne Site	FUSRAP
New Mexico	(Homestake) Grants Site	Uranium Mining, Milling, & Refining/Fuel & Target Fabrication
	(Quivira) Ambrosia Lake Site 2	Uranium Mining, Milling, & Refining/Fuel & Target Fabrication
	(UNC) Church Rock Site	Uranium Mining, Milling, & Refining/Fuel & Target Fabrication
	Waste Isolation Pilot Plant	Repository
New York	Ashland Oil #1	FUSRAP
	Ashland Oil #2	FUSRAP
	Bliss and Laughlin Steel	FUSRAP
	Colonie	FUSRAP
	Linde Air Products	FUSRAP
	Niagara Falls Storage Site	FUSRAP
	Seaway Industrial Park	FUSRAP
Ohio	Luckey	FUSRAP
	Painesville	FUSRAP
Utah	(EFN) White Mesa Site	Uranium Mining, Milling, & Refining/Fuel & Target Fabrication
	(Plateau) Shootaring Canyon Site	Uranium Mining, Milling, & Refining/Fuel & Target Fabrication
	(Rio Algom) Lisbon Valley Site	Uranium Mining, Milling, & Refining/Fuel & Target Fabrication
	11 (e) 2 Disposal Site	Disposal Site

State	*Site Name*	*Site Type***	
Washington	(Dawn) Ford Site	Uranium Mining, Milling, & Refining/Fuel & Target Fabrication	
Wyoming	(Kennecott) Sweetwater Site	Uranium Mining, Milling, & Refining/Fuel & Target Fabrication	
Subtotal of sites where DOE anticipates long-term stewardship responsibility after 2006:			**33**
Total number of sites:			**129**

* Cleanup responsibility for these 21 FUSRAP sites has been assigned to the U.S. Army Corps of Engineers. DOE and the Corps signed a Memorandum of Understanding (MOU) in March 1999, that assigns responsibility to DOE for any required long-term stewardship. However, cleanup decisions for these sites are not yet final, and, therefore, the level of long-term stewardship required for these sites, if any, is not yet known. For the purpose of this Report, all 21 FUSRAP sites are categorized along with 12 additional sites where DOE may be responsible for long-term stewardship activities (see Section 3.2).
** Site Type is referenced from *Linking Legacies: Connecting the Cold War Nuclear Weapons Production Processes to Their Environmental Consequences*, DOE/EM #97-2392, January 1997.

APPENDIX E: PROJECTED LONG-TERM STEWARDSHIP COSTS FOR YEARS 2000, 2006, AND 2050*

Appendix E provides a simple summary of expected costs by providing a "snapshot" of the costs for each site for years 2000, 2006, and 2050. As discussed in Section 3.4, the analysis for this Report focuses on cost data reported for 2000 through 2006. Annual costs for 2050 are shown in this appendix, but are considered rough estimates. These tables are provided in Appendix E: Table E-1. Long-Term Stewardship Costs by State for Years 2000, 2006, and 2050, Table E-2. Long-Term Stewardship Costs by Site for Years 2000, 2006, and 2050 (by Site), Table E-3. Long-Term Stewardship Costs by Operations/Program Office for Years 2000, 2006, and 2050.

Table E-1. Long-Term Stewardship Costs by State for Years 2000, 2006, and 2050

FY 2000		*FY 2006*		*FY 2050***	
Site	*Cost (in 000s)*	*Site*	*Cost (in 000s)*	*Site*	*Cost (in 000s)*
Alaska Sites	**0**	**Alaska Sites**	**0**	**Alaska Sites**	**0**
Amchitka Island	0	Amchitka Island	0	Amchitka Island	43
Arizona Sites	**33**	**Arizona Sites**	**63**	**Arizona Sites**	**33**
Tuba City Site	33	Tuba City Site	63	Tuba City Site	35
Monument Valley Site	0	Monument Valley Site	0	Monument Valley Site	30
California Sites	**84**	**California Sites**	**1,763**	**California Sites**	**338**
Sandia National Laboratories - CA	84	Lawrence Berkeley National Laboratory	1,179	Lawrence Livermore National Laboratory - Livermore Site	140
Lawrence Berkeley National Laboratory	0	Stanford Linear Accelerator	500	Stanford Linear Accelerator	100
Lawrence Livermore National Laboratory - Livermore Site	0	Sandia National Laboratories - CA	84	Sandia National Laboratories - CA	84
Lawrence Livermore National Laboratory - Site 300	0	Lawrence Livermore National Laboratory - Livermore Site	0	Lawrence Livermore National Laboratory - Site 300	14
Stanford Linear Accelerator	0	Lawrence Livermore National Laboratory - Site 300	0	Lawrence Berkeley National Laboratory	0
Colorado Sites	**3,947**	**Colorado Sites**	**3,992**	**Colorado Sites**	**6,633**
Fort St. Vrain	3,000	Fort St. Vrain	3,000	Rocky Flats Environmental Technology Site	5,959
Cheney Disposal Cell	575	Cheney Disposal Cell	439	(Cotter) Cañon City Site	171
Bodo Canyon Cell	107	Grand Junction Mill 2	121	Grand Junction Mill 2	128
Burro Canyon Disposal Cell	64	Bodo Canyon Cell	119	Rio Blanco	54
Grand Junction Mill 1	50	Burro Canyon Disposal Cell	63	Rulison	54
Gunnison Disposal Cell	37	Gunnison Disposal Cell	40	(UMETCO) Uravan Site	51
Rio Blanco	27	Rio Blanco	40	Bodo Canyon Cell	50

Table E-1. Long-Term Stewardship Costs by State for Years 2000, 2006, and 2050

FY 2000		*FY 2006*		*FY 2050***	
Site	*Cost (in 000s)*	*Site*	*Cost (in 000s)*	*Site*	*Cost (in 000s)*
Rulison	27	Rulison	40	Burro Canyon Disposal Cell	26
Estes Gulch Disposal Cell	24	Estes Gulch Disposal Cell	36	Maybell Mill Site	26
Naturita Site	23	Maybell Mill Site	26	(UMETCO) Maybell Site 2	26
(HECLA) Durita Site	4	(UMETCO) Maybell Site 2	26	Cheney Disposal Cell	24
(UMETCO) Maybell Site 2	4	Naturita Site	24	Gunnison Disposal Cell	16
Naval Oil Shale Reserves Site	3	(HECLA) Durita Site	11	Estes Gulch Disposal Cell	14
Maybell Mill Site	2	Grand Junction Mill 1	4	(HECLA) Durita Site	10
(Cotter) Cañon City Site	0	Naval Oil Shale Reserves Site	3	Naturita Site	9
Durango Mill	0	(Cotter) Cañon City Site	0	Grand Junction Mill 1	5
Grand Junction Mill 2	0	Durango Mill	0	Naval Oil Shale Reserves Site	4
Gunnison Mill	0	Gunnison Mill	0	Slick Rock (North Continent) Mill 1	2
Naturita Mill	0	Naturita Mill	0	Durango Mill	1
Rifle (New) Mill	0	Rifle (New) Mill	0	Naturita Mill	1
Rifle (Old) Mill	0	Rifle (Old) Mill	0	Rifle (New) Mill	1
Rocky Flats Environmental Technology Site	0	Rocky Flats Environmental Technology Site	0	Slick Rock (Union Carbide) Mill 2	1
Slick Rock (North Continent) Mill 1	0	Slick Rock (North Continent) Mill 1	0	Fort St. Vrain	0
Slick Rock (Union Carbide) Mill 2	0	Slick Rock (Union Carbide) Mill 2	0	Gunnison Mill	0
(UMETCO) Uravan Site	0	(UMETCO) Uravan Site	0	Rifle (Old) Mill	0
Florida Sites	**0**	**Florida Sites**	**0**	**Florida Sites**	**0**
Pinellas STAR Center	0	Pinellas STAR Center	0	Pinellas STAR Center	0
Idaho Sites	**40**	**Idaho Sites**	**4,259**	**Idaho Sites**	**2,424**
Lowman Site	40	Idaho National Engineering and Environmental Laboratory	4,200	Idaho National Engineering and Environmental Laboratory	2,400
Idaho National Engineering and Environmental Laboratory	0	Lowman Site	59	Lowman Site	24
Illinois Sites	**320**	**Illinois Sites**	**733**	**Illinois Sites**	**170**
Palos Forest (Site A/Plot M) Preserve	170	Argonne National Laboratory East	413	Palos Forest (Site A/Plot M) Preserve	170
Fermi National Accelerator Laboratory	150	Palos Forest (Site A/Plot M) Preserve	170	Argonne National Laboratory East	0

Table E-1. Long-Term Stewardship Costs by State for Years 2000, 2006, and 2050

FY 2000		*FY 2006*		*FY 2050***	
Site	*Cost (in 000s)*	*Site*	*Cost (in 000s)*	*Site*	*Cost (in 000s)*
Argonne National Laboratory East	0	Fermi National Accelerator Laboratory	150	Fermi National Accelerator Laboratory	0
Kentucky Sites	**6,599**	**Kentucky Sites**	**4,757**	**Kentucky Sites**	**8,716**
Paducah Gaseous Diffusion Plant	6,599	Paducah Gaseous Diffusion Plant	4,757	Paducah Gaseous Diffusion Plant	8,716
Mississippi Sites	**180**	**Mississippi Sites**	**40**	**Mississippi Sites**	**55**
Salmon Site	180	Salmon Site	40	Salmon Site	55
Missouri Sites	**0**	**Missouri Sites**	**2,510**	**Missouri Sites**	**2,275**
Kansas City Plant	0	Kansas City Plant	1,504	Kansas City Plant	1,269
Weldon Spring Site	0	Weldon Spring Site	1,006	Weldon Spring Site	1,006
Nebraska Sites	**44**	**Nebraska Sites**	**31**	**Nebraska Sites**	**32**
Hallam Nuclear Power Facility	44	Hallam Nuclear Power Facility	31	Hallam Nuclear Power Facility	32
Nevada Sites	**2,056**	**Nevada Sites**	**2,235**	**Nevada Sites**	**3,043**
Nevada Test Site	2,023	Nevada Test Site	2,155	Nevada Test Site	2,934
Central Nevada Test Area	17	Central Nevada Test Area	40	Project Shoal	55
Project Shoal	16	Project Shoal	40	Central Nevada Test Area	54
New Jersey Sites	**273**	**New Jersey Sites**	**281**	**New Jersey Sites**	**0**
Princeton Plasma Physics Laboratory	273	Princeton Plasma Physics Laboratory	281	Princeton Plasma Physics Laboratory	0
New Mexico Sites	**316**	**New Mexico Sites**	**1,393**	**New Mexico Sites**	**12,519**
Lovelace Respiratory Research Institute	140	Sandia National Laboratories - NM	1,000	Waste Isolation Pilot Plant	10,556
Shiprock Site	57	Lovelace Respiratory Research Institute	140	Sandia National Laboratories - NM	920
Bluewater Site	41	Shiprock Site	103	Los Alamos National Laboratory	700
Gasbuggy Site	28	Gasbuggy Site	40	Gasbuggy Site	59
Gnome-Coach	28	Gnome-Coach	40	Shiprock Site	59
(SOHIO) LBAR Site	17	(SOHIO) LBAR Site	35	Gnome-Coach	54
Ambrosia Lake Site	4	Ambrosia Lake Site	21	(UNC) Church Rock Site	43
Bayo Canyon	1	Bluewater Site	13	(Quivira) Ambrosia Lake Site 2	34
(Homestake) Grants Site	0	Bayo Canyon	1	(SOHIO) LBAR Site	34
Los Alamos National Laboratory	0	(Homestake) Grants Site	0	(Homestake) Grants Site	26
(Quivira) Ambrosia Lake Site 2	0	Los Alamos National Laboratory	0	Ambrosia Lake Site	20

Table E-1. Long-Term Stewardship Costs by State for Years 2000, 2006, and 2050

FY 2000		*FY 2006*		*FY 2050***	
Site	*Cost (in 000s)*	*Site*	*Cost (in 000s)*	*Site*	*Cost (in 000s)*
Sandia National Laboratories - NM	0	(Quivira) Ambrosia Lake Site 2	0	Bluewater Site	13
(UNC) Church Rock Site	0	(UNC) Church Rock Site	0	Bayo Canyon	1
Waste Isolation Pilot Plant	0	Waste Isolation Pilot Plant	0	Lovelace Respiratory Research Institute	0
New York Sites	**0**	**New York Sites**	**0**	**New York Sites**	**0**
Brookhaven National Laboratory	0	Brookhaven National Laboratory	0	Brookhaven National Laboratory	0
Ohio Sites	**6,784**	**Ohio Sites**	**6,059**	**Ohio Sites**	**3,373**
Portsmouth Gaseous Diffusion Plant	6,764	Portsmouth Gaseous Diffusion Plant	6,041	Fernald Environmental Management Project	1,928
Piqua Nuclear Power Facility	20	Piqua Nuclear Power Facility	18	Portsmouth Gaseous Diffusion Plant	1,395
Fernald Environmental Management Project	0	Fernald Environmental Management Project	0	Miamisburg Environmental Management Project	50
Miamisburg Environmental Management Project	0	Miamisburg Environmental Management Project	0	Piqua Nuclear Power Facility	0
Oregon Sites	**376**	**Oregon Sites**	**83**	**Oregon Sites**	**36**
Lakeview Mill	260	Lakeview Site	83	Lakeview Site	34
Lakeview Site	116	Lakeview Mill	0	Lakeview Mill	2
Pennsylvania	**634**	**Pennsylvania**	**102**	**Pennsylvania**	**41**
Canonsburg Site	577	Canonsburg Site	62	Canonsburg Site	25
Burrell Site	57	Burrell Site	40	Burrell Site	16
Puerto Rico Sites	**25**	**Puerto Rico Sites**	**25**	**Puerto Rico Sites**	**25**
Center for Energy and Environmental Research	25	Center for Energy and Environmental Research	25	Center for Energy and Environmental Research	25
South Carolina Sites	**35,011**	**South Carolina Sites**	**25,779**	**South Carolina Sites**	**5,607**
Savannah River Site***	35,011	Savannah River Site***	25,779	Savannah River Site***	5,607
South Dakota Sites	**11**	**South Dakota Sites**	**7**	**South Dakota Sites**	**7**
Edgemont Site	11	Edgemont Site	7	Edgemont Site	7
Tennessee Sites	**6,394**	**Tennessee Sites**	**7,508**	**Tennessee Sites**	**15,987**
Oak Ridge Reservation	6,394	Oak Ridge Reservation	7,508	Oak Ridge Reservation	15,987
Texas Sites	**107**	**Texas Sites**	**1,605**	**Texas Sites**	**1,669**
Falls City Site	82	Pantex Plant	1,374	Pantex Plant	1,513
(Exxon) Ray Point Site	15	Falls City Site	118	(Conoco) Conquista Site	51
(Chevron) Panna Maria Site	5	(Conoco) Conquista Site	52	Falls City Site	45
(Conoco) Conquista Site	5	(Chevron) Panna Maria Site	35	(Chevron) Panna Maria Site	34
Pantex Plant	0	(Exxon) Ray Point Site	26	(Exxon) Ray Point Site	26

Table E-1. Long-Term Stewardship Costs by State for Years 2000, 2006, and 2050

FY 2000		*FY 2006*		*FY 2050***	
Site	*Cost (in 000s)*	*Site*	*Cost (in 000s)*	*Site*	*Cost (in 000s)*
Utah Sites	**257**	**Utah Sites**	**743**	**Utah Sites**	**696**
Mexican Hat Site	118	Monticello Mill Site and Vicinity Properties	510	Monticello Mill Site and Vicinity Properties	520
Salt Lake City Mill	84	Mexican Hat Site	113	Mexican Hat Site	45
Green River Site	41	Green River Site	75	Green River Site	28
South Clive Disposal Cell	14	South Clive Disposal Cell	28	(EFN) White Mesa Site	26
(Atlas) Moab Mill	0	(Atlas) Moab Mill	17	(Rio Algom) Lisbon Valley Site	26
(EFN) White Mesa Site	0	(EFN) White Mesa Site	0	(Plateau) Shootaring Canyon Site	24
Monticello Mill Site and Vicinity Properties	0	(Plateau) Shootaring Canyon Site	0	(Atlas) Moab Mill	16
(Plateau) Shootaring Canyon Site	0	(Rio Algom) Lisbon Valley Site	0	South Clive Disposal Cell	11
(Rio Algom) Lisbon Valley Site	0	Salt Lake City Mill	0	Salt Lake City Mill	0
11(2)e Disposal Site	0	11(2)e Disposal Site	0	11(2)e Disposal Site	0
Washington Sites	**100**	**Washington Sites**	**97**	**Washington Sites**	**36,921**
(WNI) Sherwood Site	53	Hanford Site	62	Hanford Site	36,716
Hanford Site	47	(WNI) Sherwood Site	35	(Dawn) Ford Site	171
(Dawn) Ford Site	0	(Dawn) Ford Site	0	(WNI) Sherwood Site	34
West Virginia Sites	**16**	**West Virginia Sites**	**15**	**West Virginia Sites**	**18**
Parkersburg Site	16	Parkersburg Site	15	Parkersburg Site	18
Wyoming Sites	**36**	**Wyoming Sites**	**897**	**Wyoming Sites**	**290**
(Union Pacific) Bear Creek Site	19	Rock Springs Oil Shale Retort Site	334	(Pathfinder) Lucky Mc Site	34
Spook Site	13	Hoe Creek Underground Coal Gasification Site	273	(Pathfinder) Shirley Basin Site 2	34
(ANC) Gas Hills Site	4	(Pathfinder) Lucky Mc Site	35	(Petrotomics) Shirley Basin Site 1	34
(Exxon) Highlands Site	0	(Pathfinder) Shirley Basin Site 2	35	(Union Pacific) Bear Creek Site	34
Hoe Creek Underground Coal Gasification Site	0	(Petrotomics) Shirley Basin Site 1	35	(WNI) Split Rock Site	34
(Kennecott) Sweetwater Site	0	(UMETCO) Gas Hills Site	35	(UMETCO) Gas Hills Site	34
Naval Petroleum Reserve No. 3 Landfill/Landfarm	0	(Union Pacific) Bear Creek Site	35	(Exxon) Highlands Site	26
(Pathfinder) Lucky Mc Site	0	(WNI) Split Rock Site	35	(Kennecott) Sweetwater Site	26

Table E-1. Long-Term Stewardship Costs by State for Years 2000, 2006, and 2050

FY 2000		*FY 2006*		*FY 2050***	
Site	*Cost (in 000s)*	*Site*	*Cost (in 000s)*	*Site*	*Cost (in 000s)*
(Pathfinder) Shirley Basin Site 2	0	(Exxon) Highlands Site	26	(ANC) Gas Hills Site	20
(Petrotomics) Shirley Basin Site 1	0	Spook Site	24	Spook Site	10
Riverton Site	0	(ANC) Gas Hills Site	21	Naval Petroleum Reserve No. 3 Landfill/Landfarm	3
Rock Springs Oil Shale Retort Site	0	Riverton Site	6	Riverton Site	1
(UMETCO) Gas Hills Site	0	Naval Petroleum Reserve No. 3 Landfill/Landfarm	3	Hoe Creek Underground Coal Gasification Site	0
(WNI) Split Rock Site	0	(Kennecott) Sweetwater Site	0	Rock Springs Oil Shale Retort Site	0

* Costs are in thousands of constant 2000 dollars.
** Because post-2010 costs were reported in five-year periods, costs for 2050 were calculated by averaging the costs for years 2046-2050.
***Long-term stewardship cost estimates for the Savannah River Site in South Carolina do not include any activities scheduled to begin after 2006. At this time, these activities are not well known and cost estimates are not included in this Report. Therefore, post-2006 cost estimates provided in this section are likely to underestimate the Department's long-term cost obligations.

Table E-2. Long-Term Stewardship Costs by Site for Years 2000, 2006, and 2050

FY 2000		*FY 2006*		*FY 2050***	
Site	*Cost (in 000s)*	*Site*	*Cost (in 000s)*	*Site*	*Cost (in 000s)*
Savannah River Site***	$35,001	Savannah River Site***	$25,779	Hanford Site	$36,716
Portsmouth Gaseous Diffusion Plant	$6,764	Oak Ridge Reservation	$7,508	Oak Ridge Reservation	$15,987
Paducah Gaseous Diffusion Plant	$6,599	Portsmouth Gaseous Diffusion Plant	$6,041	Waste Isolation Pilot Plant	$10,556
Oak Ridge Reservation	$6,394	Paducah Gaseous Diffusion Plant	$4,757	Paducah Gaseous Diffusion Plant	$8,716
Fort St. Vrain	$3,000	Idaho National Engineering and Environmental Laboratory	$4,200	Rocky Flats Environmental Technology Site	$5,959
Nevada Test Site	$2,023	Fort St. Vrain	$3,000	Savannah River Site***	$5,607
Canonsburg Site	$577	Nevada Test Site	$2,155	Nevada Test Site	$2,934
Cheney Disposal Cell	$576	Kansas City Plant	$1,504	Idaho National Engineering and Environmental Laboratory	$2,400
Princeton Plasma Physics Laboratory	$273	Pantex Plant	$1,374	Fernald Environmental Management Project	$1,928
Lakeview Mill	$260	Lawrence Berkeley National Laboratory	$1,179	Pantex Plant	$1,513
Salmon Site	$180	Weldon Spring Site	$1,006	Portsmouth Gaseous Diffusion Plant	$1,395
Palos Forest (Site A/Plot M) Preserve	$170	Sandia National Laboratories - NM	$1,000	Kansas City Plant	$1,269
Fermi National Accelerator Laboratory	$150	Monticello Mill Site and Vicinity Properties	$510	Weldon Spring Site	$1,006
Lovelace Respiratory Research Institute	$140	Stanford Linear Accelerator	$500	Sandia National Laboratories - NM	$920
Mexican Hat	$118	Cheney Disposal Cell	$439	Los Alamos National Laboratory	$700
Lakeview Site	$116	Argonne National Laboratory East	$413	Monticello Mill Site and Vicinity Properties	$520
Bodo Canyon Cell	$107	Rock Springs Oil Shale Retort Site	$334	(Cotter) Cañon City Site	$171
Salt Lake City Mill	$84	Princeton Plasma Physics Laboratory	$281	(Dawn) Ford Site	$171
Sandia National Laboratories - CA	$84	Hoe Creek Underground Coal Gasification Site	$273	Palos Forest (Site A/Plot M) Preserve	$170
Falls City Site	$82	Palos Forest (Site A/Plot M) Preserve	$170	Lawrence Livermore National Laboratory - Livermore Site	$140
Burro Canyon Disposal Cell	$64	Fermi National Accelerator Laboratory	$150	Grand Junction Mill 2	$128
Burrell Site	$57	Lovelace Respiratory Research Institute	$140	Stanford Linear Accelerator	$100

Table E-2. Long-Term Stewardship Costs by Site for Years 2000, 2006, and 2050

FY 2000		*FY 2006*		*FY 2050***	
Site	*Cost (in 000s)*	*Site*	*Cost (in 000s)*	*Site*	*Cost (in 000s)*
Shiprock Site	$57	Grand Junction Mill 2	$121	Sandia National Laboratories - CA	$84
(WNI) Sherwood Site	$53	Bodo Canyon Cell	$119	Gasbuggy Site	$59
Grand Junction Mill 1	$50	Falls City Site	$118	Shiprock Site	$59
Hanford Site	$47	Mexican Hat Site	$113	Project Shoal	$55
Hallam Nuclear Power Facility	$44	Shiprock Site	$103	Salmon Site	$55
Bluewater Site	$41	Sandia National Laboratories - CA	$84	Central Nevada Test Area	$54
Green River Site	$41	Lakeview Site	$83	Gnome-Coach	$54
Lowman Site	$40	Green River Site	$75	Rio Blanco	$54
Gunnison Disposal Cell	$37	Burro Canyon Disposal Cell	$63	Rulison	$54
Tuba City Site	$33	Tuba City Site	$63	(Conoco) Conquista Site	$51
Gasbuggy Site	$28	Canonsburg Site	$62	(UMETCO) Uravan Site	$51
Gnome-Coach	$28	Hanford Site	$62	Bodo Canyon Cell	$50
Rio Blanco	$27	Lowman Site	$59	Miamisburg Environmental Management Project	$50
Rulison	$27	(Conoco) Conquista Site	$52	Falls City Site	$45
Center for Energy and Environmental Research	$25	Burrell Site	$40	Mexican Hat Site	$45
Estes Gulch Disposal Cell	$24	Central Nevada Test Area	$40	Amchitka Island	$43
Naturita Site	$23	Gasbuggy Site	$40	(UNC) Church Rock Site	$43
Piqua Nuclear Power Facility	$20	Gnome-Coach	$40	Tuba City Site	$35
(Union Pacific) Bear Creek Site	$19	Gunnison Disposal Cell	$40	(Chevron) Panna Maria Site	$34
Central Nevada Test Area	$17	Project Shoal	$40	Lakeview Site	$34
(SOHIO) LBAR Site	$17	Rio Blanco	$40	(Pathfinder) Lucky Mc Site	$34
Parkersburg Site	$16	Rulison	$40	(Pathfinder) Shirley Basin Site 2	$34
Project Shoal	$16	Salmon Site	$40	(Petrotomics) Shirley Basin Site 1	$34
(Exxon) Ray Point Site	$15	Estes Gulch Disposal Cell	$36	(Quivira) Ambrosia Lake Site 2	$34
South Clive Disposal Cell	$14	(Chevron) Panna Maria Site	$35	(SOHIO) LBAR Site	$34
Spook Site	$13	(Pathfinder) Lucky Mc Site	$35	(UMETCO) Gas Hills Site	$34
Edgemont Site	$11	(Pathfinder) Shirley Basin Site 2	$35	(Union Pacific) Bear Creek Site	$34
(Chevron) Panna Maria Site	$5	(Petrotomics) Shirley Basin Site 1	$35	(WNI) Sherwood Site	$34

Table E-2. Long-Term Stewardship Costs by Site for Years 2000, 2006, and 2050

FY 2000		*FY 2006*		*FY 2050***	
Site	*Cost (in 000s)*	*Site*	*Cost (in 000s)*	*Site*	*Cost (in 000s)*
(Conoco) Conquista Site	$5	(SOHIO) LBAR Site	$35	(WNI) Split Rock Site	$34
Ambrosia Lake Site	$4	(UMETCO) Gas Hills Site	$35	Hallam Nuclear Power Facility	$32
(ANC) Gas Hills Site	$4	(Union Pacific) Bear Creek Site	$35	Monument Valley Site	$30
(HECLA) Durita Site	$4	(WNI) Sherwood Site	$35	Green River Site	$28
(UMETCO) Maybell Site 2	$4	(WNI) Split Rock Site	$35	Burro Canyon Disposal Cell	$26
Naval Oil Shale Reserves Site	$3	Hallam Nuclear Power Facility	$31	(EFN) White Mesa Site	$26
Maybell Mill Site	$2	South Clive Disposal Cell	$28	(Exxon) Highlands Site	$26
Bayo Canyon	$1	(Exxon) Highlands Site	$26	(Exxon) Ray Point Site	$26
Amchitka Island	$0	(Exxon) Ray Point Site	$26	(Homestake) Grants Site	$26
Argonne National Laboratory East	$0	Maybell Mill Site	$26	(Kennecott) Sweetwater Site	$26
(Atlas) Moab Mill	$0	(UMETCO) Maybell Site 2	$26	Maybell Mill Site	$26
Brookhaven National Laboratory	$0	Center for Energy and Environmental Research	$25	(Rio Algom) Lisbon Valley Site	$26
(Cotter) Cañon City Site	$0	Naturita Site	$24	(UMETCO) Maybell Site 2	$26
(Dawn) Ford Site	$0	Spook Site	$24	Canonsburg Site	$25
Durango Mill	$0	Ambrosia Lake Site	$21	Center for Energy and Environmental Research	$25
(EFN) White Mesa Site	$0	(ANC) Gas Hills Site	$21	Cheney Disposal Cell	$24
(Exxon) Highlands Site	$0	Piqua Nuclear Power Facility	$18	Lowman Site	$24
Fernald Environmental Management Project	$0	(Atlas) Moab Mill	$17	(Plateau) Shootaring Canyon Site	$24
Grand Junction Mill 2	$0	Parkersburg Site	$15	Ambrosia Lake Site	$20
Gunnison Mill	$0	Bluewater Site	$13	(ANC) Gas Hills Site	$20
Hoe Creek Underground Coal Gasification Site	$0	(HECLA) Durita Site	$11	Parkersburg Site	$18
(Homestake) Grants Site	$0	Edgemont Site	$7	(Atlas) Moab Mill	$16
Idaho National Engineering and Environmental Laboratory	$0	Riverton Site	$6	Burrell Site	$16
Kansas City Plant	$0	Grand Junction Mill 1	$4	Gunnison Disposal Cell	$16
(Kennecott) Sweetwater Site	$0	Naval Oil Shale Reserves Site	$3	Estes Gulch Disposal Cell	$14
Lawrence Berkeley National Laboratory	$0	Naval Petroleum Reserve No.3 Landfill/Landfarm	$3	Lawrence Livermore National Laboratory - Site 300	$14

Table E-2. Long-Term Stewardship Costs by Site for Years 2000, 2006, and 2050

FY 2000		*FY 2006*		*FY 2050***	
Site	*Cost (in 000s)*	*Site*	*Cost (in 000s)*	*Site*	*Cost (in 000s)*
Lawrence Livermore National Laboratory - Livermore Site	$0	Bayo Canyon	$1	Bluewater Site	$13
Lawrence Livermore National Laboratory - Site 300	$0	Amchitka Island	$0	South Clive Disposal Cell	$11
Los Alamos National Laboratory	$0	Brookhaven National Laboratory	$0	(HECLA) Durita Site	$10
Miamisburg Environmental Management Project	$0	(Cotter) Cañon City Site	$0	Spook Site	$10
Monticello Mill Site and Vicinity Properties	$0	(Dawn) Ford Site	$0	Naturita Site	$9
Monument Valley Site	$0	Durango Mill	$0	Edgemont Site	$7
Naturita Mill	$0	(EFN) White Mesa Site	$0	Grand Junction Mill 1	$5
Naval Petroleum Reserve No. 3 Landfill/Landfarm	$0	Fernald Environmental Management Project	$0	Naval Oil Shale Reserves Site	$4
Pantex Plant	$0	Gunnison Mill	$0	Naval Petroleum Reserve No. 3 Landfill/Landfarm	$3
(Pathfinder) Lucky Mc Site	$0	(Homestake) Grants Site	$0	Lakeview Mill	$2
(Pathfinder) Shirley Basin Site 2	$0	(Kennecott) Sweetwater Site	$0	Slick Rock (North Continent) Mill 1	$2
(Petrotomics) Shirley Basin Site 1	$0	Lakeview Mill	$0	Bayo Canyon	$1
Pinellas STAR Center	$0	Lawrence Livermore National Laboratory- Livermore Site	$0	Durango Mill	$1
(Plateau) Shootaring Canyon Site	$0	Lawrence Livermore National Laboratory - Site 300	$0	Naturita Mill	$1
(Quivira) Ambrosia Lake Site 2	$0	Los Alamos National Laboratory	$0	Rifle (New) Mill	$1
Rifle (New) Mill	$0	Miamisburg Environmental Management Project	$0	Riverton Site	$1
Rifle (Old) Mill	$0	Monument Valley Site	$0	Slick Rock (Union Carbide) Mill 2	$1
(Rio Algom) Lisbon Valley Site	$0	Naturita Mill	$0	Argonne National Laboratory East	$0
Riverton Site	$0	Pinellas STAR Center	$0	Brookhaven National Laboratory	$0
Rock Springs Oil Shale Retort Site	$0	(Plateau) Shootaring Canyon Site	$0	Fermi National Accelerator Laboratory	$0
Rocky Flats Environmental Technology Site	$0	(Quivira) Ambrosia Lake Site 2	$0	Fort St. Vrain	$0
Sandia National Laboratories - NM	$0	Rifle (New) Mill	$0	Gunnison Mill	$0

Table E-2. Long-Term Stewardship Costs by Site for Years 2000, 2006, and 2050

FY 2000		*FY 2006*		*FY 2050***	
Site	*Cost (in 000s)*	*Site*	*Cost (in 000s)*	*Site*	*Cost (in 000s)*
Slick Rock (North Continent) Mill 1	$0	Rifle (Old) Mill	$0	Hoe Creek Underground Coal Gasification Site	$0
Slick Rock (Union Carbide) Mill 2	$0	(Rio Algom) Lisbon Valley Site	$0	Lawrence Berkeley National Laboratory	$0
Stanford Linear Accelerator	$0	Rocky Flats Environmental Technology Site	$0	Lovelace Respiratory Research Institute	$0
(UMETCO) Gas Hills Site	$0	Salt Lake City Mill	$0	Pinellas STAR Center	$0
(UMETCO) Uravan Site	$0	Slick Rock (North Continent) Mill 1	$0	Piqua Nuclear Power Facility	$0
(UNC) Church Rock Site	$0	Slick Rock (Union Carbide) Mill 2	$0	Princeton Plasma Physics Laboratory	$0
Waste Isolation Pilot Plant	$0	(UMETCO) Uravan Site	$0	Rifle (Old) Mill	$0
Weldon Spring Site	$0	(UNC) Church Rock Site	$0	Rock Springs Oil Shale Retort Site	$0
(WNI) Split Rock Site	$0	Waste Isolation Pilot Plant	$0	Salt Lake City Mill	$0

* Costs are in thousands of constant 2000 dollars.
** Because post-2010 costs were reported in five-year periods, costs for 2050 were calculated by averaging the costs for years 2046-2050.
***Long-term stewardship cost estimates for the Savannah River Site in South Carolina do not include any activities scheduled to begin after 2006. At this time, these activities are not well known and cost estimates are not included in this Report. Therefore, post-2006 cost estimates provided in this section are likely to underestimate the Department's long-term cost obligations.

Table E-3. Long-Term Stewardship Costs by Operations/Program Office for Years 2000, 2006, and 2050

FY 2000		*FY 2006*		*FY 2050***	
Site	*Cost (in 000s)*	*Site*	*Cost (in 000s)*	*Site*	*Cost (in 000s)*
Albuquerque Operations Office Sites	**224**	**Albuquerque Operations Office Sites**	**4,102**	**Albuquerque Operations Office Sites**	**4,486**
Lovelace Respiratory Research Institute	140	Kansas City Plant	1,504	Pantex Plant	1,513
Sandia National Laboratories - CA	84	Pantex Plant	1,374	Kansas City Plant	1,269
Kansas City Plant	0	Sandia National Laboratories - NM	1,000	Sandia National Laboratories - NM	920
Los Alamos National Laboratory	0	Lovelace Respiratory Research Institute	140	Los Alamos National Laboratory	700
Pantex Plant	0	Sandia National Laboratories - CA	84	Sandia National Laboratories - CA	84
Sandia National Laboratories - NM	0	Los Alamos National Laboratory	0	Lovelace Respiratory Research Institute	0
Carlsbad Office	**0**	**Carlsbad Office**	**0**	**Carlsbad Office**	**10,556**
Waste Isolation Pilot Plant	0	Waste Isolation Pilot Plant	0	Waste Isolation Pilot Plant	10,556
Chicago Operations Office	**423**	**Chicago Operations Office**	844	**Chicago Operations Office**	**0**
Princeton Plasma Physics Laboratory	273	Argonne National Laboratory East	413	Argonne National Laboratory East	0
Fermi National Accelerator Laboratory	150	Princeton Plasma Physics Laboratory	281	Brookhaven National Laboratory	0
Argonne National Laboratory East	0	Fermi National Accelerator Laboratory	150	Fermi National Accelerator Laboratory	0
Brookhaven National Laboratory	0	Brookhaven National Laboratory	0	Princeton Plasma Physics Laboratory	0
Fossil Energy	**3**	**Fossil Energy**	**613**	**Fossil Energy**	**7**
Naval Oil Shale Reserves Site	3	Rock Springs Oil Shale Retort Site	334	Naval Oil Shale Reserves Site	4
Hoe Creek Underground Coal Gasification Site	0	Hoe Creek Underground Coal Gasification Site	273	Naval Petroleum Reserve No. 3 Landfill/Landfarm	3
Naval Petroleum Reserve No. 3 Landfill/Landfarm	0	Naval Oil Shale Reserves Site	3	Hoe Creek Underground Coal Gasification Site	0
Rock Springs Oil Shale Retort Site	0	Naval Petroleum Reserve No. 3 Landfill/Landfarm	3	Rock Springs Oil Shale Retort Site	0
Grand Junction Office	**2,806**	**Grand Junction Office**	**3,535**	**Grand Junction Office**	**3,534**
Canonsburg Site	577	Weldon Spring Site	1,006	Weldon Spring Site	1,006
Cheney Disposal Cell	575	Monticello Mill Site and Vicinity Properties	510	Monticello Mill Site and Vicinity Properties	520
Lakeview Mill	260	Cheney Disposal Cell	439	(Cotter) Cañon City Site	171
Palos Forest (Site A/Plot M) Preserve	170	Palos Forest (Site A/Plot M) Preserve	170	(Dawn) Ford Site	171

Table E-3. Long-Term Stewardship Costs by Operations/Program Office for Years 2000, 2006, and 2050

FY 2000		*FY 2006*		*FY 2050***	
Site	*Cost (in 000s)*	*Site*	*Cost (in 000s)*	*Site*	*Cost (in 000s)*
Mexican Hat Site	118	Grand Junction Mill 2	121	Palos Forest (Site A/Plot M) Preserve	170
Lakeview Site	116	Bodo Canyon Cell	119	Grand Junction Mill 2	128
Bodo Canyon Cell	107	Falls City Site	118	Shiprock Site	59
Salt Lake City Mill	84	Mexican Hat Site	113	(Conoco) Conquista Site	51
Falls City Site	82	Shiprock Site	103	(UMETCO) Uravan Site	51
Burro Canyon Disposal Cell	64	Lakeview Site	83	Bodo Canyon Cell	50
Burrell Site	57	Green River Site	75	Falls City Site	45
Shiprock Site	57	Burro Canyon Disposal Cell	63	Mexican Hat Site	45
(WNI) Sherwood Site	53	Tuba City Site	63	(UNC) Church Rock Site	43
Grand Junction Mill 1	50	Canonsburg Site	62	Tuba City Site	35
Hallam Nuclear Power Facility	44	Lowman Site	59	(Chevron) Panna Maria Site	34
Bluewater Site	41	(Conoco) Conquista Site	52	Lakeview Site	34
Green River Site	41	Burrell Site	40	(Pathfinder) Lucky Mc Site	34
Lowman Site	40	Gunnison Disposal Cell	40	(Pathfinder) Shirley Basin Site 2	34
Gunnison Disposal Cell	37	Estes Gulch Disposal Cell	36	(Petrotomics) Shirley Basin Site 1	34
Tuba City Site	33	(Chevron) Panna Maria Site	35	(Quivira) Ambrosia Lake Site 2	34
Estes Gulch Disposal Cell	24	(Pathfinder) Lucky Mc Site	35	(SOHIO) LBAR Site	34
Naturita Site	23	(Pathfinder) Shirley Basin Site 2	35	(UMETCO) Gas Hills Site	34
Piqua Nuclear Power Facility	20	(Petrotomics) Shirley Basin Site 1	35	(Union Pacific) Bear Creek Site	34
(Union Pacific) Bear Creek Site	19	(SOHIO) LBAR Site	35	(WNI) Sherwood Site	34
(SOHIO) LBAR Site	17	(UMETCO) Gas Hills Site	35	(WNI) Split Rock Site	34
Parkersburg Site	16	(Union Pacific) Bear Creek Site	35	Hallam Nuclear Power Facility	32
(Exxon) Ray Point Site	15	(WNI) Sherwood Site	35	Monument Valley Site	30
South Clive Disposal Cell	14	(WNI) Split Rock Site	35	Green River Site	28
Spook Site	13	Hallam Nuclear Power Facility	31	Burro Canyon Disposal Cell	26
Edgemont Site	11	South Clive Disposal Cell	28	(EFN) White Mesa Site	26
(Chevron) Panna Maria Site	5	(Exxon) Highlands Site	26	(Exxon) Highlands Site	26
(Conoco) Conquista Site	5	(Exxon) Ray Point Site	26	(Exxon) Ray Point Site	26

Table E-3. Long-Term Stewardship Costs by Operations/Program Office for Years 2000, 2006, and 2050

FY 2000		*FY 2006*		*FY 2050***	
Site	*Cost (in 000s)*	*Site*	*Cost (in 000s)*	*Site*	*Cost (in 000s)*
Ambrosia Lake Site	4	Maybell Mill Site	26	(Homestake) Grants Site	26
(ANC) Gas Hills Site	4	(UMETCO) Maybell Site 2	26	(Kennecott) Sweetwater Site	26
(HECLA) Durita Site	4	Naturita Site	24	Maybell Mill Site	26
(UMETCO) Maybell Site 2	4	Spook Site	24	(Rio Algom) Lisbon Valley Site	26
Maybell Mill Site	2	Ambrosia Lake Site	21	(UMETCO) Maybell Site 2	26
(Atlas) Moab Mill	0	(ANC) Gas Hills Site	21	Canonsburg Site	25
(Cotter) Cañon City Site	0	Piqua Nuclear Power Facility	18	Cheney Disposal Cell	24
(Dawn) Ford Site	0	(Atlas) Moab Mill	17	Lowman Site	24
Durango Mill	0	Parkersburg Site	15	(Plateau) Shootaring Canyon Site	24
(EFN) White Mesa Site	0	Bluewater Site	13	Ambrosia Lake Site	20
(Exxon) Highlands Site	0	(HECLA) Durita Site	11	(ANC) Gas Hills Site	20
Grand Junction Mill 2	0	Edgemont Site	7	Parkersburg Site	18
Gunnison Mill	0	Riverton Site	6	(Atlas) Moab Mill	16
(Homestake) Grants Site	0	Grand Junction Mill 1	4	Burrell Site	16
(Kennecott) Sweetwater Site	0	(Cotter) Cañon City Site	0	Gunnison Disposal Cell	16
Monticello Mill Site and Vicinity Properties	0	(Dawn) Ford Site	0	Estes Gulch Disposal Cell	14
Monument Valley Site	0	Durango Mill	0	Bluewater Site	13
Naturita Mill	0	(EFN) White Mesa Site	0	South Clive Disposal Cell	11
(Pathfinder) Lucky Mc Site	0	Gunnison Mill	0	(HECLA) Durita Site	10
(Pathfinder) Shirley Basin Site 2	0	(Homestake) Grants Site	0	Spook Site	10
(Petrotomics) Shirley Basin Site 1	0	(Kennecott) Sweetwater Site	0	Naturita Site	9
Pinellas STAR Center	0	Lakeview Mill	0	Edgemont Site	7
(Plateau) Shootaring Canyon Site	0	Monument Valley Site	0	Grand Junction Mill 1	5
(Quivira) Ambrosia Lake Site 2	0	Naturita Mill	0	Lakeview Mill	2
Rifle (New) Mill	0	Pinellas STAR Center	0	Slick Rock (North Continent) Mill 1	2
Rifle (Old) Mill	0	(Plateau) Shootaring Canyon Site	0	Durango Mill	1
(Rio Algom) Lisbon Valley Site	0	(Quivira) Ambrosia Lake Site 2	0	Naturita Mill	1

Table E-3. Long-Term Stewardship Costs by Operations/Program Office for Years 2000, 2006, and 2050

FY 2000		*FY 2006*		*FY 2050***	
Site	*Cost (in 000s)*	*Site*	*Cost (in 000s)*	*Site*	*Cost (in 000s)*
Riverton Site	0	Rifle (New) Mill	0	Rifle (New) Mill	1
Slick Rock (North Continent) Mill 1	0	Rifle (Old) Mill	0	Riverton Site	1
Slick Rock (Union Carbide) Mill 2	0	(Rio Algom) Lisbon Valley Site	0	Slick Rock (Union Carbide) Mill 2	1
(UMETCO) Gas Hills Site	0	Salt Lake City Mill	0	Gunnison Mill	0
(UMETCO) Uravan Site	0	Slick Rock (North Continent) Mill 1	0	Pinellas STAR Center	0
(UNC) Church Rock Site	0	Slick Rock (Union Carbide) Mill 2	0	Piqua Nuclear Power Facility	0
Weldon Spring Site	0	(UMETCO) Uravan Site	0	Rifle (Old) Mill	0
(WNI) Split Rock Site	0	(UNC) Church Rock Site	0	Salt Lake City Mill	0
Idaho Operations Office	**3,000**	**Idaho Operations Office**	**7,200**	**Idaho Operations Office**	**2,400**
Fort St. Vrain	3,000	Idaho National Engineering and Environmental Laboratory	4,200	Idaho National Engineering and Environmental Laboratory	2,400
Idaho National Engineering and Environmental Laboratory	0	Fort St. Vrain	3,000	Fort St. Vrain	0
Nevada Operations Office	**2,346**	**Nevada Operations Office**	**2,435**	**Nevada Operations Office**	**3,362**
Nevada Test Site	2,023	Nevada Test Site	2,155	Nevada Test Site	2,934
Salmon Site	180	Central Nevada Test Area	40	Gasbuggy Site	59
Gasbuggy Site	28	Gasbuggy Site	40	Project Shoal	55
Gnome-Coach	28	Gnome-Coach	40	Salmon Site	55
Rio Blanco	27	Project Shoal	40	Central Nevada Test Area	54
Rulison	27	Rio Blanco	40	Gnome-Coach	54
Central Nevada Test Area	17	Rulison	40	Rio Blanco	54
Project Shoal	16	Salmon Site	40	Rulison	54
Amchitka Island	0	Amchitka Island	0	Amchitka Island	43
Oak Ridge Operations Office	**19,783**	**Oak Ridge Operations Office**	**18,332**	**Oak Ridge Operations Office**	**26,124**
Portsmouth Gaseous Diffusion Plant	6,764	Oak Ridge Reservation	7,508	Oak Ridge Reservation	15,987
Paducah Gaseous Diffusion Plant	6,599	Portsmouth Gaseous Diffusion Plant	6,041	Paducah Gaseous Diffusion Plant	8,716
Oak Ridge Reservation	6,394	Paducah Gaseous Diffusion Plant	4,757	Portsmouth Gaseous Diffusion Plant	1,395
Center for Energy and Environmental Research	25	Center for Energy and Environmental Research	25	Center for Energy and Environmental Research	25

Table E-3. Long-Term Stewardship Costs by Operations/Program Office for Years 2000, 2006, and 2050

FY 2000		*FY 2006*		*FY 2050***	
Site	*Cost (in 000s)*	*Site*	*Cost (in 000s)*	*Site*	*Cost (in 000s)*
Bayo Canyon	1	Bayo Canyon	1	Bayo Canyon	1
Oakland Operations Office	**0**	**Oakland Operations Office**	**1,679**	**Oakland Operations Office**	**254**
Lawrence Berkeley National Laboratory	0	Lawrence Berkeley National Laboratory	1,179	Lawrence Livermore National Laboratory - Livermore Site	140
Lawrence Livermore National Laboratory - Livermore Site	0	Stanford Linear Accelerator	500	Stanford Linear Accelerator	100
Lawrence Livermore National Laboratory - Site 300	0	Lawrence Livermore National Laboratory - Livermore Site	0	Lawrence Livermore National Laboratory - Site 300	14
Stanford Linear Accelerator	0	Lawrence Livermore National Laboratory - Site 300	0	Lawrence Berkeley National Laboratory	0
Ohio Field Office	**0**	**Ohio Field Office**	**0**	**Ohio Field Office**	**1,978**
Fernald Environmental Management Project	0	Fernald Environmental Management Project	0	Fernald Environmental Management Project	1,928
Miamisburg Environmental Management Project	0	Miamisburg Environmental Management Project	0	Miamisburg Environmental Management Project	50
Richland/Office of River Protection	**47**	**Richland/Office of River Protection**	**62**	**Richland/Office of River Protection**	**36,716**
Hanford Site	47	Hanford Site	62	Hanford Site	36,716
Rocky Flats Field Office	**0**	**Rocky Flats Field Office**	**0**	**Rocky Flats Field Office**	**5,959**
Rocky Flats Environmental Technology Site	0	Rocky Flats Environmental Technology Site	0	Rocky Flats Environmental Technology Site	5,959
Savannah River Operations Office	**35,001**	**Savannah River Operations Office**	**25,779**	**Savannah River Operations Office**	**5,607**
Savannah River Site***	35,001	Savannah River Site***	25,779	Savannah River Site***	5,607

* Costs are in thousands of constant 2000 dollars.
** Because post-2010 costs were reported in five-year periods, costs for 2050 were calculated by averaging the costs for years 2046-2050.
***Long-term stewardship cost estimates for the Savannah River Site in South Carolina do not include any activities scheduled to begin after 2006. At this time, these activities are not well known and cost estimates are not included in this Report. Therefore, post-2006 cost estimates provided in this section are likely to underestimate the Department's long-term cost obligations.

APPENDIX F: PROJECTED ANNUAL AVERAGE LONG-TERM STEWARDSHIP COSTS FOR SITES: 2000-2010, 2031-2040, AND 2061-2070

Appendix F provides average annual long-term stewardship costs for each site for 2000-2010, 2031-2040, and 2061-2070. The average only includes years where long-term stewardship costs estimates are reported. Because 10-year periods are used, regulatory scheduled activities (e.g., CERCLA five-year reviews, routine maintenance) can be incorporated along with years when fewer activities are anticipated, reducing some of the annual variability associated with single year "snapshots." The annual average costs are more representative of the cost profile of the site, but may not completely capture longer-term activities (i.e, scheduled 25-year well maintenance or replacement). These tables are provided in Appendix F: Table F-1. Annual Average Long-Term Stewardship Costs by State, Table F-2. Annual Average Long-Term Stewardship Costs by Site , Table F-3. Annual Average Long-Term Stewardship Costs by Operations/Program Office.

Table F-1. Annual Average Long-Term Stewardship Costs by State*

FY 2000-2010		*FY 2031-2040*		*FY 2061-2070*	
Site	*Cost (in 000s)*	*Site*	*Cost (in 000s)*	*Site*	*Cost (in 000s)*
Alaska Sites	**95**	**Alaska Sites**	**43**	**Alaska Sites**	**43**
Amchitka Island	95	Amchitka Island	43	Amchitka Island	43
Arizona Sites	**56**	**Arizona Sites**	**64**	**Arizona Sites**	**64**
Tuba City Site	56	Tuba City Site	34	Tuba City Site	34
Monument Valley Site	0	Monument Valley Site	30	Monument Valley Site	30
California Sites	**14,262**	**California Sites**	**1,403**	**California Sites**	**200**
Lawrence Livermore National Laboratory - Livermore Site	8,248	Lawrence Berkeley National Laboratory	525	Stanford Linear Accelerator	100
Lawrence Livermore National Laboratory - Site 300	4,247	Lawrence Livermore National Laboratory - Livermore Site	496	Sandia National Laboratories - CA	84
Lawrence Berkeley National Laboratory	1,183	Lawrence Livermore National Laboratory - Site 300	198	Lawrence Livermore National Laboratory - Livermore Site	13
Stanford Linear Accelerator	500	Stanford Linear Accelerator	100	Lawrence Livermore National Laboratory - Site 300	3
Sandia National Laboratories - CA	84	Sandia National Laboratories - CA	84	Lawrence Berkeley National Laboratory	0
Colorado Sites	**11,031**	**Colorado Sites**	**9,134**	**Colorado Sites**	**6,854**
Rocky Flats Environmental Technology Site	6,752	Rocky Flats Environmental Technology Site	6,024	Rocky Flats Environmental Technology Site	6,176
Fort St. Vrain	3,000	Fort St. Vrain	2,400	(Cotter) Cañon City Site	170
Cheney Disposal Cell	454	(Cotter) Cañon City Site	170	Grand Junction Mill 2	128
Rifle (New) Mill	152	Grand Junction Mill 2	128	Rio Blanco	54
Grand Junction Mill 2	122	Rulison	85	Rulison	54
Bodo Canyon Cell	118	Rio Blanco	55	(UMETCO) Uravan Site	51

Table F-1. Annual Average Long-Term Stewardship Costs by State*

FY 2000-2010		*FY 2031-2040*		*FY 2061-2070*	
Site	*Cost (in 000s)*	*Site*	*Cost (in 000s)*	*Site*	*Cost (in 000s)*
Rifle (Old) Mill	76	(UMETCO) Uravan Site	51	Bodo Canyon Cell	50
Burro Canyon Disposal Cell	59	Bodo Canyon Cell	50	Burro Canyon Disposal Cell	26
(UMETCO) Uravan Site	52	Burro Canyon Disposal Cell	26	Maybell Mill Site	26
Gunnison Disposal Cell	47	Maybell Mill Site	26	(UMETCO) Maybell Site 2	26
Rulison	45	(UMETCO) Maybell Site 2	26	Cheney Disposal Cell	24
Rio Blanco	39	Cheney Disposal Cell	24	Gunnison Disposal Cell	16
Estes Gulch Disposal Cell	32	Gunnison Disposal Cell	16	Estes Gulch Disposal Cell	14
Maybell Mill Site	25	Estes Gulch Disposal Cell	14	(HECLA) Durita Site	10
(UMETCO) Maybell Site 2	25	(HECLA) Durita Site	10	Naturita Site	9
Naturita Site	22	Naturita Site	9	Grand Junction Mill 1	5
Durango Mill	21	Grand Junction Mill 1	5	Naval Oil Shale Reserves Site	4
Gunnison Mill	14	Naval Oil Shale Reserves Site	4	Slick Rock (North Continent) Mill 1	4
Grand Junction Mill 1	13	Slick Rock (North Continent) Mill 1	4	Durango Mill	2
Slick Rock (North Continent) Mill 1	11	Durango Mill	2	Naturita Mill	2
(HECLA) Durita Site	10	Naturita Mill	2	Slick Rock (Union Carbide) Mill 2	2
Slick Rock (Union Carbide) Mill 2	6	Slick Rock (Union Carbide) Mill 2	2	Rifle (New) Mill	1
Naval Oil Shale Reserves Site	3	Rifle (New) Mill	1	Fort St. Vrain	0
Naturita Mill	2	Gunnison Mill	0	Gunnison Mill	0
(Cotter) Cañon City Site	0	Rifle (Old) Mill	0	Rifle (Old) Mill	0
Florida Sites	**0**	**Florida Sites**	**0**	**Florida Sites**	**0**
Pinellas STAR Center	0	Pinellas STAR Center	77	Pinellas STAR Center	0
Idaho Sites	**4,532**	**Idaho Sites**	**4,259**	**Idaho Sites**	**3,624**
Idaho National Engineering and Environmental Laboratory	4,479	Idaho National Engineering and Environmental Laboratory	3,000	Idaho National Engineering and Environmental Laboratory	3,600
Lowman Site	53	Lowman Site	24	Lowman Site	24
Illinois Sites	**615**	**Illinois Sites**	**535**	**Illinois Sites**	**170**
Argonne National Laboratory East	295	Argonne National Laboratory East	215	Palos Forest (Site A/Plot M) Preserve	170
Palos Forest (Site A/Plot M) Preserve	170	Palos Forest (Site A/Plot M) Preserve	170	Argonne National Laboratory East	0

Table F-1. Annual Average Long-Term Stewardship Costs by State*

FY 2000-2010		*FY 2031-2040*		*FY 2061-2070*	
Site	*Cost (in 000s)*	*Site*	*Cost (in 000s)*	*Site*	*Cost (in 000s)*
Fermi National Accelerator Laboratory	150	Fermi National Accelerator Laboratory	150	Fermi National Accelerator Laboratory	0
Kentucky Sites	**5,881**	**Kentucky Sites**	**5,716**	**Kentucky Sites**	**9,560**
Paducah Gaseous Diffusion Plant	5,881	Paducah Gaseous Diffusion Plant	5,716	Paducah Gaseous Diffusion Plant	9,560
Mississippi Sites	**59**	**Mississippi Sites**	**54**	**Mississippi Sites**	**54**
Salmon Site	59	Salmon Site	54	Salmon Site	54
Missouri Sites	**2,285**	**Missouri Sites**	**2,308**	**Missouri Sites**	**2,308**
Kansas City Plant	1,279	Kansas City Plant	1,302	Kansas City Plant	1,302
Weldon Spring Site	1,006	Weldon Spring Site	1,006	Weldon Spring Site	1,006
Nebraska Sites	**40**	**Nebraska Sites**	**31**	**Nebraska Sites**	**32**
Hallam Nuclear Power Facility	40	Hallam Nuclear Power Facility	31	Hallam Nuclear Power Facility	32
Nevada Sites	**2,267**	**Nevada Sites**	**5,870**	**Nevada Sites**	**7,430**
Nevada Test Site	2,191	Nevada Test Site	5,643	Nevada Test Site	7,322
Central Nevada Test Area	38	Central Nevada Test Area	135	Central Nevada Test Area	54
Project Shoal	38	Project Shoal	92	Project Shoal	54
New Jersey Sites	**280**	**New Jersey Sites**	**0**	**New Jersey Sites**	**0**
Princeton Plasma Physics Laboratory	280	Princeton Plasma Physics Laboratory	0	Princeton Plasma Physics Laboratory	0
New Mexico Sites	**1,641**	**New Mexico Sites**	**1,963**	**New Mexico Sites**	**12,519**
Sandia National Laboratories - NM	922	Sandia National Laboratories - NM	1,010	Waste Isolation Pilot Plant	10,556
Los Alamos National Laboratory	332	Los Alamos National Laboratory	490	Sandia National Laboratories - NM	1,070
Lovelace Respiratory Research Institute	140	Gasbuggy Site	154	Los Alamos National Laboratory	310
Shiprock Site	91	Gnome-Coach	79	Gasbuggy Site	154
Gasbuggy Site	43	Shiprock Site	59	Gnome-Coach	79
Gnome-Coach	39	(UNC) Church Rock Site	43	Shiprock Site	59
(SOHIO) LBAR Site	34	(Quivira) Ambrosia Lake Site 2	34	(UNC) Church Rock Site	43
Ambrosia Lake Site	20	(SOHIO) LBAR Site	34	(Quivira) Ambrosia Lake Site 2	34
Bluewater Site	19	(Homestake) Grants Site	26	(SOHIO) LBAR Site	34
Bayo Canyon	1	Ambrosia Lake Site	20	(Homestake) Grants Site	26
(Homestake) Grants Site	0	Bluewater Site	13	Ambrosia Lake Site	20
(Quivira) Ambrosia Lake Site 2	0	Bayo Canyon	1	Bluewater Site	13

Table F-1. Annual Average Long-Term Stewardship Costs by State*

FY 2000-2010		*FY 2031-2040*		*FY 2061-2070*	
Site	*Cost (in 000s)*	*Site*	*Cost (in 000s)*	*Site*	*Cost (in 000s)*
(UNC) Church Rock Site	0	Lovelace Respiratory Research Institute	0	Bayo Canyon	1
Waste Isolation Pilot Plant	0	Waste Isolation Pilot Plant	0	Lovelace Respiratory Research Institute	0
New York Sites	**4,150**	**New York Sites**	**711**	**New York Sites**	**0**
Brookhaven National Laboratory	4,150	Brookhaven National Laboratory	711	Brookhaven National Laboratory	0
Ohio Sites	**11,184**	**Ohio Sites**	**3,652**	**Ohio Sites**	**3,373**
Portsmouth Gaseous Diffusion Plant	6,067	Fernald Environmental Management Project	1,928	Fernald Environmental Management Project	1,928
Fernald Environmental Management Project	5,049	Portsmouth Gaseous Diffusion Plant	1,674	Portsmouth Gaseous Diffusion Plant	1,395
Miamisburg Environmental Management Project	50	Miamisburg Environmental Management Project	50	Miamisburg Environmental Management Project	50
Piqua Nuclear Power Facility	18	Piqua Nuclear Power Facility	0	Piqua Nuclear Power Facility	0
Oregon Sites	**126**	**Oregon Sites**	**36**	**Oregon Sites**	**36**
Lakeview Site	82	Lakeview Site	34	Lakeview Site	34
Lakeview Mill	44	Lakeview Mill	2	Lakeview Mill	2
Pennsylvania	**141**	**Pennsylvania**	**41**	**Pennsylvania**	**41**
Canonsburg Site	103	Canonsburg Site	25	Canonsburg Site	25
Burrell Site	38	Burrell Site	16	Burrell Site	16
Puerto Rico Sites	**25**	**Puerto Rico Sites**	**25**	**Puerto Rico Sites**	**25**
Center for Energy and Environmental Research	25	Center for Energy and Environmental Research	25	Center for Energy and Environmental Research	25
South Carolina Sites	**20,240**	**South Carolina Sites**	**3,139**	**South Carolina Sites**	**13,267**
Savannah River Site**	20,240	Savannah River Site**	3,139	Savannah River Site**	13,267
South Dakota Sites	**8**	**South Dakota Sites**	**7**	**South Dakota Sites**	**7**
Edgemont Site	8	Edgemont Site	7	Edgemont Site	7
Tennessee Sites	**7,633**	**Tennessee Sites**	**8,499**	**Tennessee Sites**	**8,562**
Oak Ridge Reservation	7,633	Oak Ridge Reservation	8,499	Oak Ridge Reservation	8,562
Texas Sites	**1.645**	**Texas Sites**	**2,070**	**Texas Sites**	**1,669**
Pantex Plant	1,437	Pantex Plant	1,912	Pantex Plant	990
Falls City Site	105	(Conoco) Conquista Site	51	(Conoco) Conquista Site	51
(Conoco) Conquista Site	44	Falls City Site	47	Falls City Site	47
(Chevron) Panna Maria Site	33	(Chevron) Panna Maria Site	34	(Chevron) Panna Maria Site	34
(Exxon) Ray Point Site	26	(Exxon) Ray Point Site	26	(Exxon) Ray Point Site	26
Utah Sites	**648**	**Utah Sites**	**696**	**Utah Sites**	**696**

Table F-1. Annual Average Long-Term Stewardship Costs by State*

FY 2000-2010		*FY 2031-2040*		*FY 2061-2070*	
Site	*Cost (in 000s)*	*Site*	*Cost (in 000s)*	*Site*	*Cost (in 000s)*
Monticello Mill Site and Vicinity Properties	386	Monticello Mill Site and Vicinity Properties	520	Monticello Mill Site and Vicinity Properties	520
Mexican Hat Site	106	Mexican Hat Site	45	Mexican Hat Site	45
Green River Site	67	Green River Site	28	Green River Site	28
(Rio Algom) Lisbon Valley Site	26	(EFN) White Mesa Site	26	(EFN) White Mesa Site	26
South Clive Disposal Cell	24	(Rio Algom) Lisbon Valley Site	26	(Rio Algom) Lisbon Valley Site	26
Salt Lake City Mill	22	(Plateau) Shootaring Canyon Site	24	(Plateau) Shootaring Canyon Site	24
(Atlas) Moab Mill	17	(Atlas) Moab Mill	16	(Atlas) Moab Mill	16
(EFN) White Mesa Site	0	South Clive Disposal Cell	11	South Clive Disposal Cell	11
(Plateau) Shootaring Canyon Site	0	Salt Lake City Mill	0	Salt Lake City Mill	0
Washington Sites	**96**	**Washington Sites**	**949**	**Washington Sites**	**39,904**
Hanford Site	59	Hanford Site	745	Hanford Site	39,700
(WNI) Sherwood Site	37	(Dawn) Ford Site	170	(Dawn) Ford Site	170
(Dawn) Ford Site	0	(WNI) Sherwood Site	34	(WNI) Sherwood Site	34
West Virginia Sites	**17**	**West Virginia Sites**	**18**	**West Virginia Sites**	**18**
Parkersburg Site	17	Parkersburg Site	18	Parkersburg Site	18
Wyoming Sites	**891**	**Wyoming Sites**	**290**	**Wyoming Sites**	**290**
Rock Springs Oil Shale Retort Site	334	(Pathfinder) Lucky Mc Site	34	(Pathfinder) Lucky Mc Site	34
Hoe Creek Underground Coal Gasification Site	273	(Pathfinder) Shirley Basin Site 2	34	(Pathfinder) Shirley Basin Site 2	34
(Pathfinder) Lucky Mc Site	35	(Petrotomics) Shirley Basin Site 1	34	(Petrotomics) Shirley Basin Site 1	34
(Pathfinder) Shirley Basin Site 2	35	(UMETCO) Gas Hills Site	34	(UMETCO) Gas Hills Site	34
(Petrotomics) Shirley Basin Site 1	35	(Union Pacific) Bear Creek Site	34	(Union Pacific) Bear Creek Site	34
(UMETCO) Gas Hills Site	35	(WNI) Split Rock Site	34	(WNI) Split Rock Site	34
(WNI) Split Rock Site	35	(Exxon) Highlands Site	26	(Exxon) Highlands Site	26
(Union Pacific) Bear Creek Site	34	(Kennecott) Sweetwater Site	26	(Kennecott) Sweetwater Site	26
(Exxon) Highlands Site	26	(ANC) Gas Hills Site	20	(ANC) Gas Hills Site	20
Spook Site	21	Spook Site	10	Spook Site	10
(ANC) Gas Hills Site	20	Naval Petroleum Reserve No. 3 Landfill/Landfarm	3	Naval Petroleum Reserve No. 3 Landfill/Landfarm	3
Riverton Site	5	Riverton Site	1	Riverton Site	1

Table F-1. Annual Average Long-Term Stewardship Costs by State*

FY 2000-2010		*FY 2031-2040*		*FY 2061-2070*	
Site	*Cost (in 000s)*	*Site*	*Cost (in 000s)*	*Site*	*Cost (in 000s)*
Naval Petroleum Reserve No. 3 Landfill/Landfarm	3	Hoe Creek Underground Coal Gasification Site	0	Hoe Creek Underground Coal Gasification Site	0
(Kennecott) Sweetwater Site	0	Rock Springs Oil Shale Retort Site	0	Rock Springs Oil Shale Retort Site	0

* The average only includes years where long-term stewardship cost estimates are non-zero. Costs are in thousands of constant 2000 dollars.
** Long-term stewardship cost estimates for the Savannah River Site in South Carolina do not include any activities scheduled to begin after 2006. At this time, these activities are not well known and cost estimates are not included in this Report. Therefore, post-2006 cost estimates provided in this section are likely to underestimate the Department's long-term cost obligations.

**Table F-2. Annual Average Long-Term Stewardship Costs by Site*
(listed in order of highest to lowest cost)**

FY 2000 - 2010		*FY 2031-2040*		*FY 2061-2070*	
Site	*Average Annual Cost (in 000s)*	*Site*	*Average Annual Cost (in 000s)*	*Site*	*Average Annual Cost (in 000s)*
Savannah River Site**	$20,240	Oak Ridge Reservation	$8,499	Hanford Site	$39,700
Lawrence Livermore National Laboratory - Livermore Site	$8,248	Rocky Flats Environmental Technology Site	$6,024	Savannah River Site**	$13,267
Oak Ridge Reservation	$7,633	Paducah Gaseous Diffusion Plant	$5,716	Waste Isolation Pilot Plant	$10,556
Rocky Flats Environmental Technology Site	$6,752	Nevada Test Site	$5,643	Paducah Gaseous Diffusion Plant	$9,560
Portsmouth Gaseous Diffusion Plant	$6,067	Savannah River Site**	$3,139	Oak Ridge Reservation	$8,562
Paducah Gaseous Diffusion Plant	$5,881	Idaho National Engineering and Environmental Laboratory	$3,000	Nevada Test Site	$7,322
Fernald Environmental Management Project	$5,049	Fort St. Vrain	$2,400	Rocky Flats Environmental Technology Site	$6,176
Idaho National Engineering and Environmental Laboratory	$4,479	Fernald Environmental Management Project	$1,928	Idaho National Engineering and Environmental Laboratory	$3,600
Lawrence Livermore National Laboratory - Site 300	$4,247	Pantex Plant	$1,912	Fernald Environmental Management Project	$1,928
Brookhaven National Laboratory	$4,150	Portsmouth Gaseous Diffusion Plant	$1,674	Portsmouth Gaseous Diffusion Plant	$1,395
Fort St. Vrain	$3,000	Kansas City Plant	$1,302	Kansas City Plant	$1,302
Nevada Test Site	$2,191	Sandia National Laboratories - NM	$1,010	Sandia National Laboratories - NM	$1,070
Pantex Plant	$1,437	Weldon Spring Site	$1,006	Weldon Spring Site	$1,006
Kansas City Plant	$1,279	Hanford Site	$745	Pantex Plant	$990
Lawrence Berkeley National Laboratory	$1,183	Brookhaven National Laboratory	$711	Monticello Mill Site and Vicinity Properties	$520
Weldon Spring Site	$1,006	Lawrence Berkeley National Laboratory	$525	Los Alamos National Laboratory	$310
Sandia National Laboratories - NM	$922	Monticello Mill Site and Vicinity Properties	$520	(Cotter) Cañon City Site	$170
Stanford Linear Accelerator	$500	Lawrence Livermore National Laboratory - Livermore Site	$496	(Dawn) Ford Site	$170
Cheney Disposal Cell	$454	Los Alamos National Laboratory	$490	Palos Forest (Site A/Plot M) Preserve	$170

Table F-2. Annual Average Long-Term Stewardship Costs by Site*
(listed in order of highest to lowest cost)

FY 2000 - 2010		*FY 2031-2040*		*FY 2061-2070*	
Site	*Average Annual Cost (in 000s)*	*Site*	*Average Annual Cost (in 000s)*	*Site*	*Average Annual Cost (in 000s)*
Monticello Mill Site and Vicinity Properties	$386	Argonne National Laboratory East	$251	Gasbuggy Site	$154
Rock Springs Oil Shale Retort Site	$334	Lawrence Livermore National Laboratory - Site 300	$198	Grand Junction Mill 2	$128
Los Alamos National Laboratory	$332	(Cotter) Cañon City Site	$170	Stanford Linear Accelerator	$100
Argonne National Laboratory East	$295	(Dawn) Ford Site	$170	Sandia National Laboratories - CA	$84
Princeton Plasma Physics Laboratory	$280	Palos Forest (Site A/Plot M) Preserve	$170	Gnome-Coach	$79
Hoe Creek Underground Coal Gasification Site	$273	Gasbuggy Site	$154	Shiprock Site	$59
Palos Forest (Site A/Plot M) Preserve	$170	Central Nevada Test Area	$135	Central Nevada Test Area	$54
Rifle (New) Mill	$152	Grand Junction Mill 2	$128	Project Shoal	$54
Fermi National Accelerator Laboratory	$150	Stanford Linear Accelerator	$100	Rio Blanco	$54
Lovelace Respiratory Research Institute	$140	Project Shoal	$92	Rulison	$54
Grand Junction Mill 2	$122	Rulison	$85	Salmon Site	$54
Bodo Canyon Cell	$118	Sandia National Laboratories - CA	$84	(Conoco) Conquista Site	$51
Mexican Hat Site	$106	Gnome-Coach	$79	(UMETCO) Uravan Site	$51
Falls City Site	$105	Pinellas STAR Center	$77	Bodo Canyon Cell	$50
Canonsburg Site	$103	Shiprock Site	$59	Miamisburg Environmental Management Project	$50
Amchitka Island	$95	Rio Blanco	$55	Falls City Site	$47
Shiprock Site	$91	Salmon Site	$54	Mexican Hat Site	$45
Sandia National Laboratories - CA	$84	(Conoco) Conquista Site	$51	Amchitka Island	$43
Lakeview Site	$82	(UMETCO) Uravan Site	$51	(UNC) Church Rock Site	$43
Rifle (Old) Mill	$76	Bodo Canyon Cell	$50	(Chevron) Panna Maria Site	$34
Green River Site	$67	Miamisburg Environmental Management Project	$50	Lakeview Site	$34
Burro Canyon Disposal Cell	$59	Falls City Site	$47	(Pathfinder) Lucky MC Site	$34

Table F-2. Annual Average Long-Term Stewardship Costs by Site*
(listed in order of highest to lowest cost)

FY 2000 - 2010		*FY 2031-2040*		*FY 2061-2070*	
Site	*Average Annual Cost (in 000s)*	*Site*	*Average Annual Cost (in 000s)*	*Site*	*Average Annual Cost (in 000s)*
Hanford Site	$59	Mexican Hat Site	$45	(Pathfinder) Shirley Basin Site 2	$34
Salmon Site	$59	Amchitka Island	$43	(Petrotomics) Shirley Basin Site 1	$34
Tuba City Site	$56	(UNC) Church Rock Site	$43	Quivira Ambrosia Lake Site 2	$34
Lowman Site	$53	Hallam Nuclear Power Facility	$37	(SOHIO) LBAR Site	$34
(UMETCO) Uravan Site	$52	(Chevron) Panna Maria Site	$34	Tuba City Site	$34
Miamisburg Environmental Management Project	$50	Lakeview Site	$34	(UMETCO) Gas Hills Site	$34
Gunnison Disposal Cell	$47	(Pathfinder) Lucky Mc Site	$34	(Union Pacific) Bear Creek Site	$34
Rulison	$45	(Pathfinder) Shirley Basin Site 2	$34	(WNI) Sherwood Site	$34
(Conoco) Conquista Site	$44	(Petrotomics) Shirley Basin Site 1	$34	(WNI) Split Rock Site	$34
Lakeview Mill	$44	(Quivira) Ambrosia Lake Site 2	$34	Hallam Nuclear Power Facility	$32
Gasbuggy Site	$43	(SOHIO) LBAR Site	$34	Monument Valley Site	$30
Hallam Nuclear Power Facility	$40	Tuba City Site	$34	Green River Site	$28
Gnome-Coach	$39	(UMETCO) Gas Hills Site	$34	Burro Canyon Disposal Cell	$26
Rio Blanco	$39	(Union Pacific) Bear Creek Site	$34	(EFN) White Mesa Site	$26
Burrell Site	$38	(WNI) Sherwood Site	$34	(Exxon) Highlands Site	$26
Central Nevada Test Area	$38	(WNI) Split Rock Site	$34	(Exxon) Ray Point Site	$26
Project Shoal	$38	Monument Valley Site	$30	(Homestake) Grants Site	$26
(WNI) Sherwood Site	$37	Green River Site	$28	(Kennecott) Sweetwater Site	$26
(Pathfinder) Lucky Mc Site	$35	Burro Canyon Disposal Cell	$26	Maybell Mill Site	$26
(Pathfinder) Shirley Basin Site 2	$35	(EFN) White Mesa Site	$26	(Rio Algom) Lisbon Valley Site	$26
(Petrotomics) Shirley Basin Site 1	$35	(Exxon) Highlands Site	$26	(UMETCO) Maybell Site 2	$26

Table F-2. Annual Average Long-Term Stewardship Costs by Site*
(listed in order of highest to lowest cost)

FY 2000 - 2010		*FY 2031-2040*		*FY 2061-2070*	
Site	*Average Annual Cost (in 000s)*	*Site*	*Average Annual Cost (in 000s)*	*Site*	*Average Annual Cost (in 000s)*
(UMETCO) Gas Hills Site	$35	(Exxon) Ray Point Site	$26	Center for Energy and Environmental Research	$25
(WNI) Split Rock Site	$35	(Homestake) Grants Site	$26	Canonsburg Site	$25
(SOHIO) LBAR Site	$34	(Kennecott) Sweetwater Site	$26	Cheney Disposal Cell	$24
(Union Pacific) Bear Creek Site	$34	Maybell Mill Site	$26	Lowman Site	$24
(Chevron) Panna Maria Site	$33	(Rio Algom) Lisbon Valley Site	$26	(Plateau) Shootaring Canyon Site	$24
Estes Gulch Disposal Cell	$32	(UMETCO) Maybell Site 2	$26	Ambrosia Lake Site	$20
(Exxon) Highlands Site	$26	Canonsburg Site	$25	(ANC) Gas Hills Site	$20
(Exxon) Ray Point Site	$26	Center for Energy and Environmental Research	$25	Parkersburg Site	$18
(Rio Algom) Lisbon Valley Site	$26	Cheney Disposal Cell	$24	(Atlas) Moab Mill	$16
Center for Energy and Environmental Research	$25	Lowman Site	$24	Burrell Site	$16
Maybell Mill Site	$25	(Plateau) Shootaring Canyon Site	$24	Gunnison Disposal Cell	$16
(UMETCO) Maybell Site 2	$25	Ambrosia Lake Site	$20	Estes Gulch Disposal Cell	$14
South Clive Disposal Cell	$24	(ANC) Gas Hills Site	$20	Bluewater Site	$13
Naturita Site	$22	Parkersburg Site	$18	Lawrence Livermore National Laboratory - Livermore Site	$13
Salt Lake City Mill	$22	(Atlas) Moab Mill	$16	South Clive Disposal Cell	$11
Durango Mill	$21	Burrell Site	$16	(HECLA) Durita Site	$10
Spook Site	$21	Gunnison Disposal Cell	$16	Spook Site	$10
Ambrosia Lake Site	$20	Estes Gulch Disposal Cell	$14	Naturita Site	$9
(ANC) Gas Hills Site	$20	Bluewater Site	$13	Edgemont Site	$7
Bluewater Site	$18	South Clive Disposal Cell	$11	Grand Junction Mill 1	$5
Piqua Nuclear Power Facility	$18	(HECLA) Durita Site	$10	Naval Oil Shale Reserves Site	$4
(Atlas) Moab Mill	$17	Spook Site	$10	Slick Rock (North Continent) Mill 1	$4

Table F-2. Annual Average Long-Term Stewardship Costs by Site*
(listed in order of highest to lowest cost)

FY 2000 - 2010		*FY 2031-2040*		*FY 2061-2070*	
Site	*Average Annual Cost (in 000s)*	*Site*	*Average Annual Cost (in 000s)*	*Site*	*Average Annual Cost (in 000s)*
Parkersburg Site	$17	Naturita Site	$9	Lawrence Livermore National Laboratory - Site 300	$3
Gunnison Mill	$14	Edgemont Site	$7	Naval Petroleum Reserve No. 3 Landfill/Landfarm	$3
Grand Junction Mill 1	$13	Grand Junction Mill 1	$5	Durango Mill	$2
Slick Rock (North Continent) Mill 1	$11	Naval Oil Shale Reserves Site	$4	Lakeview Mill	$2
(HECLA) Durita Site	$10	Slick Rock (North Continent) Mill 1	$4	Naturita Mill	$2
Edgemont Site	$8	Naval Petroleum Reserve No. 3 Landfill/Landfarm	$3	Slick Rock (Union Carbide) Mill 2	$2
Slick Rock (Union Carbide) Mill 2	$6	Durango Mill	$2	Bayo Canyon	$1
Riverton Site	$5	Lakeview Mill	$2	Rifle (New) Mill	$1
Naval Oil Shale Reserves Site	$3	Naturita Mill	$2	Riverton Site	$1
Naval Petroleum Reserve No. 3 Landfill/Landfarm	$3	Slick Rock (Union Carbide) Mill 2	$2	Argonne National Laboratory East	$0
Bayo Canyon	$1	Bayo Canyon	$1	Brookhaven National Laboratory	$0
(Cotter) Cañon City Site	$0	Rifle (New) Mill	$1	Fermi National Accelerator Laboratory	$0
(Dawn) Ford Site	$0	Riverton Site	$1	Fort St. Vrain	$0
(EFN) White Mesa Site	$0	Fermi National Accelerator Laboratory	$0	Gunnison Mill	$0
(Homestake) Grants Site	$0	Gunnison Mill	$0	Hoe Creek Underground Coal Gasification Site	$0
(Kennecott) Sweetwater Site	$0	Hoe Creek Underground Coal Gasification Site	$0	Lawrence Berkeley National Laboratory	$0
Monument Valley Site	$0	Lovelace Respiratory Research Institute	$0	Lovelace Respiratory Research Institute	$0
Naturita Mill	$0	Piqua Nuclear Power Facility	$0	Pinellas STAR Center	$0
Pinellas STAR Center	$0	Princeton Plasma Physics Laboratory	$0	Piqua Nuclear Power Facility	$0
(Plateau) Shootaring Canyon Site	$0	Rifle (Old) Mill	$0	Princeton Plasma Physics Laboratory	$0

Table F-2. Annual Average Long-Term Stewardship Costs by Site*
(listed in order of highest to lowest cost)

FY 2000 - 2010		*FY 2031-2040*		*FY 2061-2070*	
Site	*Average Annual Cost (in 000s)*	*Site*	*Average Annual Cost (in 000s)*	*Site*	*Average Annual Cost (in 000s)*
(Quivira) Ambrosia Lake Site 2	$0	Rock Springs Oil Shale Retort Site	$0	Rifle (Old) Mill	$0
(UNC) Church Rock Site	$0	Salt Lake City Mill	$0	Rock Springs Oil Shale Retort Site	$0
Waste Isolation Pilot Plant	$0	Waste Isolation Pilot Plant	$0	Salt Lake City Mill	$0

* The average only includes years where long-term stewardship cost estimates are non-zero. Costs are in thousands of constant 2000 dollars.
** Long-term stewardship cost estimates for the Savannah River Site in South Carolina do not include any activities scheduled to begin after 2006. At this time, these activities are not well known and cost estimates are not included in this Report. Therefore, post-2006 cost estimates provided in this section are likely to underestimate the Department's long-term cost obligations.

Table F-3. Annual Average Long-Term Stewardship Costs by Operations/Program Office*

FY 2000-2010		*FY 2031-2040*		*FY 2061-2070*	
Site	*Cost (in 000s)*	*Site*	*Cost (in 000s)*	*Site*	*Cost (in 000s)*
Albuquerque Operations Office Sites	**4,194**	**Albuquerque Operations Office Sites**	**4,798**	**Albuquerque Operations Office Sites**	**4,096**
Pantex Plant	1,437	Pantex Plant	1,912	Kansas City Plant	1,302
Kansas City Plant	1,279	Kansas City Plant	1,302	Sandia National Laboratories - NM	1,070
Sandia National Laboratories - NM	922	Sandia National Laboratories - NM	1,010	Pantex Plant	990
Los Alamos National Laboratory	332	Los Alamos National Laboratory	490	Los Alamos National Laboratory	310
Lovelace Respiratory Research Institute	140	Sandia National Laboratories - CA	84	Sandia National Laboratories - CA	84
Sandia National Laboratories - CA	84	Lovelace Respiratory Research Institute	0	Lovelace Respiratory Research Institute	0
Carlsbad Office	**0**	**Carlsbad Office**	**0**	**Carlsbad Office**	**10,556**
Waste Isolation Pilot Plant	0	Waste Isolation Pilot Plant	0	Waste Isolation Pilot Plant	10,556
Chicago Operations Office	**4,875**	**Chicago Operations Office**	**215**	**Chicago Operations Office**	**0**
Brookhaven National Laboratory	4,150	Princeton Plasma Physics Laboratory	0	Argonne National Laboratory East	0
Argonne National Laboratory East	295	Argonne National Laboratory East	215	Brookhaven National Laboratory	0
Princeton Plasma Physics Laboratory	280	Fermi National Accelerator Laboratory	0	Fermi National Accelerator Laboratory	0
Fermi National Accelerator Laboratory	150	Brookhaven National Laboratory	0	Princeton Plasma Physics Laboratory	0
Fossil Energy	**3**	**Fossil Energy**	**7**	**Fossil Energy**	**7**
Rock Springs Oil Shale Retort Site	334	Naval Oil Shale Reserves Site	4	Naval Oil Shale Reserves Site	4
Hoe Creek Underground Coal Gasification Site	273	Naval Petroleum Reserve No. 3 Landfill/Landfarm	3	Naval Petroleum Reserve No. 3 Landfill/Landfarm	3
Naval Oil Shale Reserves Site	3	Hoe Creek Underground Coal Gasification Site	0	Hoe Creek Underground Coal Gasification Site	0
Naval Petroleum Reserve No. 3 Landfill/Landfarm	3	Rock Springs Oil Shale Retort Site	0	Rock Springs Oil Shale Retort Site	0
Grand Junction Office	**4,137**	**Grand Junction Office**	**3,595**	**Grand Junction Office**	**3,538**
Weldon Spring Site	1,006	Weldon Spring Site	1,006	Weldon Spring Site	1,006
Cheney Disposal Cell	454	Monticello Mill Site and Vicinity Properties	520	Monticello Mill Site and Vicinity Properties	520
Monticello Mill Site and Vicinity Properties	386	(Cotter) Cañon City Site	170	(Cotter) Cañon City Site	170
Palos Forest (Site A/Plot M) Preserve	170	(Dawn) Ford Site	170	(Dawn) Ford Site	170

Table F-3. Annual Average Long-Term Stewardship Costs by Operations/Program Office*

FY 2000-2010		*FY 2031-2040*		*FY 2061-2070*	
Site	*Cost (in 000s)*	*Site*	*Cost (in 000s)*	*Site*	*Cost (in 000s)*
Rifle (New) Mill	152	Palos Forest (Site A/Plot M) Preserve	170	Palos Forest (Site A/Plot M) Preserve	170
Grand Junction Mill 2	122	Grand Junction Mill 2	128	Grand Junction Mill 2	128
Bodo Canyon Cell	118	Pinellas STAR Center	77	Shiprock Site	59
Mexican Hat Site	106	Shiprock Site	59	(Conoco) Conquista Site	51
Falls City Site	105	(Conoco) Conquista Site	51	(UMETCO) Uravan Site	51
Canonsburg Site	103	(UMETCO) Uravan Site	51	Bodo Canyon Cell	50
Shiprock Site	91	Bodo Canyon Cell	50	Falls City Site	47
Lakeview Site	82	Falls City Site	47	Mexican Hat Site	45
Rifle (Old) Mill	76	Mexican Hat Site	45	(UNC) Church Rock Site	43
Green River Site	67	(UNC) Church Rock Site	43	(Chevron) Panna Maria Site	34
Burro Canyon Disposal Cell	59	Hallam Nuclear Power Facility	37	Lakeview Site	34
Tuba City Site	56	(Chevron) Panna Maria Site	34	(Pathfinder) Lucky Mc Site	34
Lowman Site	53	Lakeview Site	34	(Pathfinder) Shirley Basin Site 2	34
(UMETCO) Uravan Site	52	(Pathfinder) Lucky Mc Site	34	(Petrotomics) Shirley Basin Site 1	34
Gunnison Disposal Cell	47	(Pathfinder) Shirley Basin Site 2	34	(Quivira) Ambrosia Lake Site 2	34
(Conoco) Conquista Site	44	(Petrotomics) Shirley Basin Site 1	34	(SOHIO) LBAR Site	34
Lakeview Mill	44	(Quivira) Ambrosia Lake Site 2	34	Tuba City Site	34
Hallam Nuclear Power Facility	40	(SOHIO) LBAR Site	34	(UMETCO) Gas Hills Site	34
Burrell Site	38	Tuba City Site	34	(Union Pacific) Bear Creek Site	34
(WNI) Sherwood Site	37	(UMETCO) Gas Hills Site	34	(WNI) Sherwood Site	34
(Pathfinder) Lucky Mc Site	35	(Union Pacific) Bear Creek Site	34	(WNI) Split Rock Site	34
(Pathfinder) Shirley Basin Site 2	35	(WNI) Sherwood Site	34	Hallam Nuclear Power Facility	32
(Petrotomics) Shirley Basin Site 1	35	(WNI) Split Rock Site	34	Monument Valley Site	30
(UMETCO) Gas Hills Site	35	Monument Valley Site	30	Green River Site	28
(WNI) Split Rock Site	35	Green River Site	28	Burro Canyon Disposal Cell	26
(SOHIO) LBAR Site	34	Burro Canyon Disposal Cell	26	(EFN) White Mesa Site	26
(Union Pacific) Bear Creek Site	34	(EFN) White Mesa Site	26	(Exxon) Highlands Site	26

Table F-3. Annual Average Long-Term Stewardship Costs by Operations/Program Office*

FY 2000-2010		*FY 2031-2040*		*FY 2061-2070*	
Site	*Cost (in 000s)*	*Site*	*Cost (in 000s)*	*Site*	*Cost (in 000s)*
(Chevron) Panna Maria Site	33	(Exxon) Highlands Site	26	(Exxon) Ray Point Site	26
Estes Gulch Disposal Cell	32	(Exxon) Ray Point Site	26	(Homestake) Grants Site	26
(Exxon) Highlands Site	26	(Homestake) Grants Site	26	(Kennecott) Sweetwater Site	26
(Exxon) Ray Point Site	26	(Kennecott) Sweetwater Site	26	Maybell Mill Site	26
(Rio Algom) Lisbon Valley Site	26	Maybell Mill Site	26	(Rio Algom) Lisbon Valley Site	26
Maybell Mill Site	25	(Rio Algom) Lisbon Valley Site	26	(UMETCO) Maybell Site 2	26
(UMETCO) Maybell Site 2	25	(UMETCO) Maybell Site 2	26	Canonsburg Site	25
South Clive Disposal Cell	24	Canonsburg Site	25	Cheney Disposal Cell	24
Naturita Site	22	Cheney Disposal Cell	24	Lowman Site	24
Salt Lake City Mill	22	Lowman Site	24	(Plateau) Shootaring Canyon Site	24
Durango Mill	21	(Plateau) Shootaring Canyon Site	24	Ambrosia Lake Site	20
Spook Site	21	Ambrosia Lake Site	20	(ANC) Gas Hills Site	20
Ambrosia Lake Site	20	(ANC) Gas Hills Site	20	Parkersburg Site	18
(ANC) Gas Hills Site	20	Parkersburg Site	18	(Atlas) Moab Mill	16
Bluewater Site	18	(Atlas) Moab Mill	16	Burrell Site	16
Piqua Nuclear Power Facility	18	Burrell Site	16	Gunnison Disposal Cell	16
(Atlas) Moab Mill	17	Gunnison Disposal Cell	16	Estes Gulch Disposal Cell	14
Parkersburg Site	17	Estes Gulch Disposal Cell	14	Bluewater Site	13
Gunnison Mill	14	Bluewater Site	13	South Clive Disposal Cell	11
Grand Junction Mill 1	13	South Clive Disposal Cell	11	(HECLA) Durita Site	10
Slick Rock (North Continent) Mill 1	11	(HECLA) Durita Site	10	Spook Site	10
(HECLA) Durita Site	10	Spook Site	10	Naturita Site	9
Edgemont Site	8	Naturita Site	9	Edgemont Site	7
Slick Rock (Union Carbide) Mill 2	6	Edgemont Site	7	Grand Junction Mill 1	5
Riverton Site	5	Grand Junction Mill 1	5	Slick Rock (North Continent) Mill 1	4
(Cotter) Cañon City Site	0	Slick Rock (North Continent) Mill 1	4	Durango Mill	2
(Dawn) Ford Site	0	Durango Mill	2	Lakeview Mill	2
(EFN) White Mesa Site	0	Lakeview Mill	2	Naturita Mill	2

Table F-3. Annual Average Long-Term Stewardship Costs by Operations/Program Office*

FY 2000-2010		*FY 2031-2040*		*FY 2061-2070*	
Site	*Cost (in 000s)*	*Site*	*Cost (in 000s)*	*Site*	*Cost (in 000s)*
(Homestake) Grants Site	0	Naturita Mill	2	Slick Rock (Union Carbide) Mill 2	2
(Kennecott) Sweetwater Site	0	Slick Rock (Union Carbide) Mill 2	2	Rifle (New) Mill	1
Monument Valley Site	0	Rifle (New) Mill	1	Riverton Site	1
Naturita Mill	0	Riverton Site	1	Gunnison Mill	0
Pinellas STAR Center	0	Gunnison Mill	0	Pinellas STAR Center	0
(Plateau) Shootaring Canyon Site	0	Piqua Nuclear Power Facility	0	Piqua Nuclear Power Facility	0
(Quivira) Ambrosia Lake Site 2	0	Rifle (Old) Mill	0	Rifle (Old) Mill	0
(UNC) Church Rock Site	0	Salt Lake City Mill	0	Salt Lake City Mill	0
Idaho Operations Office	**7,479**	**Idaho Operations Office**	**5,400**	**Idaho Operations Office**	**3,600**
Idaho National Engineering and Environmental Laboratory	4,479	Idaho National Engineering and Environmental Laboratory	3,000	Idaho National Engineering and Environmental Laboratory	3,600
Fort St. Vrain	3,000	Fort St. Vrain	2,400	Fort St. Vrain	0
Nevada Operations Office	**2,587**	**Nevada Operations Office**	**6,340**	**Nevada Operations Office**	**7,868**
Nevada Test Site	2,191	Nevada Test Site	5,643	Nevada Test Site	7,322
Amchitka Island	95	Gasbuggy Site	154	Gasbuggy Site	154
Salmon Site	59	Central Nevada Test Area	135	Gnome-Coach	79
Rulison	45	Project Shoal	92	Central Nevada Test Area	54
Gasbuggy Site	43	Rulison	85	Project Shoal	54
Gnome-Coach	39	Gnome-Coach	79	Rio Blanco	54
Rio Blanco	39	Rio Blanco	55	Rulison	54
Central Nevada Test Area	38	Amchitka Island	43	Salmon Site	54
Project Shoal	38	Salmon Site	40	Amchitka Island	43
Oak Ridge Operations Office	**19,607**	**Oak Ridge Operations Office**	**15,915**	**Oak Ridge Operations Office**	**19,543**
Oak Ridge Reservation	7,633	Oak Ridge Reservation	8,499	Paducah Gaseous Diffusion Plant	9,560
Portsmouth Gaseous Diffusion Plant	6,067	Paducah Gaseous Diffusion Plant	5,716	Oak Ridge Reservation	8,562
Paducah Gaseous Diffusion Plant	5,881	Portsmouth Gaseous Diffusion Plant	1,674	Portsmouth Gaseous Diffusion Plant	1,395
Center for Energy and Environmental Research	25	Center for Energy and Environmental Research	25	Center for Energy and Environmental Research	25
Bayo Canyon	1	Bayo Canyon	1	Bayo Canyon	1
Oakland Operations Office	**14,178**	**Oakland Operations Office**	**1,319**	**Oakland Operations Office**	**116**

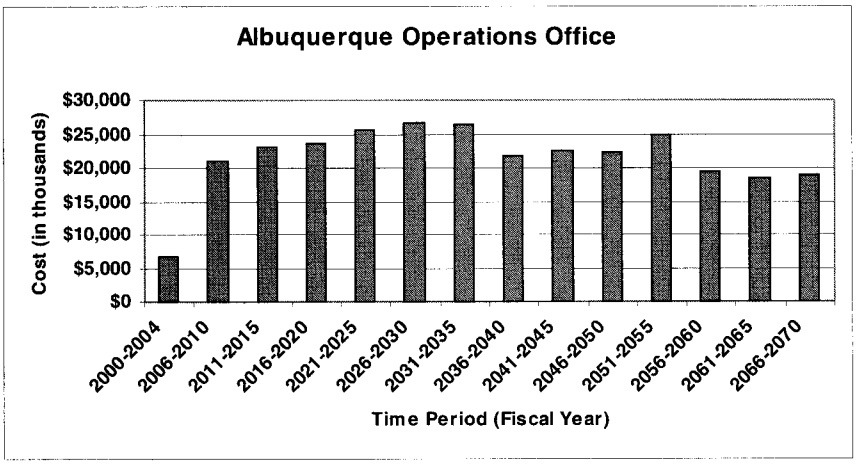
Table F-3. Annual Average Long-Term Stewardship Costs by Operations/Program Office*

FY 2000-2010		*FY 2031-2040*		*FY 2061-2070*	
Site	*Cost (in 000s)*	*Site*	*Cost (in 000s)*	*Site*	*Cost (in 000s)*
Lawrence Livermore National Laboratory - Livermore Site	8,248	Lawrence Berkeley National Laboratory	1,313	Lawrence Livermore National Laboratory - Livermore Site	150
Lawrence Livermore National Laboratory - Site 300	4,247	Lawrence Livermore National Laboratory - Livermore Site	496	Stanford Linear Accelerator	100
Lawrence Berkeley National Laboratory	1,183	Lawrence Livermore National Laboratory - Site 300	198	Lawrence Livermore National Laboratory - Site 300	22
Stanford Linear Accelerator	500	Stanford Linear Accelerator	100	Lawrence Berkeley National Laboratory	0
Ohio Field Office	**5,099**	**Ohio Field Office**	**1,978**	**Ohio Field Office**	**1,978**
Fernald Environmental Management Project	5,049	Fernald Environmental Management Project	1,928	Fernald Environmental Management Project	1,928
Miamisburg Environmental Management Project	50	Miamisburg Environmental Management Project	50	Miamisburg Environmental Management Project	50
Richland/Office of River Protection	**59**	**Richland/Office of River Protection**	**745**	**Richland/Office of River Protection**	**39,700**
Hanford Site	59	Hanford Site	745	Hanford Site	39,700
Rocky Flats Field Office	**6,752**	**Rocky Flats Field Office**	**6,024**	**Rocky Flats Field Office**	**6,176**
Rocky Flats Environmental Technology Site	6,752	Rocky Flats Environmental Technology Site	6,024	Rocky Flats Environmental Technology Site	6,176
Savannah River Operations Office	**20,240**	**Savannah River Operations Office**	**3,139**	**Savannah River Operations Office**	**13,267**
Savannah River Site**	20,240	Savannah River Site**	3,139	Savannah River Site**	13,267

* The average only includes years where long-term stewardship cost estimates are non-zero. Costs are in thousands of constant 2000 dollars.

** Long-term stewardship cost estimates for the Savannah River Site in South Carolina do not include any activities scheduled to begin after 2006. At this time, these activities are not well known and cost estimates are not included in this Report. Therefore, post-2006 cost estimates provided in this section are likely to underestimate the Department's long-term cost obligations.

APPENDIX G: CUMULATIVE COST BAR CHARTS DISPLAYED IN Five-Year INCREMENTS FOR EACH OPERATIONS OFFICE[55]



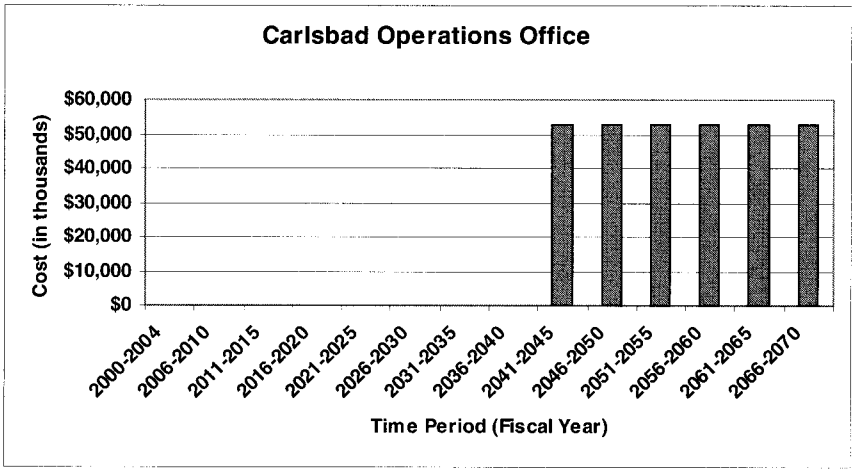
The Albuquerque Operations Office has six sites that will require long-term stewardship with sites (Lovelace Respiratory Research Institute and Sandia National Laboratories - CA) already conducting long-term stewardship activities by 2000. The long-term stewardship costs for the Albuquerque Operations Office increase sharply during the first five-year period (2000-2004), when two additional sites (the Pantex Plant and Sandia National Laboratories - NM) are scheduled to begin long-term stewardship activities. The final two sites (Los Alamos National Laboratory and the Kansas City Plant)are not scheduled to begin long-term stewardship activities until the second five-year period (2006-2010).

Long-term stewardship activities at the Pantex Plant are responsible for the largest costs for the Albuquerque Operations Office. Between 2000-2070 the Pantex Plant's long-term stewardship costs comprise approximately half of the total long-term stewardship costs. There is a small cost decrease between 2036 and 2040 precipitated solely by the long-term stewardship costs at the Pantex Plant. However, the site's costs are expected to increase until the end of 2055, at which time groundwater treatment and corrective action monitoring are expected to be completed (the time period for conducting groundwater compliance monitoring is not yet determined).

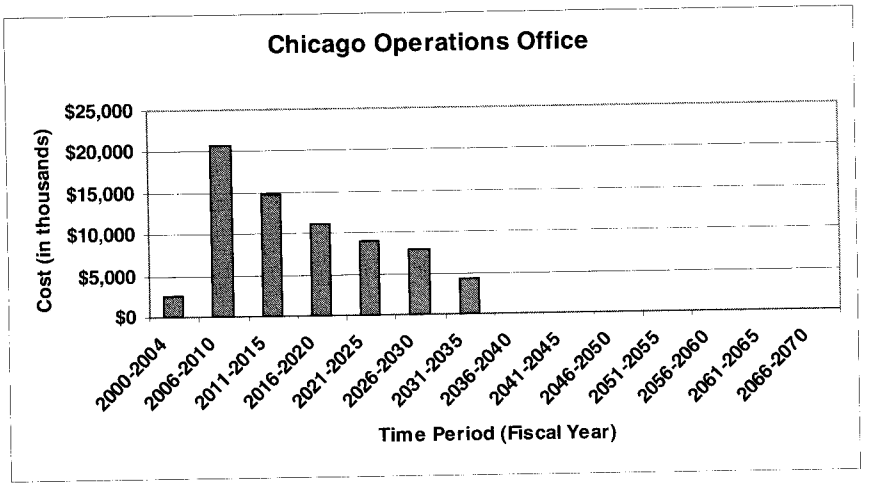
Only one site, the Lovelace Respiratory Research Institute (LRRI) is scheduled to complete long-term stewardship activities by 2070. LRRI is forecasted to complete long-term stewardship activities in 2010.

One additional site is under the Albuquerque Operations Office where DOE will not have long-term stewardship responsibility: the South Valley Superfund Site. Since the Department is not expected to have responsibility for long-term stewardship after remediation is complete, costs were not included for this site.

[55] All costs in thousands of constant 2000 dollars.



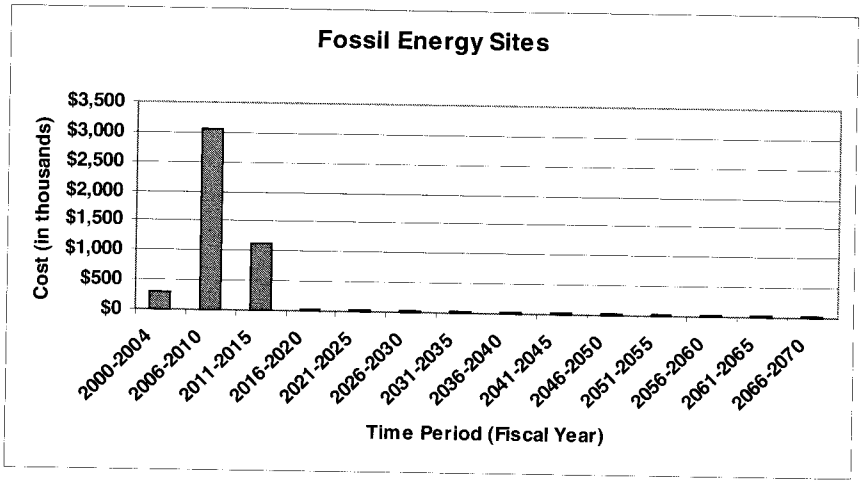
The Waste Isolation Pilot Plant (WIPP) is the only site in the Carlsbad Operations Office. WIPP is not projected to close until 2039, when DOE is expected to complete decontamination and decommissioning activities at the site. Therefore, long-term stewardship costs do not begin until 2040. Long-term stewardship costs are for maintaining active institutional controls. The expected long-term stewardship costs are anticipated to remain constant after 2040.



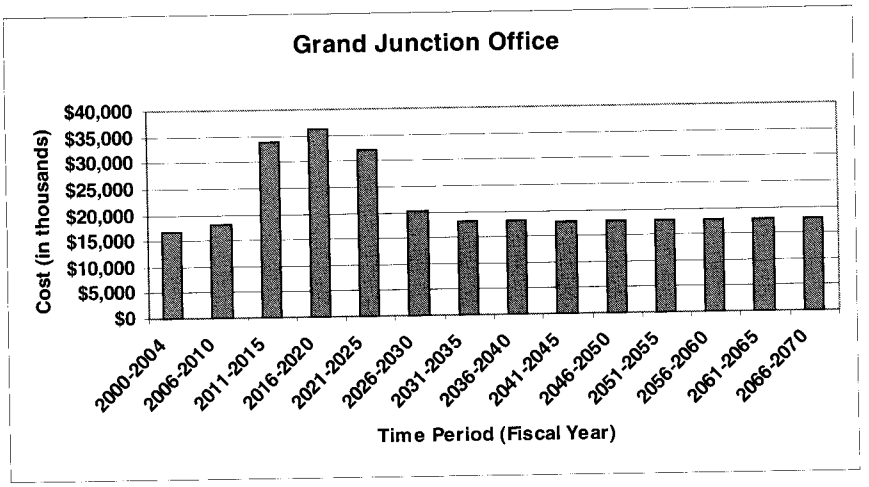
The Chicago Operations Office has four sites that will require long-term stewardship: Argonne National Laboratory-East (ANL-E), Brookhaven National Laboratory (BNL), Fermi National Accelerator Laboratory, Princeton Plasma Physics Laboratory. The Brookhaven National Laboratory represent nearly 80 percent of all long-term stewardship costs for the Chicago Operations Office. Therefore, projected long-term stewardship costs for the Chicago Operations Office closely mirror those of the Brookhaven National Laboratory. Cost estimates for the Chicago Operations Office peak during 2006-2010 period when costs for the Brookhaven National Laboratory are at their highest.

Costs for the Chicago Operations Office begin to drop in 2011, when the long-term stewardship programs at BNL and ANL-E (the site with the next highest long-term stewardship cost estimate) mature and have fewer high cost activities. Long-term stewardship costs will continue to gradually decrease at each of these sites until the projected long-term stewardship end dates of 2033 for ANL-E and 2035 for BNL. Smaller long-term stewardship commitments will end earlier for the two remaining Chicago Operations Office sites, the Princeton Plasma Physics Laboratory and the Fermi National Accelerator Laboratory, in 2010 and 2015 respectively.

One additional site is under the Chicago Operations Office where DOE will not have long-term stewardship responsibility: the Ames Laboratory in Iowa. Since the Department is not expected to conduct long-term stewardship, other than record-keeping activities, after remediation is complete, costs were not included for this site.



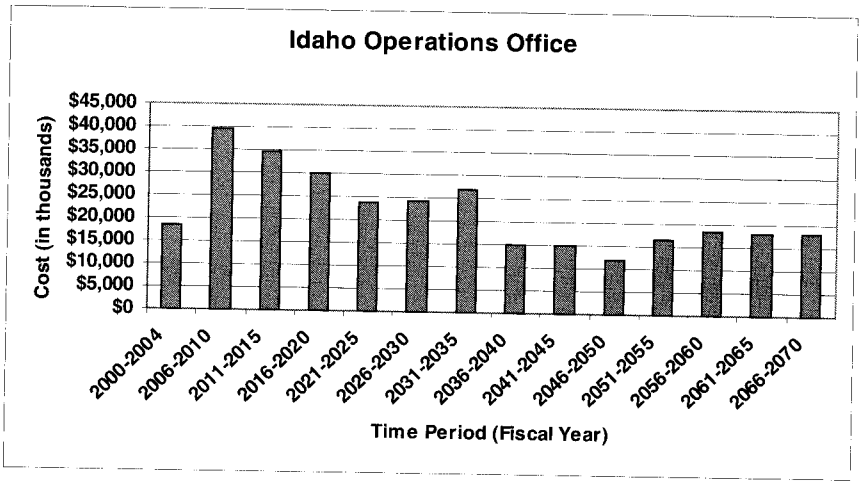
The majority of long-term stewardship costs for the four fossil energy sites (the Hoe Creek Underground Coal Gasification Site, the Naval Oil Shale Reserves Site, the Naval Petroleum Reserve No. 3 Landfill/Landfarm, and the Rock Springs Oil Shale Retort Site) are in the first 15 years, when the long-term stewardship costs for these sites consist of short-lived monitoring requirements. The vast majority of the costs are associated with two sites; the Hoe Creek Underground Gasification Site and the Rock Springs Oil Shale Retort Site. Costs continue beyond 2070 for two of the fossil energy sites(the Naval Oil Shale Reserves Site and the Naval Petroleum Reserve No. 3 Landfill/Landfarm), but are relatively small and are expected to remain constant.



The Grand Junction Office has 67 sites that require long-term stewardship. Long-term stewardship costs peak between 2011 and 2025. These costs are largely attributable to the groundwater monitoring activities at the various sites. During the 2011-2025 time frame, ten sites are scheduled to begin long-term stewardship activities, including nine UMTRCA Title II sites and the Pinellas STAR Center. The Cheney Cell, the Monument Valley Site, the Shiprock Site, and the Tuba City Site have the largest long-term stewardship costs among the sites under the Grand Junction Office.

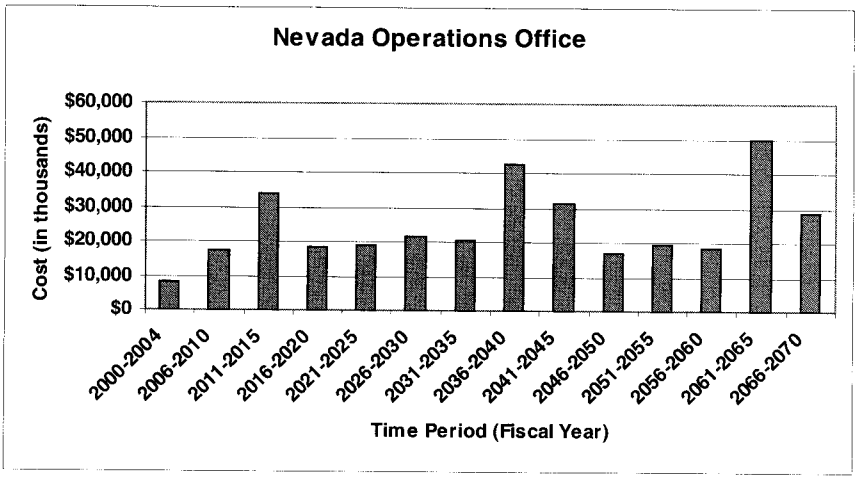
As the long-term stewardship program matures, monitoring requirements diminish for some of the sites in the Grand Junction Office. The effect of these reductions, particularly for groundwater monitoring, begin to take effect during the 2021-2025 time period and are visible in the graphic above. However, some of these decreases are offset by a cost increase at the Cheney Disposal Cell. In 2026, the remaining open section of the Cheney Disposal Cell is schedule to close, at which time long-term stewardship activities will be conducted across the entire site.

Beginning in 2026, the total projected long-term stewardship costs for the Grand Junction Office remain fairly constant through 2070. The remaining costs are primarily for activities associated with groundwater monitoring, disposal cell monitoring, and repair and maintenance.

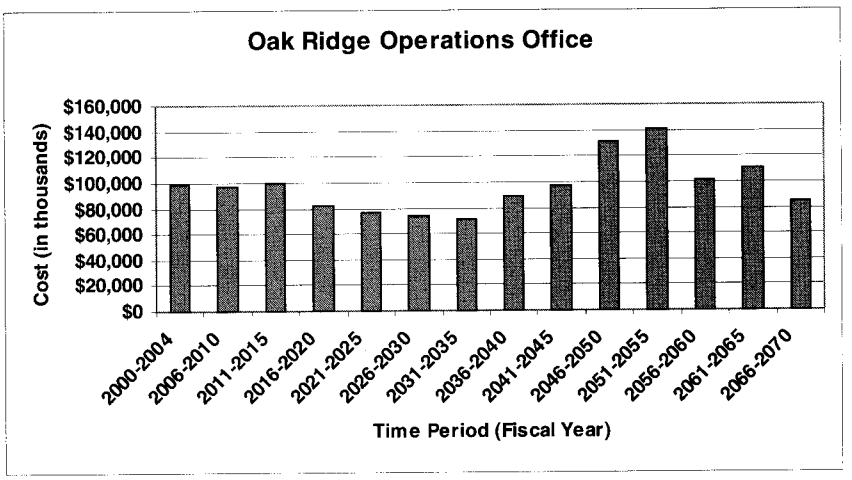


Site-wide remediation for INEEL is not scheduled to be completed until 2050, which explains a subtle increase in long-term stewardship costs in 2051-2055. However, long-term stewardship costs for INEEL peak during earlier years when monitoring requirements along with other long-term stewardship activities are expected to be most extensive. DOE anticipates that after 2070, INEEL's overall long-term stewardship cost estimate will continue to decrease slightly.

The major long-term stewardship activities that contribute to the Idaho Operations Office's cost estimate include engineered controls monitoring and maintenance (e.g., engineered unit caps and soil caps); quarterly groundwater monitoring; enforcing institutional controls, including access restrictions, for decontaminated and decommissioned facilities, residually contaminated soils, engineered units, and groundwater; and conducting CERCLA five-year reviews of those areas where residual contamination remains.



The Nevada Operations Office has nine sites that will require long-term stewardship. The Nevada Test Site's long-term stewardship activities represent the majority of the Nevada Operations Office's long-term stewardship cost estimate. The significant spikes in the Nevada Test Site's long-term stewardship cost estimate and, therefore, the Operations Office's cost estimate, are the result of well replacement activities approximately every 25 years at the site's underground test areas. Additional activities that contribute to the Nevada Operations Office cost estimate include air and groundwater monitoring. Aside from the Nevada Test Site, the other individual site cost estimates that comprise the Nevada Operations Office's long-term stewardship costs remain virtually unchanged across the seventy-year period, but also have small spikes approximately every 25 years for well replacement.

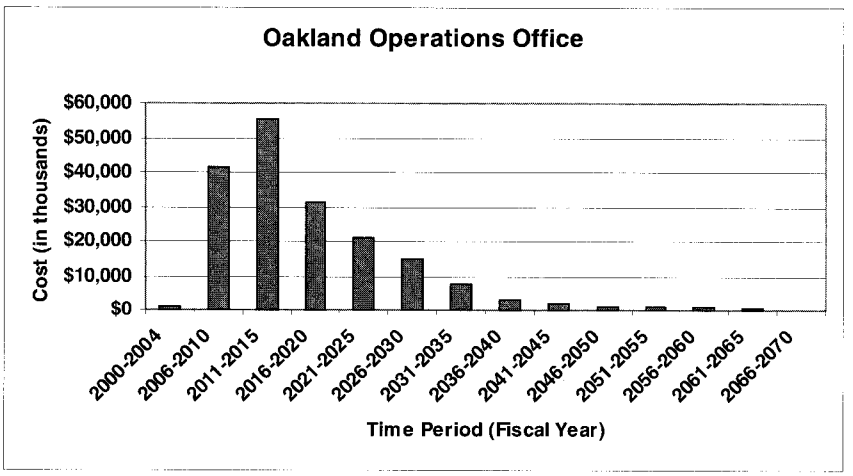


The Oak Ridge Operations Office's long-term stewardship cost estimate is composed of the long-term stewardship cost estimates for five sites: Bayo Canyon, the Center for Energy and Environmental Research, the Oak Ridge Reservation, the Paducah Gaseous Diffusion Plant, and the Portsmouth Gaseous Diffusion Plant. However, three sites (the Oak Ridge Reservation, Paducah Gaseous Diffusion Plant, and Portsmouth Gaseous Diffusion Plant) are primary contributors to the overall operations office cost estimate.

The long-term stewardship cost estimates for the other two sites (Bayo Canyon and the Center for Energy and Environmental Research) are small and remain constant between 2000 and 2070.

Generally, the long-term stewardship cost estimates for the three major sites or the overall operations long-term stewardship cost estimate decrease between 2000 and 2070, as monitoring requirements subside. The major long-term stewardship activities at these sites include groundwater monitoring and treatment; surface water monitoring and treatment; engineered barrier maintenance; monitoring, maintenance, and replacement of engineered controls; and institutional controls enforcement. However, some cost increases occur later due to scheduled replacement activities (e.g., cap replacement, water treatment and monitoring component replacement).

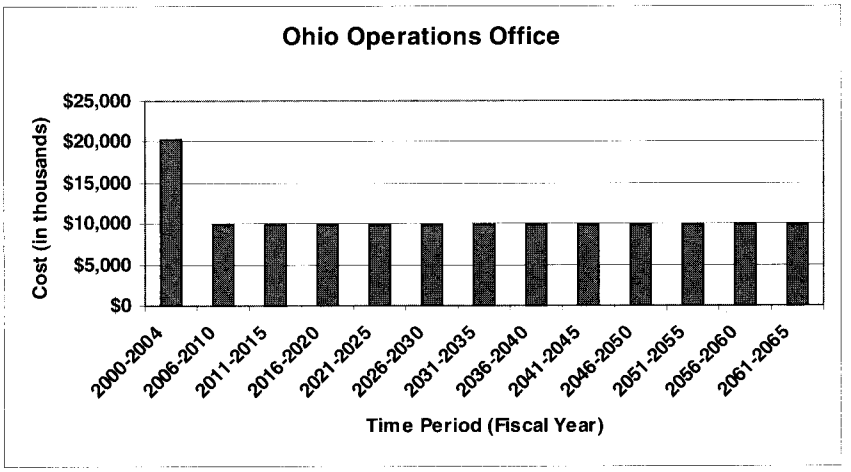
Two additional sites are under the Oak Ridge Operations Office where DOE will not have long-term stewardship responsibility: Maxey Flats Disposal Site and the Westlake Disposal Site. Since the Department is not expected to have responsibility for long-term stewardship after remediation is complete, costs were not included for these sites.



The Oakland Operations Office's long-term stewardship cost estimate is composed of the individual cost estimates of four sites: Lawrence Livermore National Laboratory - Livermore Site, Lawrence Livermore National Laboratory - Site 300, Berkeley National Laboratory, and the Stanford Linear Accelerator.

Only one of the four sites, the Stanford Linear Accelerator Center, is expected to begin accruing long-term stewardship costs during the initial period (2000-2004). The remaining three sites (Lawrence Berkeley National Laboratory, Lawrence Livermore National Laboratory-Livermore Site, and Lawrence Livermore National Laboratory-Site 300) begin reporting long-term stewardship costs during the second period (2006-2010), explaining the large increase in the projected long-term stewardship costs (approximately $40.6 million) between the 2000-2004 and 2006-2010 periods. The significant long-term stewardship activities at these sites include soil vapor extraction, subsurface barrier maintenance, well maintenance and operation, groundwater monitoring, and possibly active groundwater remediation. Only two sites (Lawrence Livermore National Laboratory-Livermore Site and Lawrence Livermore National Laboratory-Site 300) are expected to continue long-term stewardship activities beyond 2065.

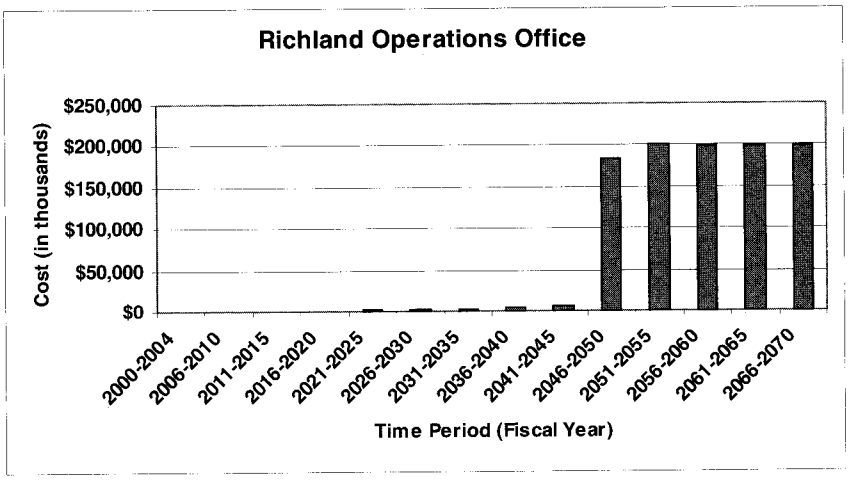
Four additional sites are under the Oakland Operations Office where DOE will not have long-term stewardship responsibility: the Energy Technology Engineering Center, General Atomics, General Electric Vallecitos Nuclear Center, and the Laboratory for Energy Related Health Research. Since the Department is not expected to have responsibility for long-term stewardship after remediation is complete, costs were not included for these sites.



The Ohio Operations Office's long-term stewardship cost estimate is comprised of two sites: the Fernald and Miamisburg Environmental Management Project sites. The high cost estimate for long-term stewardship activities during the first five-year period (2000-2004) is attributable to long-term stewardship activities at Fernald. After the initial five-year period, the Ohio Operations Office's long-term stewardship cost estimate remains constant at nearly $10 million for each of the remaining five-year periods. The primary long-term stewardship activities at the sites within the Ohio Operations Office include site monitoring with associated sampling, analysis, and reporting; maintenance activities; leachate removal and treatment; disposal cell monitoring; groundwater monitoring; and enforcement of institutional controls.

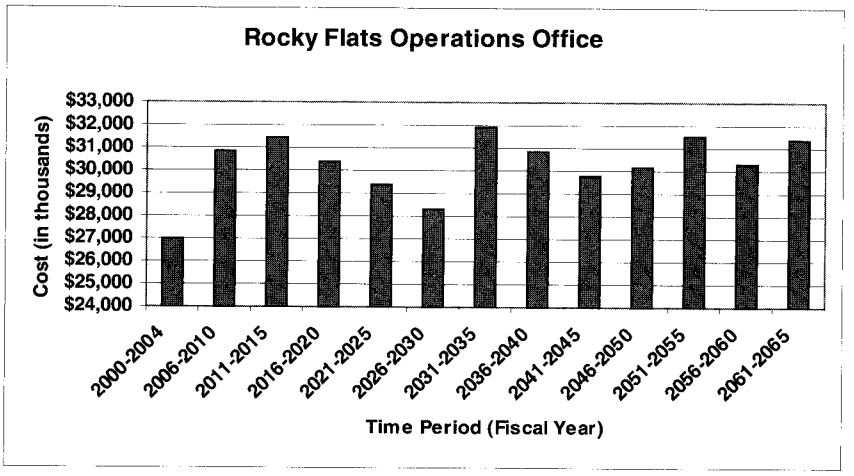
Four additional sites are under the Ohio Operations Office where DOE will not have long-term stewardship responsibility: the Ashtabula Environmental Management Project (*RMI Titanium Company Site*), Battelle Columbus-King Avenue, Battelle Columbus-West Jefferson, and the West Valley Demonstration Project.[56] Since the Department is not expected to have responsibility for long-term stewardship after remediation is complete, costs were not included for these sites.

[56] Long-term stewardship responsibilities for the West Valley Demonstration Project are yet to be determined.



The costs for the Richland Operations Office are represented by the Hanford Site. For the purposes of this Report the long-term stewardship costs for the Office of River Protection have been combined with the Richland Operations Office estimates. Although long-term stewardship activities began prior to 2000, the significant long-term stewardship costs are not expected until the completion of remediation at critical areas of the site, such as the Environmental Restoration Disposal Facility and the high level waste tank farm. The completion of site-wide remediation is not scheduled until 2048. Consequently, the many long-term stewardship costs are scheduled to begin following the completion of remediation for the entire site. Also, ongoing activities (i.e., access restrictions) which are currently categorized under other budget categories will fall under long-term stewardship responsibilities after the completion of site-wide cleanup.

The Hanford Site will determine the specific institutional controls, and surveillance and maintenance activities for each area as the remediation activities are completed. However, the major ongoing or anticipated activities in the site's long-term stewardship cost estimate are: institutional controls enforcement (including deed restrictions), radiological surveys (reactors), confinement systems repair (reactors), air monitoring, effluent monitoring, surface contamination monitoring, vegetation growth control and contaminated vegetation removal (contaminated soil), semi-annual groundwater monitoring, and facility repairs (major facility repairs every five years and roof replacement every 20 years).

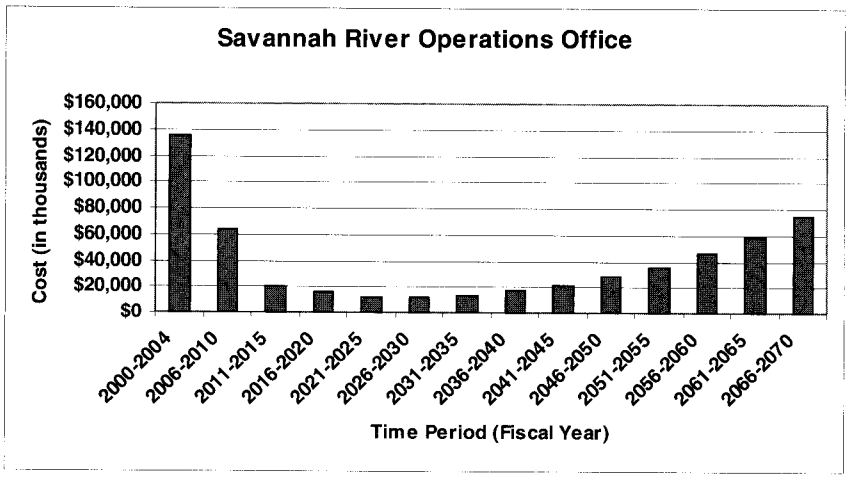


The Rocky Flats Operations Office consists solely of the Rocky Flats Environmental Technology Site. Remediation of this site is scheduled to be complete by 2006. Therefore, no long-term stewardship costs are reported between 2000-2005. Costs are expected to remain relatively constant throughout the following years and are dedicated for a number of long-term stewardship activities, including: groundwater and surface water monitoring, passive groundwater treatment, cap maintenance (if caps are needed), and ecological monitoring in the site's buffer zone.

DOE expects that if caps are needed as engineered barriers for facility foundations, the Solar Evaporation Ponds, and the Present Landfill, they will require period inspections, including the surrounding vegetation. Leachate collection and passive groundwater treatment at the Present Landfill are expected to continue during long-term stewardship. Weekly air sampling of the Present Landfill (and other engineered units if needed) and monthly analysis of the samples for particulate air quality will likely be required as part of the long-term stewardship activities.

The cost estimate assumes that the iron filings in each of the three groundwater treatment vessels (located at the Mound Site, the East Trenches, and the Solar Evaporation Ponds) will need to be replaced approximately every 10 years. The spent filings will be disposed of as low-level waste. A fourth passive groundwater treatment system may be installed to control the Industrial Area groundwater plume.

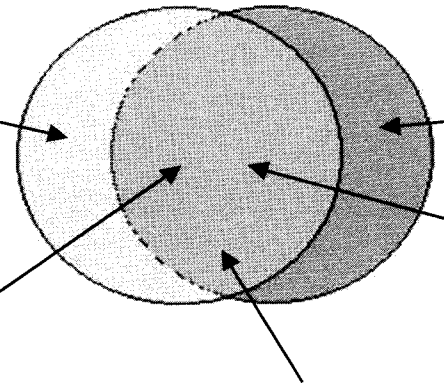
There are 89 groundwater monitoring wells on the site. Groundwater monitoring is expected to continue as part of the site's long-term stewardship program. The number of active groundwater monitoring wells may decrease over time. DOE estimates that groundwater monitoring will be the single greatest long-term stewardship cost for the site. Surface water is sampled monthly at eight locations on the site.



The Savannah River Operations Office consists solely of the Savannah River Site. High costs in the 2000-2004 period are due to significant pump and treat operations. These activities steadily decline during 2006-2010. A significant difference between the cost estimate for the Savannah River Site and other sites is that the estimate for the Savannah River Site only includes long-term stewardship costs for activities scheduled to begin by the end of 2006. The post-2006 activities are not included due to the high uncertainty in determining the extent of long-term stewardship activities. Therefore, the estimate provided is likely to be an underestimate of the Department's long-term stewardship cost obligation at the site. Also, the Savannah River Site assumes a standard cost increase for long-term care and maintenance of site facilities, which is expected to cause an upward trend for costs in later years.

The major long-term stewardship activities that drive the site's cost estimate include monitoring the closed tanks in the F and H Tank Areas (four tanks in the F Tank Area by the end of 2006); annually monitoring inactive site facilities; groundwater monitoring; engineered units monitoring, operation and maintenance of treatment facilities; maintenance of institutional (e.g., deed restrictions) and engineered controls (e.g., caps); and compliance support.

APPENDIX H: COMPARISON OF *STATUS REPORT ON PATHS TO CLOSURE* AND *REPORT TO CONGRESS, LONG-TERM STEWARDSHIP* SITE LISTS



Sites that are included in the Report to Congress but are not included in the *Paths to Closure* report: 58

(ANC) Gas Hills Site
Ashland Oil #1
Ashland Oil #2
Bliss and Laughlin Steel
Bluewater Site
Burrell Site
Burro Canyon Disposal Cell
CE
(Chevron) Panna Maria Site
Colonie
(Conoco) Conquista Site
(Cotter) Cañon City Site
(Dawn) Ford Site
DuPont & Company
Edgemont Site
(EFN) White Mesa Site
Estes Gulch Disposal Cell
(Exxon) Highlands Site
(Exxon) Ray Point Site
Fort St. Vrain
(HECLA) Durita Site
Hoe Creek Underground Coal Gasification Site
(Homestake) Grants Site
(Kennecott) Sweetwater Site
Latty Avenue Properties
Linde Air Products
Luckey
Madison
Maywood Chemical Works
Middlesex Sampling Plant
Naval Oil Shale Reserves Site
Naval Petroleum Reserve No. 3 Landfill/Landfarm
Niagara Falls Storage Site
Painesville
Parkersburg Site
(Pathfinder) Lucky Mc Site
(Pathfinder) Shirley Basin Site 2
(Petrotomics) Shirley Basin Site 1
(Plateau) Shootaring Canyon Site
(Quivira) Ambrosia Lake Site 2
(Rio Algom) Lisbon Valley Site
Rock Springs Oil Shale Retort Site
St. Louis Airport Site
St. Louis Airport Site Vicinity Properties
St. Louis Downtown Site
Seaway Industrial Park
Shpack Landfill
(SOHIO) LBAR Site
(UMETCO) Gas Hills Site
(UMETCO) Uravan Site
(UNC) Church Rock Site
(Union Pacific) Bear Creek Site
W.R. Grace and Company
Wayne Site
Westlake Disposal Site
(WNI) Sherwood Site
(WNI) Split Rock Site
11(e)2 Disposal Site

Sites that are included in both Paths to Closure and the Report to Congress: 69*

Ambrosia Lake Site (Ambrosia Lake, NM)
Amchitka Island
Ames Laboratory
Argonne National Laboratory East
Ashtabula Environmental Management Project
(Atlas) Moab Mill
Battelle Columbus - King Avenue (Columbus Environmental Management Project - King Avenue
Battelle Columbus - West Jefferson (Columbus Environmantal Management Project - West Jefferson)
Bayo Canyon
Brookhaven National Laboratory
Canonsburg Site (Canonsburg, PA)
Center for Energy and Environmental Research
Central Nevada Test Area
Energy Technology Engineering Center
Falls City Site (Falls City, TX)
Fermi National Accelerator Laboratory
Fernald Environmental Management Project
Gasbuggy Site
General Atomics
General Electric Vallecitos Nuclear Center
Gnome-Coach
Green River Site (Green River, UT)
Grand Junction Mill 1 (Grand Junction Mill Tailings Site, CO)
Hallam Nuclear Power Facility
Hanford Site
Idaho National Engineering and Environmental Laboratory
Kansas City Plant
Laboratory for Energy Related Health Research
Lawrence Berkeley Naitonal Laboratory
Lawrence Livermore National Laboratory - Livermore Site
Lawrence Livermore National Laboratory - Site 300
Lowman Site (Lowman, ID)
Los Alamos National Laboratory
Lovelace Respiratory Research Institute (Inhalation Toxicology Research Institute)
Maxey Flats Disposal Site
Mexican Hat Site (Mexican Hat, UT)
Miamisburg Environmental Management Project
Monticello Remedial Action Project
Monument Valley Site (Monument Valley, AZ)
Nevada Test Site
Oak Ridge Reservation
Paducah Gaseous Diffusion Plant
Portsmouth Gaseous Diffusion Plant
Palos Forest (Site A/Plot M) Preserve (Site A/Plot M)
Pantex Plant
Pinellas STAR Center (Pinellas Plant)
Piqua Nuclear Power Facility
Princeton Plasma Physics Laboratory
Project Shoal
Rifle (New) Mill Site (New Rifle, CO)
Rifle (Old) Mill Site (Old Rifle, CO)
Rio Blanco
Riverton Site (Riverton, WY)
Rocky Flats Environmental Technology Site
Rulison
Salmon Site
Sandia National Laboratories - CA
Sandia National Laboratories - NM
Savannah River Site
Shiprock Site (Shiprock, NM)
Slick Rock (North Continent) Mill 1 (Slick Rock Old North Continent, CO)
Slick Rock (Union Carbide) Mill 2 (Slick Rock Union Carbide, CO)
South Valley Superfund Site
Spook Site (Spook, WY)
Stanford Linear Accelerator (Stanford Linear Accelerator Center)
Tuba City Site (Tuba City, AZ)
Waste Isolation Pilot Plant
Weldon Spring Site
West Valley Demonstration Project

Sites that are included in the *Paths to Closure* report but are not included in the Report to Congress: 35

Acid/Pueblo Canyons
Alba Craft
Albany Research Center
Aliquippa Forge
Associate Aircraft
B&T Metals
Baker and Williams Warehouses
Baker Brothers
Belfield, ND
Bowman, ND
C.H. Schnoor
Chapman Valve
Chupadera Mesa
Elza Gate
General Motors
Geothermal Test Facility
Granite City Steel
Herring-Hall Marvin Safe Co.
Holloman Air Force Base
Kauai Test Facility
Kellex/Pierpont
Middlesex Municipal Landfill
National Guard Armory
New Brunswick Site
Niagara Falls Storage Site Vicinity Properties
Oxnard Facility
Pagano Salvage Yard
Peak Oil PRP Participation
Project Chariot
Salton Sea Test Base
Separation Process Research Unit
Seymour Specialty Wire
University of California
University of Chicago
Ventron

Sites in the *Paths to Closure* report that have been divided into two or more sites in the Report to Congress: 7*

(Durango, CO)
Bodo Canyon Cell
Durango Mill

(Grand Junction Office)
Cheney Disposal Cell
Grand Junction Mill 1
Grand Junction Mill 2

(Gunnison, CO)
Gunnison Disposal Cell
Gunnison Mill Site

(Lakeview, OR)
Lakeview Mill
Lakeview Site

(Maybell, CO)
Maybell Mill Site
(UMETCO) Mill Site 2

(Naturita, CO)
Naturita Mill
Naturita Site

(Salt Lake City, UT)
Salt Lake City Mill
South Clive Disposal Cell

* *Paths to Closure* site names are in parentheses.

Sites in the *Paths to Closure* report that are considered portions of other sites in the Report to Congress: 3

Argonne National Laboratory West (INEEL)
Oak Ridge Associated Universities (ORR)
Tonopah Test Range (NTS)

* Site names in the *Paths to Closure* report are in parentheses if they differ from their corresponding names in the Report to Congress.

APPENDIX I: SUMMARY OF THE "LONG-TERM STEWARDSHIP TRANSITION TO SITE LANDLORD" POLICY

The Deputy Secretary has directed that the landlord Program Secretarial Officers shall be responsible for conducting the Long-Term Stewardship program at their sites, unless other arrangements are made. The objective of this policy is to initiate actions which will lead facilities to plan, budget and transition long-term stewardship activities in a timely fashion. The smooth transition of long-term stewardship responsibility depends on three important factors: (1) establishing a plan and an operating baseline for long-term stewardship activities; (2) determining and programming the resources and budget required to execute those activities; and (3) formalizing a memorandum of agreement to conduct those activities and to make continuous enhancements to the program.

Sites should consider the following factors when determining the appropriate long-term stewardship activities to ensure that Departmental Long-term stewardship objectives are met.

A. **Monitoring hazards and maintaining engineered and institutional controls.** Understanding the relationship between technologies being implemented during cleanup and the long-term management of residual site hazards; operating and maintaining engineered and institutional controls; and performing surveillance, monitoring, and reporting associated with residual hazards. Includes developing and using new science and technology before cleanup to ensure decisions are based on the best science available.

B. **Re-evaluating controls and strategies.** Periodically re-evaluating long-term stewardship strategies given changes in knowledge, science, and site conditions. Long-term stewardship is not simply the oversight of engineered barriers and technologies already put in place; it also determines the appropriate changes in engineered/institutional controls based on new information and knowledge (e.g., changing cancer potency estimates).

C. **Emergency response.** Responding to incidents onsite or offsite (e.g., fire and rescue); spills and other chemical releases; and natural disasters (e.g., earthquakes, tornadoes). Emergencies may directly involve residual hazards (e.g., discovery of new contamination) or may involve such hazards indirectly (e.g., a fire may sweep across areas containing residual hazards).

D. **Compliance oversight.** Ensuring that: established standards or early warning "triggers" are not exceeded; protection of health, safety, and the environment is adequate; and monitoring data and other information are being collected and disseminated in accordance with existing requirements.

E. **Resource management.** Activities related to managing natural, mineral, land, and cultural resources onsite and offsite. Some resources (e.g., endangered species, cultural resources) may require special protection unrelated to the primary long-term stewardship mission.

F. **Administrative support.** Includes annual budget preparation; status reporting to Congress and others; policy or regulatory analyses; business management (e.g., payroll, accounting); maintaining roads and infrastructure; providing safeguards and security; and supporting research, development, and implementation of new technologies to address residual hazards.

G. **Site redevelopment.** Economic redevelopment of the site after cleanup is complete, including re-use of existing facilities or infrastructure; construction of new facilities or infrastructure; and revising land and resource use restrictions as new information and knowledge become available.

H. **Mission planning.** Planning for new site missions, including siting, design and operation of the mission (including construction or modification of facilities); demobilization of the mission; cleanup; and additional long-term stewardship activities.

I. **Community planning.** Conducted primarily by State, local, and tribal governments, includes siting of roads, schools, hospitals, residences, and other important infrastructure; supporting decisions regarding zoning and other land use issues; granting of easements and other "rights of way;" and economic development in communities surrounding the site.

Glossary

GLOSSARY

Active Long-Term Stewardship: The direct performance of continuous or periodic custodial activities, such as controlling access to a site by means other than passive institutional controls, controlling or cleaning up releases from a site, performing maintenance operations on remediated areas at a site, or monitoring performance parameters at a disposal or release site.

Activity: The rate at which radioactive material emits radiation. Stated in terms of the number of nuclear disintegrations occurring in a unit of time, the common unit of radioactivity is the curie (Ci).

Agricultural Land Use: Unfenced areas where subsistence or commercial agriculture predominates without any restrictions on surface or groundwater use.

Atomic Energy Act: The Federal law created in 1946 to create a virtual monopoly on uses of nuclear energy and information within the U.S. Atomic Energy Commission. Substantially amended in 1954 to promote and regulate the production and uses of atomic power, with minor amendments since then.

Atomic Energy Commission (AEA): The Federal agency created by the United States Congress in 1946 (through the Atomic Energy Act) as the civilian agency responsible for uses of nuclear energy, including development of nuclear weapons. It also regulated the private use of radioactive materials and promoted energy development. In 1974, its weapons production and research activities were transferred to the Energy Research and Development Administration (ERDA), and its regulatory responsibility was given to the new Nuclear Regulatory Commission (see Energy Reorganization Act of 1974). The functions of ERDA were transferred to the U.S. Department of Energy in 1977.

Background Concentration: The concentration of a substance in an environmental media (air, water, or soil) that occurs naturally and is not the result of human activities.

Base Case: The estimated total program cost (i.e., reported in the 1995 and 1996 Baseline Environmental Management Reports) that reflects the most likely activities and schedule under current projections.

Berm: A mound or wall of earth; a narrow shelf, path, or ledge typically at the top or bottom of a slope.

Biodegradation: The breakdown of a substance by living things (as microorganisms) into innocuous products.

Burial Grounds: Areas designated for near-surface disposal of containers of low-level radioactive waste and obsolete or worn-out radioactively contaminated equipment.

Byproduct: Radioactive material from producing or processing nuclear materials. Some waste, materials, and contaminated media have beneficial commercial uses.

Canyon: A vernacular term for a chemical separations plant, inspired by the plant's long, high, narrow structure (e.g., the Savannah River Site's F and H Canyons). However, not all chemical separations plants are canyons.

Characterization: Sampling, monitoring, and analysis activities to determine the extent and nature of contamination at a facility or site. Characterization provides the necessary technical information to develop, screen, analyze, and select appropriate cleanup techniques.

Clean Closure: Closure of a site by removal or decontamination of contaminated materials. All hazardous wastes have been removed from a given Resource Conservation and Recovery Act (RCRA) regulated unit and any releases at or from the unit have been remediated so that further regulatory control under RCRA Subtitle C is not necessary to protect human health and the environment. As part of meeting the clean closure performance standard, facility owners/operators must remove all wastes from the closing unit and remove or decontaminate

all waste residues, contaminated containment system components, contaminated soils (including groundwater and any other environmental media contaminated by releases from the closing unit), and structures and equipment contaminated with hazardous waste and hazardous waste leachate to the extent necessary to protect human health and the environment.

Cleanup: The process of addressing contaminated land, facilities, and materials in accordance with applicable requirements. Cleanup does not imply that all hazards will be removed from the site. The term "remediation" is often used synonymously with cleanup. See also "environmental restoration."

Cocooning: (See Entombing).

Cold War Mortgage: The cost and effort associated with addressing the environmental legacy of 50 years of nuclear weapons production.

Completion of Cleanup: A condition in which cleanup of a site is considered complete or when deactivation or decommissioning of all facilities currently in the Environmental Management program has been complete, excluding any long-term surveillance and monitoring; all releases to the environment have been cleaned up in accordance with agreed-upon cleanup standards; groundwater contamination has been contained or long-term treatment or monitoring is place; nuclear material and spent fuel have been stabilized and/or placed in safe long-term storage; and "legacy" waste (i.e, waste produced by past nuclear weapons production activities, with the exception of high-level waste) has been disposed of in an approved manner.

Compliance Agreement: Legally binding agreement between regulators and regulated entities that sets standards and schedules for compliance with environmental statutes.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA): Public Law 96-510, 42 U.S.C. 9601 et seq.: a Federal law (also known as Superfund), enacted in 1980 and reauthorized in 1986, that provides the legal authority for emergency response and cleanup of hazardous substances released into the environment and for the cleanup of inactive waste sites.

Comprehensive Land Use Planning: A required site planning and management system to develop and maintain current and future land use plans and any type of development, use, or disposal planning for the site. Stakeholders are involved in development of Comprehensive Land Use Plans.

Consent Decree: A legally binding document that delineates actions previously agreed upon by the parties. In the case of DOE, a Consent Order outlines planned DOE actions to remediate environmental problems in return for the other party's consent to cease litigation.

Constant Dollars: A term that represents a dollar value adjusted for changes in prices. Dollars in the future are adjusted to strip out inflation by dividing current dollar amounts by an appropriate index, a process known as deflating. The result is a constant dollar series as it would exist if prices and transactions were the same in all subsequent years as the base year. Any changes in such a series would reflect only changes in the real volume of goods and services. This Report's cost projections are in thousands of constant 2000 dollars.

Contaminant: Any physical, chemical, biological, or radiological substance or matter that has an adverse effect on air, water, or soil.

Contaminant of Concern: Radionuclide or nonradionuclide contaminants that pose a risk to human health or the environment and are addressed by the remedial alternatives.

Controlled Access Land Use: DOE maintains restricted access for secure storage or disposal of nuclear materials or waste. Barriers and security fences prevent access by unauthorized persons. Wildlife and plants are controlled or removed.

Curie (Ci): A unit of radioactivity equal to 37 billion disintegrations per second (i.e., 37 billion becquerels); also a quantity of any radionuclide or mixture or radionuclides having one curie of

radioactivity.

Decommissioning: Retirement of a nuclear facility, including decontamination and/or dismantlement.

Decontamination: Removal of radioactive or hazardous contamination by a chemical or mechanical process.

Disposal Cell: An engineered unit or waste disposal and containment structure that is designed to safely store waste for extended periods and prevent escape of contaminants to the surrounding environment. The disposal cell may include a multi-layered cover which inhibits the escape of contaminants, prevents wind and water erosion of the contaminated materials in the cell, and prevents precipitation from percolating through the waste.

DNAPLs: An acronym for dense, non-aqueous phase liquids. DNAPLs are composed of one or more organic contaminants, do not mix with water, and are denser than water. The most common DNAPLs contaminants in groundwater are chlorinated solvents.

Department of Energy (DOE): The cabinet-level U.S. Government agency responsible for nuclear weapons production, energy research, isotope production, and the cleanup of hazardous and radioactive waste at it sites. It was created from the Energy Research and Development Administration and other Federal Government functions in 1977.

DOE Office of Environmental Management: An office of DOE that was created in 1989 to oversee the Department's waste management and environmental cleanup efforts. Originally called the Office of Environmental Restoration and Waste Management, it was renamed in 1993.

Disposition: Recycling and reuse, sale, transfer, storage, treatment, or disposal.

Encapsulation: A process whereby waste is placed and sealed in casks, cans, or other containers to prevent the material from moving through the environment.

End State: The physical state of a site after agreed upon remediation activities have been completed.

Energy Reorganization Act of 1974: The Federal law that divided the Atomic Energy Commission (AEC) into the Energy Research and Development Agency (ERDA) and the Nuclear Regulatory Commission (NRC). The weapons and research portions of AEC were transferred to ERDA and later merged into DOE (1977). The regulatory aspects of AEC were assigned to the Nuclear Regulatory Commission.

Engineered Controls: Includes radioactive, hazardous, and sanitary landfills; vaults; repositories; in-situ stabilization; caps on residual contamination; or other man-made controls designed to isolate or to contain waste or materials.

Engineered Units: Includes radioactive, hazardous, and sanitary landfills; vaults; tank farms; and other units with manmade containment systems.

Enriched Uranium: Uranium that, as a result of the process of enrichment, has more uranium-235 than natural uranium.

Entombment: An alternative for dispositioning surplus facilities by burial or covering in a vault.

Environmental Contamination: The release into the environment of radioactive, hazardous, or toxic materials.

Environmental Impact Statement (EIS): The detailed written statement that is required by Section 102(2)(C) of the *National Environmental Policy Act (NEPA)* for a proposed major Federal action that could significantly affect the quality of the human environment. A DOE EIS is prepared in accordance with applicable requirements of the Council on Environmental Quality's *NEPA* regulations in 40 CFR Parts 1500-1508, and the DOE *NEPA* regulations in 10 CFR 102 1. The statement includes, among other information, discussions of the environmental impacts of the proposed action and all reasonable alternatives, adverse environmental effects that cannot be avoided should the proposal be implemented, the

relationship between short-term uses of the human environment and enhancement of long-term productivity, and any irreversible and irretrievable commitments of resources.

Environmental Protection Agency: A Federal agency established in 1970 to enforce environmental laws, including the *Resource Conservation and Recovery Act*; the *Comprehensive Environmental Response, Compensation, and Liability Act*; and the *Toxic Substances Control Act.*

Environmental Restoration: Often described broadly as "cleanup," this function encompasses a wide range of activities, such as stabilizing contaminated soil; treating groundwater; decommissioning process buildings, nuclear reactors, chemical separations plants, and many other facilities; and exhuming sludge and buried drums of waste.

Feasibility Study: An analysis of the practicality of a proposal, such as a description and analysis of the potential cleanup alternatives for a site. The Feasibility Study emphasizes data analysis and usually recommends selecting a cost-effective alternative. It is usually performed with and uses physical engineering measures, such as treatment and containment systems.

Federal Facility Agreement: A type of compliance agreement under Section 120 of the *Comprehensive Environmental Response, Compensation, and Liability Act*, which requires written interagency agreements for compliance activities between the U.S. Department of Energy and the U.S. Environmental Protection Agency.

Finding of Suitability for Transfer (FOST). FOST determines that the property is suitable for transfer by deed for the intended purpose, if known, because the requirements of *CERCLA* Section 120(h)(3) have been met for the property, taking into account the potential risk of future liability.

Fiscal Year: A 12-month period for which an organization plans the use of its funds. In the Federal Government this period extends from October 1 through September 30 of the following calendar year. Fiscal year is commonly denoted by its abbreviation "FY."

Fissile: Capable of being split by a low-energy neutron. The most common fissile isotopes are uranium-235 and plutonium-239.

Formerly Utilized Sites Remedial Action Program (FUSRAP): A Federal program initiated in 1974 to identify and remediate sites around the country that were contaminated during the 1940s and 1950s as a result of researching, developing, processing, and producing uranium and thorium, and storing the subsequent processing residues. In October 1997, the Energy and Water Development Appropriations Act for fiscal year 1998 transferred responsibility for the administration and execution of the FUSRAP program from DOE to the U.S. Army Corps of Engineers. At the time of transfer on October 13, 1997, DOE had completed the cleanup of 25 of the 46 FUSRAP sites.

French Drain: A drainage pipe.

Funding Organization: Agency which provides financial support for stewardship activities.

Gaseous Diffusion: The process used in the United States to enrich uranium-235 so that it is usable in weapons production and nuclear energy.

Half-Life: The time it takes for one-half of any given number of unstable atoms to decay to another nuclear form. Each isotope has its own characteristic half-life. They range from millionths of a second to billions of years.

Hazard: Materials or conditions that have the potential to cause adverse effects to health, safety, or the environment.

Hazardous Waste: A category of waste regulated under the *Resource Conservation and Recovery Act* (*RCRA*, 42 U.S.C. 6901 et seq.). To be considered hazardous, a waste must be solid waste under *RCRA* and must exhibit at least one of four characteristics described in 40 CFR 261.20 through 40 CFR 261.24 (i.e., ignitability, corrosivity, reactivity, or toxicity) or be specifically listed by

the Environmental Protection Agency in 40 CFR 261.31 through 40 CFR 261.33. Source, special nuclear, or byproduct materials, as defined by the *Atomic Energy Act,* are not hazardous waste because they are not defined as solid waste under *RCRA*.

High-Level Waste (HLW): Highly radioactive waste material resulting from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing and any solid materials derived from such liquid waste that contains fission products in sufficient concentrations; and other highly radioactive material that is determined, consistent with existing law, to require permanent isolation.

Highly Enriched Uranium: Uranium with more than 20 percent of the uranium-235 isotope, used for making nuclear weapons and also as fuel for some isotope production, research, and power reactors. Weapons-grade uranium is a subset of this group.

Holding Pond: A structure built to contain large volumes of liquid waste to ensure that it meets environmental requirements prior to release.

Hot Cells: Heavily shielded compartments in which highly radioactive material can be handled, generally by remote control.

In-Situ: In its natural position or place.

Institutional Controls: Non-engineering measures – usually, but not always, legal controls – intended to affect human activities in such a way as to prevent or to reduce exposure to hazardous substances. Institutional controls include, but are not necessarily limited to: land and resource (e.g., water) use and deed restrictions; well-drilling prohibitions; building permits; and well use advisories and deed notices; and other legally enforceable measures. However, they are distinct from physical engineering measures, such as treatment and containment systems.

Isotopes: Any of two or more variations of an element in which the nuclei have the same number of protons (i.e., the same atomic number) but different numbers of neutrons so that their atomic masses differ. Isotopes of a single element possess almost identical chemical properties but often different physical properties (i.e., carbon-12 and -13 are stable, while carbon-14 is radioactive).

Land Use: The ultimate uses to be permitted for currently contaminated lands, waters, and structures at each Department of Energy installation.

Land Use Control Assurance Plan (LUCAP): A written installation-wide plan that sets out the procedure to assure that land use controls remain effective over the long-term for all areas at the particular installation where they are required.

Landlord Activities: Activities that involve the physical operation and maintenance of DOE installations. Specific tasks vary but generally include providing utilities, maintenance, and general infrastructure for the entire installation.

Legacy Waste: Any waste within a complex that was generated by past weapons production or research activities and is in storage awaiting treatment or disposal.

Life-Cycle Cost Estimate: All the anticipated costs associated with a project or program alternative throughout its life. This includes costs from pre-operations through operations or to the end of the alternative.

Long-Term Stewardship: Encompasses all activities required to maintain an adequate level of protection to human health and the environment posed by nuclear and/or chemical materials, waste, and residual contamination remaining after cleanup is complete.

Low-Level Waste (LLW): Low-level radioactive waste is radioactive waste that is not high-level radioactive waste, spent nuclear fuel, transuranic waste, byproduct material (as defined in Section 11e.(2) *of* the *Atomic Energy Act of 1954,* as amended), or naturally occurring radioactive material.

Manhattan Project: The U.S. Government project

that produced the first nuclear weapons during World War II. Started in 1942, the Manhattan Project formally ended in 1946. The Hanford Site, Oak Ridge Reservation, and Los Alamos National Laboratory were created for this effort. The project was named for the Manhattan Engineer District of the U.S. Army Corps of Engineers.

Maximum Contaminant Level (MCL): The maximum permissible level of a contaminant in water delivered to any user of a public system. MCLs are enforceable standards.

Mixed Waste: Waste that contains both source, special nuclear, or byproduct material subject to the *Atomic Energy Act of 1954,* as amended, and a hazardous component subject to the *Resource Conservation and Recovery Act.*

National Environmental Policy Act of 1969 (NEPA): *NEPA* is the basic national charter for protection of the environment. It establishes policy, sets goals (in Section 101), and provides means (in Section 102) for carrying out the policy. Section 102(2) contains "action-forcing" provisions to ensure that Federal agencies follow the letter and spirit of the Act. For major Federal actions significantly affecting the quality of the human environment, Section 102(2)(C) of *NEPA* requires Federal agencies to prepare a detailed statement that includes the environmental impacts of the proposed action and alternatives and other specified information.

National Nuclear Security Administration: DOE program that is responsible for carrying out DOE responsibilities to achieve national security objectives established by the President. These include, among other things, responsibility for nuclear weapons and for assisting in reducing the global nuclear danger by planning for and maintaining a safe, secure and reliable stockpile of nuclear weapons and associated materials, capabilities, and technologies in a safe, environmentally sound, and cost-effective manner.

National Priorities List (NPL): The Environmental Protection Agency's list of the most serious uncontrolled or abandoned hazardous waste sites identified for possible long-term remedial action under *CERCLA*. The list is based primarily on the score a site receives from the EPA Hazard Ranking System described in 40 CFR Part 300, Appendix A. EPA must update the NPL at least once a year.

Natural Attenuation: Cleanup process that relies on natural processes to remediate contamination (e.g., radioactive decay, biodegradation, dispersion, dilution, sorption, volatilization, chemical or biological stabilization, transformation, or destruction of the contaminants).

Natural Flushing: A passive groundwater remediation technique which uses natural groundwater movement and geochemical processes to decrease contaminant concentrations. Criteria for use of natural flushing require that the contaminated groundwater is not a current or potential drinking water source. (See also "natural attenuation.")

Nevada Offsites: Underground nuclear tests conducted at eight locations in five different States (Alaska, Colorado, Mississippi, Nevada, and New Mexico) from 1957 to 1973. Test were part of the Plowshare program to develop peaceful (industrial and scientific) applications for nuclear explosives and the Vela Uniform program to improve the capability of detecting, monitoring, and identifying underground nuclear detonations.

No Further Action: A determination made, based upon technical evidence, that remedial action is not warranted at a given site.

Nuclear Reactor: A device that sustains a controlled nuclear fission chain reaction.

Nuclear Waste Policy Act (NWPA): The Federal law that primarily provides for the development of Federal geologic repositories for disposal of high-level waste and spent nuclear fuel (amended several times since).

Nuclear Weapons Complex: The chain of foundries, uranium enrichment plants, reactors, chemical separation plants, factories, laboratories, assembly plants, and test sites that produced

nuclear weapons. Sixteen major U.S. facilities in 12 States formed the nuclear weapons complex.

Open Space Land Use: Posted areas reserved generally as buffer or wildlife management zones. Native Americans or other authorized parties may be allowed permits for occasional surface area use. Access to or use of certain areas may be prevented by passive barriers (e.g., where soil is capped). Limited hunting or livestock grazing may be allowed.

Operable Unit: Organizational unit used to clean up a site. It may address geographical portions of a site, specific site problems, or initial phases of an action. It may also consist of any set of actions performed over time or any actions that are concurrent but located in different parts of a site.

Owner: Entity who owns the deed to the property. In some instances, the owner leases the property to someone else, known as a landlord.

Phytoremediation: An innovative/emerging technology that utilizes plants to uptake toxic metals and radionuclides through roots in situ.

Polychlorinated Biphenyls (PCBs): A group of commercially produced organic chemicals used since the 1940s in industrial applications throughout commercial industry and the nuclear weapons complex. Polychlorinated biphenyls are found in many gaskets and large electrical transformers and capacitors in the gaseous diffusion plants and other DOE facilities. They have been proven to be toxic to both humans and laboratory animals.

Potentially Responsible Party (PRP): The *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA) defines a PRP as any individual(s) or company(ies) identified as potentially liable under CERCLA for cleanup or payment for costs of cleanup of hazardous substance sites. PRPs may include individual(s) or company(ies) identified as having owned, operated, or in some other manner contributed wastes to hazardous substance sites.

Plutonium (Pu): A heavy, radioactive, metallic element with the atomic number 94. It is produced artificially by neutron bombardment of uranium. Plutonium has 15 isotopes with atomic masses ranging from 232 to 246 and half lives from 20 minutes to 76 million years. Its most important isotope is fissile plutonium-239.

Preliminary Remediation Goals (PRGs): PRGs provide remedial design staff with long-term targets to use during analysis and selection of remedial alternatives. Ideally, such goals, if achieved, should both comply with applicable or relevant and appropriate requirements and result in residual risks that fully satisfy the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) requirements for the protection of human health and the environment. By developing PRGs early in the decision-making process (before the remedial investigation/feasibility study and the baseline risk assessment are completed), design staff may be able to streamline the consideration of remedial alternatives.

Pump-and-Treat System: A system which extracts groundwater and removes contaminating substances before returning the water (e.g., recharge in injection wells) or disposing of it elsewhere.

Production Reactor: A nuclear reactor designed to produce manmade isotopes. Tritium and plutonium are made in production reactors. The United States has 14 such reactors: nine at the Hanford Site and five at the Savannah River Site. Some research reactors are also used to produce isotopes.

Radioactive: Of, caused by, or exhibiting radioactivity.

Radioactivity: The spontaneous transformation of unstable atomic nuclei, usually accompanied by the emission of ionizing radiation.

Radioisotope or Radionuclide: An unstable isotope that undergoes spontaneous transformation and emits radiation.

Receptor: Any human or other living thing that could be exposed and/or threatened by hazardous

or toxic contaminants.

Record of Decision (ROD): A public document that explains the cleanup alternatives to be used at National Priorities List sites under *CERCLA*. In addition, a ROD under *NEPA* is a concise public document that records a Federal agency's decision(s) concerning a proposed action for which the agency has prepared an environmental impact statement (EIS). The NEPA ROD is prepared in accordance with the requirements of the Council on Environmental Quality NEPA regulations (40 CFR 1505.2) and DOE's NEPA regulations (10 CFR 1021.315). A ROD identifies the alternatives considered by the agency and specifies the environmentally preferable alternative(s) evaluated, factors balanced by the agency in making the decision, whether all practicable means to avoid or minimize environmental harm have been adopted, and, if not, why they were not.

Recreational Land Use: Unfenced areas where daytime use for recreational activities (e.g., hiking, biking, sports), hunting, and some overnight camping is allowed. Fishing may be limited to catch-and-release.

Remedy or Remedial Action (RA): Those actions consistent with permanent remedy taken instead of, or in addition to, removal action in the event of a release or threatened release of a hazardous substance into the environment. A remedy or RA seeks to prevent or minimize the release of hazardous substances so that they do not migrate to cause substantial danger to present or future public health or welfare or the environment. The term includes, but is not limited to, such actions at the location of the release as storage, confinement, perimeter protection (using dikes, trenches, or ditches), clay cover, neutralization, cleanup of released hazardous substances and associated contaminated materials, recycling or reuse, diversion, destruction, segregation of reactive wastes, dredging or excavations, repair or replacement of leaking containers, collection of leachate and runoff, onsite treatment or incineration, provision of alternative water supplies, any monitoring reasonably required to assure that such actions protect the public health and welfare and the environment and, where appropriate, post-removal site control activities. The term includes the costs of permanent relocation of residents and businesses and community facilities (including the cost of providing "alternative land of equivalent value" to an Indian tribe pursuant to CERCLA Section 126(b)) where EPA determines that, alone or in combination with other measures, such relocation is more cost-effective than, and environmentally preferable to, the transportation, storage, treatment, destruction, or secure disposition offsite of such hazardous substances, or may otherwise be necessary to protect the public health or welfare. The term includes offsite transport and offsite storage, treatment, destruction, or secure disposition of hazardous substances and associated contaminated materials. For the purpose of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), the term also includes enforcement activities related thereto.

Remedial Investigation: The CERCLA process of gathering the data necessary to determine the nature and extent of contamination at a CERCLA site, establishing criteria for cleaning up the site, identifying preliminary alternatives for remedial action, and supporting the technical and cost analyses of the alternatives. The Remedial Investigation is usually done together with the Feasibility Study. Together, they are usually referred to as the "Remedial Investigation/ Feasibility Study."

Residential Land Use: Unfenced areas where permanent residential use predominates. There is no restriction on surface water use, but groundwater use may be restricted.

Research Reactor: A class of nuclear reactors used to do research into nuclear physics, reactor materials and design, and nuclear medicine. Some research reactors also produce isotopes for industrial and medical use.

Residual Contamination Standards: The amount and concentrations of contaminants in soil, water, and other media that will remain following environmental management activities.

Resource Conservation and Recovery Act

(RCRA): A Federal law enacted in 1976 to address the treatment, storage, and disposal of hazardous waste.

Rip Rap: A rock layer which can be used to cover disposal cells.

***Risk*:** Risk requires the presence of a hazard but, in addition to the hazard, considers the probability that the potential harm or undesirable consequences will be realized. Risk is expressed (qualitatively or quantitatively) in terms of the likelihood that an adverse effect will occur as a result of the existence of a hazard. The existence of a hazard does not automatically imply the existence of a risk since risk requires a pathway (to a receptor) for an exposure to occur. Barriers and other controls can block or eliminate the pathway and related risk from the residual hazard.

Risk (in the context of human health): The probability of injury, disease, or death from exposure to a hazard or a combination of hazards. In quantitative terms, risk is expressed in values ranging from zero (representing the certainty that harm will not occur) to one (representing certainty that harm will occur). The U.S. Environmental Protection Agency's Integrated Risk Information System expresses risk as follows:

- 10^{-1} = a risk of 1/10 (one person out of 10);
- 10^{-4} = a risk of 1/10,000 (one person out of 10,000);
- 10^{-6} = a risk of 1/1,000,000 (one person out of 1,000,000);
- 1.3×10^{-3} = a risk of 1.3/1,000 = 1/770 (one person out of 770);
- 8×10^{-3} = a risk of 1/125 (one person out of 125); and
- 1.2×10^{-5} = a risk of 1/83,000 (one person out of 83,000).

Site Characterization: An onsite investigation at a known or suspected contaminated waste or release site to determine the extent and type(s) of contamination.

Sludge: Slushy matter or sediment, such as that precipitated by the treatment of waste.

Spent Nuclear Fuel (SNF): Fuel that has been withdrawn from a nuclear reactor following irradiation, the constituent elements of which have not been separated by reprocessing.

Steward: Individuals or groups responsible for performing and/or ensuring that the required long-term stewardship activities take place.

Stockpile Stewardship: A DOE program to ensure core competencies in activities associated with the research, design, development, and testing of nuclear weapons. It also refers to the assessment and certification of their safety and reliability.

Superfund Amendments and Reauthorization Act (SARA): (also know as Superfund) The 1986 Act reauthorizing and amending the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

Target Cleanup Level: A level of concentration of a contaminant in an environmental media (e.g., soil, groundwater) established in a *CERCLA* Record of Decision as a level to be achieved by the selected remedy.

Toxic Substances Control Act (TSCA): A Federal law enacted in 1976 to protect human health and the environment from unreasonable risk caused by the manufacture, distribution, use, disposal of, or exposure to substances containing toxic chemicals.

Transuranic Elements: All elements beyond uranium on the periodic table; that is, all elements with an atomic number greater than 92. All transuranic elements are man-made. They include neptunium, plutonium, americium, and curium.

Transuranic Waste (TRU): Transuranic waste is radioactive waste containing more than 100 nanocuries (3700 becquerels) of alpha-emitting transuranic isotopes per gram of waste, with half-lives greater than 20 years, except for: (1) high-level radioactive waste; (2) waste that the Secretary of Energy has determined, with the concurrence of the Administrator of the Environmental Protection Agency, does not need the degree of isolation required by the 40 CFR, Part 191 disposal regulations; or (3) waste that the Nuclear Regulatory Commission has approved for

disposal on a case-by-case basis in accordance with 10 CFR, Part 61.

Unrestricted Land Use: Unfenced areas where there is no restriction on the types of activities that may occur, including permanent residential use.

Uranium (U): A radioactive, metallic element with the atomic number 92, the heaviest naturally occurring element. Uranium has 14 known isotopes, of which uranium-238 is the most abundant in nature. Uranium-235 is commonly used as a fuel for nuclear fission.

Uranium Milling Site: A site where uranium is separated from ore taken from mines.

Uranium Mill Tailings: Tailings or waste produced by the extraction or concentration of uranium or thorium from ore processed primarily for its source material content.

Uranium Mill Tailings Radiation Control Act (UMTRCA) of 1978: The Act that directed DOE to provide for stabilization and control of the uranium mill tailings from inactive uranium milling sites in a safe and environmentally sound manner to minimize radiation health hazards to the public. It authorized the U.S. Department of Energy to undertake remedial actions at 24 designated inactive uranium processing sites and at an estimated 5,048 vicinity properties.

Uranium Mill Tailings Remedial Action Project (UMTRA): A DOE program to plan, implement, and complete environmental restoration (e.g. cleanup of contaminated surface water and groundwater) at inactive uranium-processing sites and their vicinity sites, as directed and authorized by the *Uranium Mill Tailings Radiation Control Act of 1978.*

Vitrification: A process by which waste is transformed from a liquid or sludge into an immobile solid that traps radionuclides and prevents waste from contaminating soil, groundwater, and surface water. While the process does not reduce radioactivity, it is used to solidify and stabilize certain forms of radioactive and hazardous waste. For example, borosilicate glass is used to immobilize high-level radioactive waste.

Waste Isolation Pilot Plant (WIPP): A DOE facility designed and authorized to permanently dispose of transuranic radioactive waste in a mined, underground facility in deep geologic salt beds. It is located in southeastern New Mexico, 42 kilometers (26 miles) east of the city of Carlsbad.

Waste Management: Activities that include treating, storing, and disposing of high-level radioactive waste, transuranic waste, transuranic mixed waste, low-level radioactive waste, low-level mixed waste, hazardous chemical waste, and sanitary waste.

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UNITED STATES DEPARTMENT OF ENERGY

Washington, DC 20585

OFFICE OF ENVIRONMENTAL MANAGEMENT OFFICE OF LONG-TERM STEWARDSHIP

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January 2001

Library

A Report to Congress on Long-Term Stewardship

Volume II – Site Summaries

U.S. Department of Energy
Office of Environmental Management

Office of Long-Term Stewardship

- "Caution - Do Not Dig" Marker

  Fermi Marker located 20 miles outside of Chicago, Illinois, identifying the site of buried radioactive wastes that include materials from Enrico Fermi's uranium-graphite pile at the University of Chicago. *Plot M., Palos Forest Preserve, Illinois, November 1995.*

- "RCRA Cap"

  Ten acres of black, high-density polyethylene cover a mixed waste landfill at the Oak Ridge Reservation Site. The cap is designed to prevent gases from escaping, reduce erosion, and keep rainwater from leaching contaminants into groundwater. Installed in 1989, the cap is designed to last from 15 to 20 years. Maintenance and monitoring will be required at least until 2019. *Solid Waste Storage Area 6, Oak Ridge Reservation, Tennessee, January 1994.*

AVAILABILITY OF THE REPORT TO CONGRESS:

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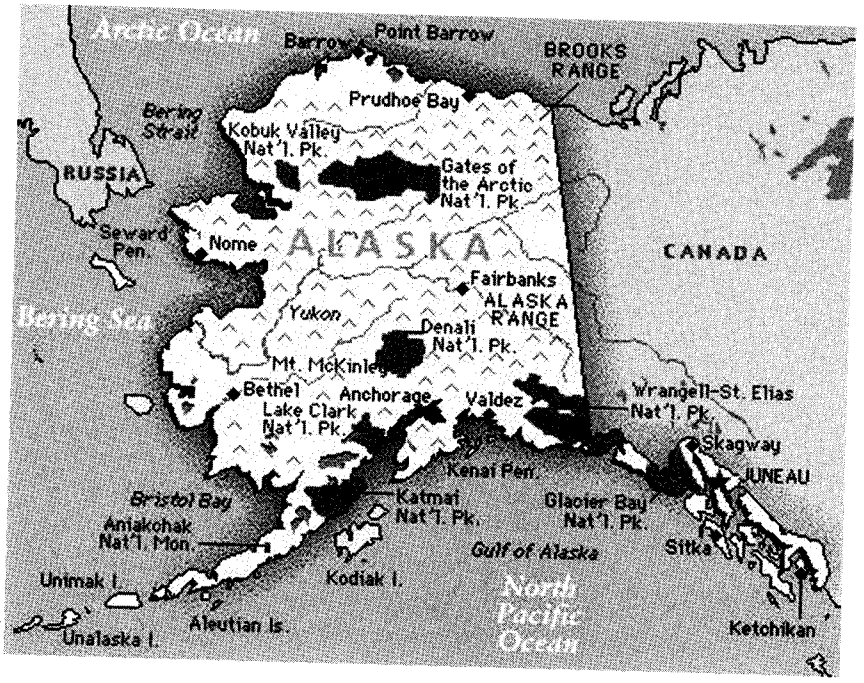

Amchitka Island

Long-Term Stewardship Site Highlights

Amchitka Island (page 3)

Major Activities - soil and groundwater monitoring; enforcing access restrictions for subsurface contamination
Site Size - 30,000 hectares (74,000 acres)
Start/End Years - 2004/in perpetuity
Estimated Average Annual Cost FY 2004-2006 - $23,000

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AMCHITKA ISLAND

1.0 SITE SUMMARY

1.1 Site Description and Mission

Amchitka Island is in the western Aleutian Islands chain and is about 2,156 kilometers (1,340 miles) southwest of Anchorage, Alaska. The site was first used by the U.S. Government in 1943, when American troops landed on the island to establish an airfield to prevent the enemy forces from gaining strategic control of the islands during World War II. Anti-personnel devices such as steel spikes still remain scattered across the island and continue to pose a hazard for onsite workers.

LONG-TERM STEWARDSHIP HIGHLIGHTS

Major Long-Term Stewardship Activities - soil and groundwater monitoring; enforcing access restrictions for subsurface contamination
Total Site Area - 30,000 hectares (74,000 acres)
Estimated Volume of Residual Contaminants - unknown
Long-Term Stewardship Start-End Years - 2004-in perpetuity
Average Annual Long-Term Stewardship Cost FY 2004-2006 - $23,000
Landlord - U.S. Department of Interior

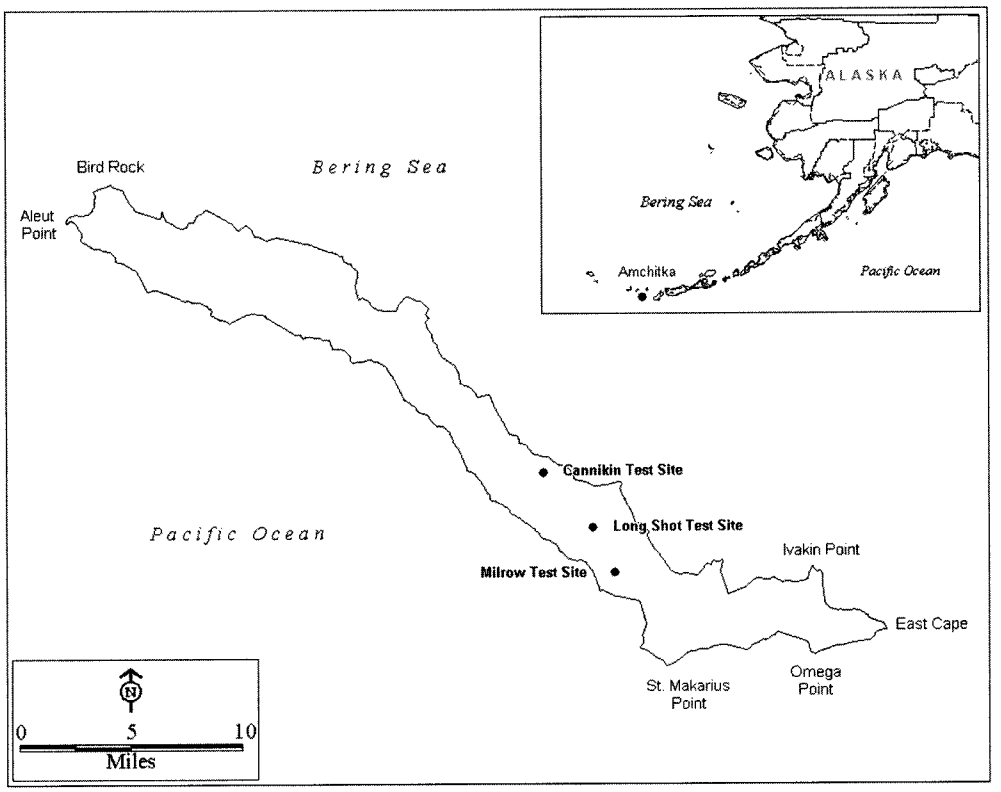
The U.S. Atomic Energy Commission (later known as the U.S. Department of Energy) conducted three sub-surface nuclear detonations on Amchitka Island in October 1965, October 1969, and November 1971. The first of the three underground tests, known as Long Shot, was a nuclear detection research experiment detonated at a depth of 700 meters (2,300 feet), with a yield of about 80 kilotons. The second detonation, referred to as Milrow, was a high-yield seismic calibration test detonated at a depth of 1,220 meters (4,000 feet), with a yield of about one megaton. The third and final detonation, known as Cannikin, was a test of a proposed warhead. Cannikin was detonated at a depth of about 1,790 meters (5,875 feet), with a yield of almost five megatons. In addition to the three test locations, DOE is responsible for three other areas where emplacement holes were drilled but never used for testing.

DOE's mission at Amchitka Island is to complete remediation of surface contamination and continue the long-term stewardship of residual subsurface contamination. Amchitka Island is currently part of the Alaska Maritime National Wildlife Refuge and is managed by the U.S. Fish and Wildlife Service (USFWS). The USFWS will continue to manage the site for the foreseeable future. DOE's expected end-state for Amchitka Island will allow for future surface use at the site, with restrictions placed on intrusion into any capped soil areas. DOE will restrict access to the test cavities, subsurface, and groundwater indefinitely.

1.2 Site Cleanup and Accomplishments

Drilling of the emplacement holes and post-test sampling resulted in surface contamination that consists of approximately 30 contaminated areas, including six emplacement holes, one adjacent drill back hole, multiple monitoring wells, multiple mud pits, landfills, and shaker pad areas. The potential constituents of concern for surface soils and surface waters are total petroleum hydrocarbons from diesel fuel, volatile organic compounds, lead, chromium, and tritium. A corrective action plan for the surface contamination is currently being developed and corrective actions are scheduled to begin in 2001. A joint DOE, USFWS, and State of Alaska examination of the area is currently scheduled for June 2000.

Based on site characterization, the DOE, USFWS, and State will make a decision for each area of contamination, whether corrective action is warranted or if no surface remediation is necessary. Based on these decisions, each area of surface contamination on the Island will either be "clean closed" or closed in place, although most are expected to be closed in place. Closure in place will entail leaving the drilling muds in their present location, draining water collected in basins above the mud pits, placing an engineered cover over the drilling muds, and



Amchitka Island

increasing the strength of the pit walls, where necessary. DOE anticipates that all negotiations with the State, and any resulting surface corrective actions, will be completed by 2004.

Subsurface contamination associated with the underground detonation of nuclear tests consists of radionuclides in the test cavities. Subsurface contamination will not be remediated due to the lack of feasible technologies for removing the site's subsurface contamination. The primary concerns of the State of Alaska will be to ensure that the existing subsurface contamination associated with the underground nuclear detonation does not impact the marine environment or result in health risks to subsistence fishermen in the area. Remaining subsurface activities at the site include continued characterization of groundwater flow, assessing risk, and developing the site closure report. DOE anticipates that subsurface closure activities will be completed by 2004.

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

DOE will be responsible for monitoring and maintaining institutional controls over the subsurface. By 2004, DOE's role at the site will be limited to conducting long-term stewardship activities. Final long-term stewardship requirements for the site will be negotiated with the USFWS, the State of Alaska, and Tribal Nations once a risk assessment is completed. There will be two closure reports for the site, one for the surface and another for the subsurface. The surface closure report will describe surface contaminants and corrective action activities. The subsurface closure report will focus on the subsurface and marine environments. Final long-term stewardship requirements will be detailed in each of these closure reports.

DOE maintains the project-specific records at the Nevada Operations Office in Las Vegas, Nevada. These records include a compilation of work plans, data reports, numerical models, numerical model results, monitoring results, health assessments, risk assessments, Letters of Accomplishment, Closure Reports, comments and information submitted by the public, relevant State agreements, and other writings pursuant to the negotiated corrective action process. Records are retained according to DOE records retention procedures. Upon the completion of the project, all project files will be transferred to controlled storage at the Nevada Operations Office in Las Vegas, Nevada, and other entities, as required by agreements with the State of Alaska.

STAKEHOLDER INVOLVEMENT

Public participation for the Amchitka Island environmental restoration project is being implemented in accordance with the State of Alaska regulations and agreements reached with the USFWS and the Aleutian/Pribilof Islands Association (which represents the native population). At the initiation of project work, DOE identified the relevant state regulators, federal agencies, tribal governments, interest groups, and stakeholders expected to have an interest in the project and the site. Issues of interest and concern and key decision points were identified with stakeholders to determine the means by which public involvement will occur. DOE conducts frequent project status meetings/conference calls; informational and technical briefings in accordance with the project schedule; public meetings at designated key decision points in the schedule; and additional technical meetings on an as-needed basis. Other opportunities for involvement might include public hearings, town hall meetings, public workshops, informational and technical briefings, and document reviews.

2.2 Specific Long-Term Stewardship Activities

Soil

If contaminated surface areas are closed in place with engineered caps, institutional controls to restrict access to the residual contamination may be required. The specific long-term stewardship activities for the surface areas will be detailed in the site closure report, but will include visual inspections, cap maintenance, information management, and environmental monitoring activities.

Groundwater

A monument has been placed at the site to mark the locations of the test. DOE will maintain institutional controls over the subsurface to prevent access to the test cavities, groundwater, and associated subsurface contamination in perpetuity. The institutional controls will include a restriction on well drilling on the site. DOE will work with the USFWS to ensure that all restrictions are incorporated into the USFWS management plan for the island. Due to the geographic isolation of the site and the cost associated with visiting the site, DOE assumes that long-term stewardship and monitoring activities will be conducted every five years. Monitoring wells are estimated to require repair or replacement every 25 years. At the end of the post-closure groundwater monitoring period in 2104, the monitoring wells will be plugged and abandoned in place in accordance with state regulations.

2.3 Regulatory Regime

In accordance with applicable regulatory drivers listed below, DOE is responsible for identifying the nature and extent of contamination, determining potential risk to the public and the environment, and performing the necessary corrective actions in compliance with guidelines and requirements under federal regulatory drivers, as well as the state-specific regulatory drivers associated with the site location.

Resource Conservation and Recovery Act (RCRA): RCRA was the first comprehensive federal effort to deal with solid and hazardous waste and regulates the generation, transportation, treatment, storage, and disposal of hazardous waste. At Amchitka Island, RCRA is enforced to protect human health and the environment; conserve energy and natural resources; reduce the amount of generated waste; and ensure that wastes are managed in an environmentally sound manner.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA): CERCLA supplies a system for identifying and providing corrective action to sites where hazardous substances have been released into any part of the air, water, groundwater, or land. Provisions of CERCLA include a National Contingency Plan, which establishes procedures for corrective action for hazardous substance releases. Amchitka Island is not regulated under CERCLA; however, the regulations are useful as developmental guidelines.

In addition to federal regulations, DOE must comply with state regulatory requirements in Alaska. In most cases, State of Alaska requirements are based on federal guidelines; however, in specific cases they may be more detailed and stringent than federal regulations.

Nuclear Regulatory Commission (NRC): NRC regulations establish "free release" criteria. Amchitka Island is not regulated under the NRC; however, the regulations are useful as developmental guidelines.

2.4 Assumptions and Uncertainties

A correction action plan is currently being developed and remediation is scheduled to begin at the site in 2001. While much of the surface contamination has been characterized, the extent of groundwater and associated subsurface contamination is continuing to be characterized. Subsurface closure is not scheduled until 2004.

Long-term stewardship activities have not yet been finalized with the State and regulators. Therefore, long-term stewardship activities and associated costs may change, depending on final agreements. DOE assumes that Amchitka Island will not be placed on the National Priorities List and that regulators and stakeholders will agree to implement closures in place for the mud pits. In most cases, engineered caps will be placed over the contaminated areas to contain residual contamination. DOE also assumes that groundwater remediation will not be necessary at the site due to technical infeasibility.

3.0 Estimated Site-Wide Long-Term Stewardship Costs

The cost profile in the table below applies to the entire Amchitka Island site. The major long-term stewardship costs are for monitoring activities, data analysis, and repair and replacement of monitoring wells. DOE estimates that monitoring wells would need to be repaired or replaced every 25 years.

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	***Amount***	***Year(s)***	***Amount***	***Year(s)***	***Amount***
FY 2000	$0	**FY 2008**	$0	**FY 2036-2040**	$215,000
FY 2001	$0	**FY 2009**	$70,000	**FY 2041-2045**	$215,000
FY 2002	$0	**FY 2010**	$145,000	**FY 2046-2050**	$215,000
FY 2003	$0	**FY 2011-2015**	$215,000	**FY 2051-2055**	$215,000
FY 2004	$70,000	**FY 2016-2020**	$215,000	**FY 2056-2060**	$215,000
FY 2005	$0	**FY 2021-2025**	$215,000	**FY 2061-2065**	$215,000
FY 2006	$0	**FY 2026-2030**	$215,000	**FY 2066-2070**	$215,000
FY 2007	$0	**FY 2031-2035**	$215,000	**Post FY 2070**	$1,400,000

The long-term stewardship cost estimates for Amchitka Island are approximately $70,000 every fifth year through 2009. These costs include a visual site inspection, soil and groundwater sampling, and monitoring activities conducted every five years. In addition, each five-year cost increment from FY 2011 to FY 2070 includes $145,000 for data and sample analysis in the year following the collection of soil and groundwater samples. DOE projects that the total post-FY 2070 (FY 2071-2104) costs will be approximately $1.4 million dollars.

4.0 FUTURE USES

DOE anticipates that the USFWS will continue to manage the island 30,000 hectares (74,000 acres) as a wildlife refuge. Access to the test cavities, subsurface, and groundwater will continue to be restricted in perpetuity.

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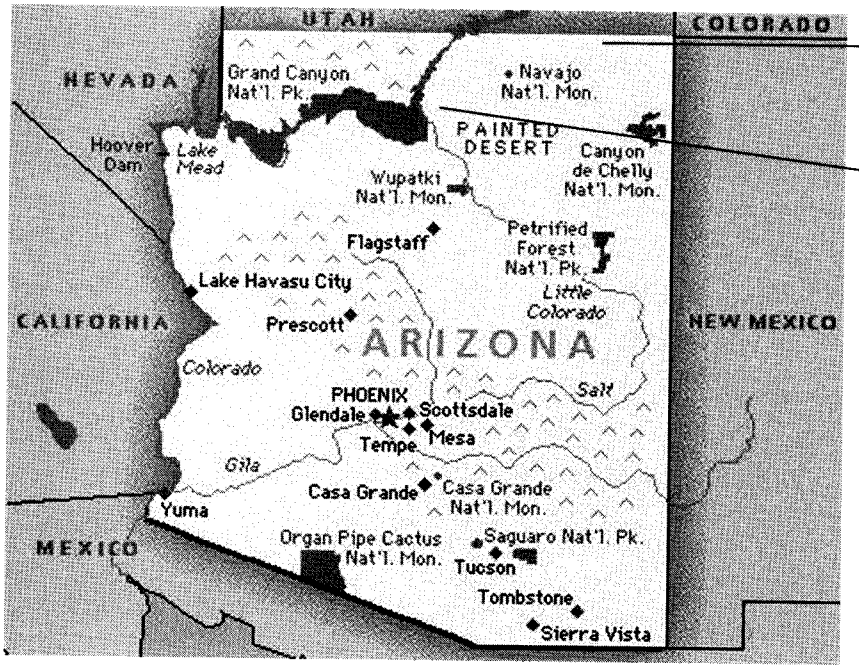

Monument Valley Site

Tuba City Site

Long-Term Stewardship Site Highlights

Monument Valley Site (page 3)
Major Activities - groundwater monitoring
Site Size - 37 hectares (90 acres)
Start/End Years - 1994/2070
Estimated Average Annual Cost FY 2000-2006 - n/a (costs begin in FY 2013)

Tuba City Site (page 7)
Major Activities - monitoring and maintenance of the disposal cell; groundwater monitoring
Site Size - 58 hectares (145 acres)
Start/End Years - groundwater 2011/in perpetuity; engineered unit 1990/in perpetuity
Estimated Average Annual Cost FY 2000-2006 - $74,000

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MONUMENT VALLEY SITE

1.0 SITE SUMMARY

1.1 Site Description and Mission

The Monument Valley Site was the former location of an uranium milling site which operated from 1943 until 1968. The site is located in an isolated setting along Cane Valley Wash on Navajo Nation land in Apache County, Arizona. The site is 21 kilometers (13 miles) east of the Monument Valley Tribal Park, and approximately 27 kilometers (17 miles) south of the Mexican Hat Site in Utah, and about eight kilometers (five miles) south of the Utah-Arizona border.

LONG-TERM STEWARDSHIP HIGHLIGHTS

Major Long-Term Activities - groundwater monitoring
Total Site Area - 37 hectares (90 acres)
Estimated Volume of Residual Contaminants - groundwater 4.5 million cubic meters (5.9 million cubic yards)
Long-Term Stewardship Start-End Years - 1994-2070
Average Annual Long-Term Stewardship Cost FY 2000-2006 - n/a (costs begin in FY 2013)
Landlord - U.S. Department of Energy, Grand Junction Office

As a result of past milling and mining operations, the site was contaminated. The remaining contamination consisted of uranium mill tailings, the old mill building foundations, contaminated soil, and wind-blown material. Tailings were located in two piles, covering about 12 hectares (30 acres) of the approximately 37-hectare (90-acre) site. The older heap-leach pile covered about four hectares (ten acres). The newer tailings pile was cone-shaped, about 17 meters (55 feet) high, covered about eight hectares (20 acres), and contained more than two-thirds of the tailings at the site.

The current mission of the site is remediation and monitoring of the groundwater. The Monument Valley Site is subject to Title I of the *Uranium Mill Tailings Radiation Control Act of 1978* (UMTRCA). As such, the U.S. Department of Energy (DOE) is responsible for remediation and conducting long-term stewardship activities.

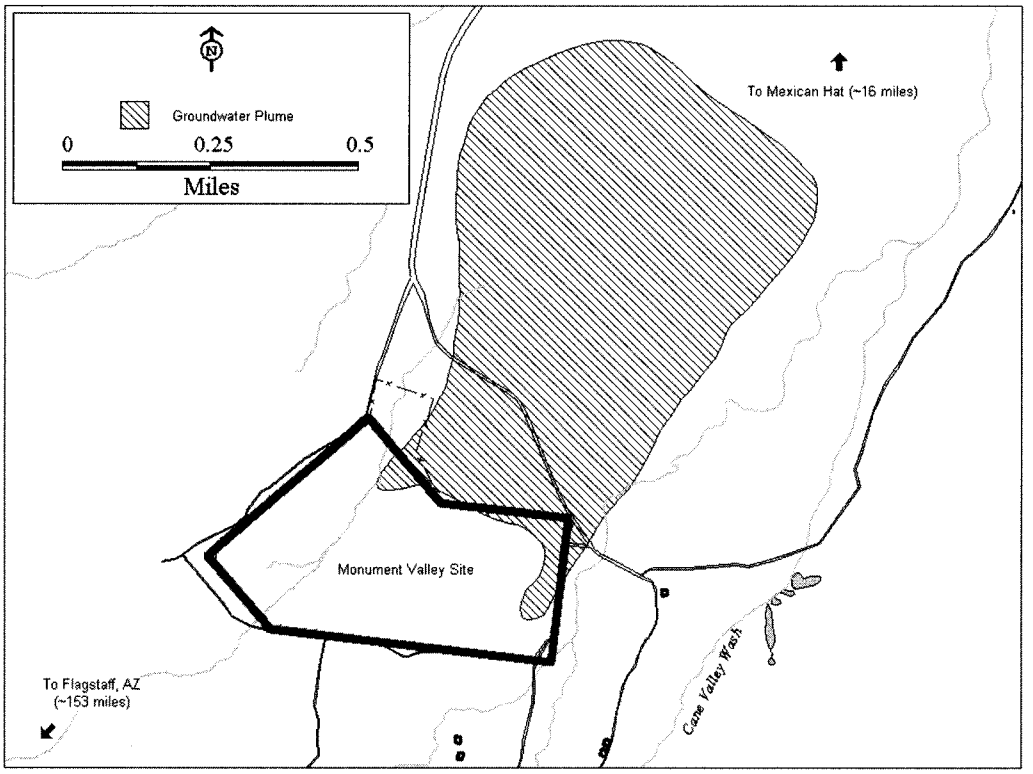
The former mission of the site was to mine and mill uranium ore for use in the United States national defense program. Uranium ore was discovered in 1942 approximately one-half mile west of the former mill site. Vanadium Corporation of America acquired mining rights for the uranium ore deposit from the U.S. Bureau of Indian Affairs in 1943 and mined the property from 1943 to 1968. A total of 767,166 tons of ore were produced using a mechanical upgrader, a concentrator, and a heap leach that operated at various times at the site. The Monument Valley Site produced more uranium than any other mine in Arizona.

1.2 Site Cleanup and Accomplishments

The Monument Valley Site was one of 24 sites designated by DOE for cleanup of surface soils and groundwater contaminated by uranium processing activities. The total amount of contaminated material at the site was 751,000 cubic meters (983,000 cubic yards) on 34 hectares (83 acres). All the contaminated material, including tailings piles, leach areas, an evaporation pond, and associated contaminated surface materials, was moved to the Mexican Hat Site, approximately 27 kilometers (17 miles) to the north. The surface remedial action was completed in May 1994. No residual soil contamination above U.S. Environmental Protection Agency (EPA) standards remains onsite.

An estimated 4.5 million cubic meters (5.9 million cubic yards) of contaminated groundwater remain at the site. The contaminants of concern include nitrate, radium, and uranium. There is also concern about the levels of net gross alpha. Maximum concentration levels have been exceeded at least two times since 1990. Groundwater will be remediated through active treatment. However, the treatment methods have not yet been selected. DOE

is currently monitoring groundwater to characterize the system and existing contamination.



Monument Valley Site

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

DOE is responsible for long-term stewardship activities and funding at the Monument Valley Site. Currently, drilling or other intrusive activities are not allowed on the property (until the groundwater complies with regulatory standards). Once initiated, any groundwater treatment system will be considered a long-term stewardship activity. Groundwater monitoring will continue during the remediation phase and the post-remediation period.

The land is owned by the Navajo Nation, which entered into a cooperative agreement with DOE in 1983 that outlines the roles and responsibilities of each party. DOE is responsible for 100 percent of costs of assessment and remediation, in addition to paying 100 percent of any costs the Tribe incurs. A custodial access agreement grants DOE permanent access to the site. The Navajo Nation has enforcement responsibilities (e.g., prosecution) under the cooperative agreement. DOE and the Indian Health Service will provide an alternate water supply for affected residents.

The site records for the Monument Valley Site are kept in permanent storage at the DOE Grand Junction Office in Colorado. Types of records kept include characterization data, the remedial action design, the completion report, the groundwater compliance plan, annual inspection reports, and groundwater monitoring results.

2.2 Specific Long-Term Stewardship Activities

Groundwater

Groundwater sampling has been conducted at the Monument Valley Site for many years. Groundwater constituents exceeding EPA maximum concentration limits have been detected in both the alluvial/dune sand aquifer and the two uppermost bedrock aquifers. These aquifers are the Shinarump Member of the Chinle Formation. Site-specific field investigations indicate that groundwater in the alluvial/dune sand aquifer is the most negatively affected by the former milling operations. The contaminants of concern in the alluvial aquifer are nitrate, sulfate, and uranium.

DOE's goal is to implement a cost-effective strategy for remediating the groundwater at the Monument Valley Site to ensure protection of human health and the environment and compliance with the EPA groundwater standards. The proposed compliance strategy to clean up the alluvial groundwater at the Monument Valley Site is to perform active groundwater remediation for constituents that pose a potential risk and/or exceed EPA standards. The specific remediation method, however, has not yet been selected. An active remediation program is being designed and cleanup levels are under negotiation. DOE plans to pump the contaminated groundwater and use it to irrigate Sudan Grass, which will use the nitrates as fertilizer. Natural flushing and attenuation will likely be the option selected to remediate the uranium in the groundwater. According to the groundwater models, any uranium that is present in the irrigated groundwater will not cause any surface contamination or health hazards. DOE assumes that routine groundwater compliance monitoring will be required for an indefinite period of time after active remediation is completed.

> ***STAKEHOLDER INTERACTION***
>
> Community interaction has been extensive since the surface remedial action was completed. Frequent meetings with various agencies of the Navajo Nation and their representatives have been held. Copies of the annual inspection report for the Monument Valley Site are distributed to the local library and to any stakeholder that requests one. The report is also published on the DOE Grand Junction Office website at www.doegjpo.com.

2.3 Regulatory Regime

Upon completion of remediation, the Monument Valley Site will be subject to a general license issued by the Nuclear Regulatory Agency (NRC) for custody and long-term care of residual radioactive disposal sites (in Title 10, *Code of Federal Regulations,* Section 40.27). The purpose of the general license is to ensure that such sites will be cared for in a manner that protects human health and the environment. The general license will go into effect when NRC concurs that the site meets cleanup standards and formally accepts the site-specific long-term surveillance plan.

Long-term stewardship of the Monument Valley Site is governed by several regulations, including UMTRCA; the *Atomic Energy Act of 1954,* as amended; EPA Groundwater Protection Standards, including Title 40 of the *Code of Federal Regulations*, Part 192; a cooperative agreement between DOE and the State of Arizona; a cooperative agreement between DOE and the Navajo Nation; and the *National Environmental Policy Act of 1969,* as amended.

2.4 Assumptions and Uncertainties

DOE assumes that active remediation will result in compliance with EPA groundwater standards by 2013. However, these standards may not be achieved until later. In addition, DOE assumes that routine groundwater compliance monitoring will be required after active remediation. Some long-term stewardship activities will be based upon anticipated final cleanup levels and regulatory agreements.

3.0 ESTIMATED LONG-TERM STEWARDSHIP COSTS

The following table shows the estimated costs of long-term stewardship for the Monument Valley Site. The remedial action will be funded through DOE's Uranium Mill Tailings Remedial Action Ground Water Project until FY 2013. Long-term stewardship costs will begin to be incurred after the completion of groundwater remedial action. From FY 2013 to FY 2025, long-term stewardship costs are associated primarily with monitoring and active groundwater remediation activities. Costs after FY 2026 are associated primarily with routine sampling and monitoring compliance. Additional funds of $20,000 are included in FY 2012 and FY 2022 for the cooperative agreement with the Navajo Nation.

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	***Amount***	***Year(s)***	***Amount***	***Year(s)***	***Amount***
FY 2000	$0	**FY 2008**	$0	**FY 2036-2040**	$148,900
FY 2001	$0	**FY 2009**	$0	**FY 2041-2045**	$146,800
FY 2002	$0	**FY 2010**	$0	**FY 2046-2050**	$148,900
FY 2003	$0	**FY 2011-2015**	$6,492,100	**FY 2051-2055**	$146,800
FY 2004	$0	**FY 2016-2020**	$8,225,300	**FY 2056-2060**	$148,900
FY 2005	$0	**FY 2021-2025**	$3,380,300	**FY 2061-2065**	$146,800
FY 2006	$0	**FY 2026-2030**	$148,900	**FY 2066-2070**	$148,900
FY 2007	$0	**FY 2031-2035**	$146,800		

4.0 FUTURE USES

The mill site was leased from the Navajo Nation (the owner) until 1968, when the mill closed and the lease expired. Control of the site, structures, and materials reverted to the Navajo Nation at that time. The Navajo Nation has granted DOE access to the site until groundwater remediation is complete. Groundwater use will be restricted until the groundwater complies with regulatory standards. DOE and the Indian Health Service will provide an alternate water supply for affected residents until such time that the groundwater complies with the regulatory standards for the intended future use. Following active groundwater treatment, the site will be revegetated. Future use of the site will be residential and agriculture.

For more information about the Monument Valley Site, contact:

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Phone: 970-248-6037
or visit the Internet website at http://www.doegjpo.com

TUBA CITY SITE

1.0 SITE SUMMARY

1.1 Site Description and Mission

The Tuba City Site is the location of a disposal cell and former uranium milling site that operated between 1956 and 1966. The site is located in northern Arizona on the Navajo Nation in Coconino County, 9 kilometers (5.5 miles) east of Tuba City, and 136.8 kilometers (85 miles) north of Flagstaff. The 58-hectare (145-acre) site, which is accessible by U.S. Highway 160, is semi-arid and desert-like. Vegetation is sparse, and land use is currently limited to grazing. The milling operations created process-related waste and uranium mill tailings. The U.S. Department of Energy (DOE) encapsulated these contaminated materials, totaling 1.1 million cubic meters (1.4 million cubic yards), in an onsite 20-hectare (50-acre) engineered disposal cell in 1990.

LONG-TERM STEWARDSHIP HIGHLIGHTS

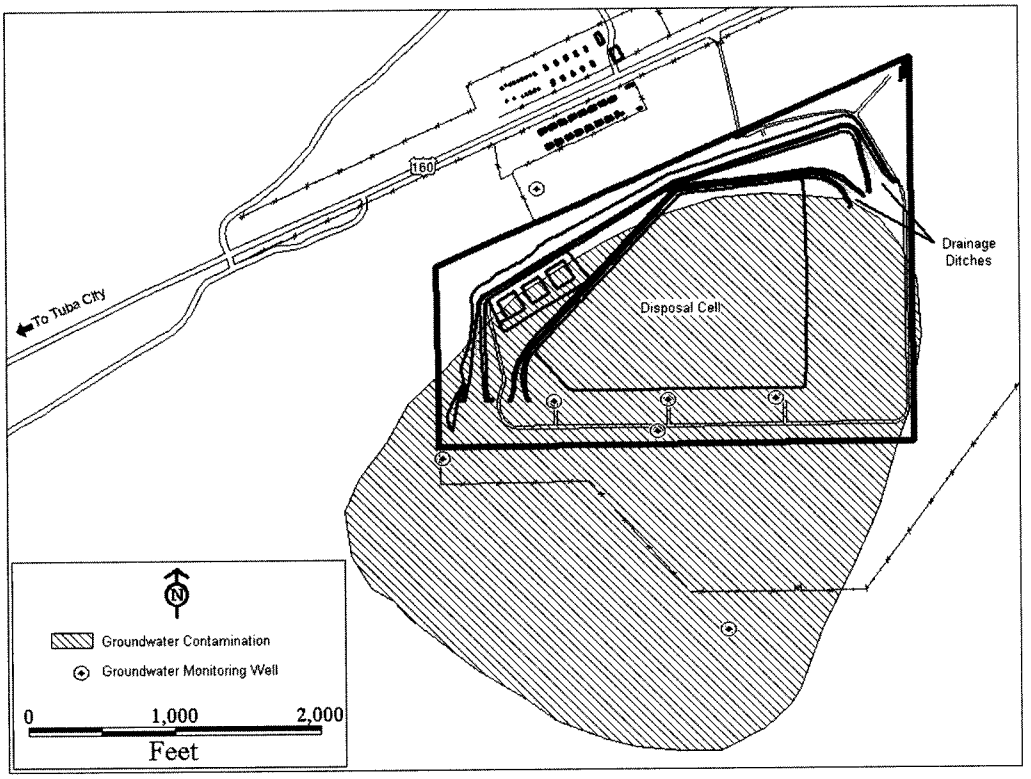
Major Long-Term Stewardship Activities - monitoring and maintenance of the disposal cell; groundwater monitoring
Total Site Area - 58 hectares (145 acres)
Estimated Volume of Residual Contaminants - disposal cell 1.1 million cubic meters (1.4 million cubic yards); groundwater 2.95 million cubic meters (3.8 million cubic yards)
Long-Term Stewardship Start-End Years - groundwater 2011-in perpetuity, engineered unit 1990-in perpetuity
Average Annual Long-Term Stewardship Cost FY 2000-2006 - $74,000
Landlord - U.S. Department of Energy, Grand Junction Office

The current mission of the Tuba City Site is long-term monitoring and surveillance of the disposal cell, to prevent release of contaminated materials to the environment, and remediation and long-term monitoring of the groundwater. The historic mission of the Tuba City Site was to process uranium ore for use in the U.S. Government national defense program and nuclear research activities. Rare Metals Corporation of America built the uranium mill on the site between 1955 and 1956. Rare Metals Corporation merged with El Paso Natural Gas Company, which operated the mill until 1966. The U.S. Government ended its uranium procurement program in 1970.

1.2 Site Cleanup and Accomplishments

The Tuba City Site was designated by DOE for cleanup of surface and groundwater contamination under provisions of the *Uranium Mill Tailings Radiation Control Act of 1978* (UMTRCA). DOE is the landlord and is responsible for the current remediation activities at the Tuba City Site. Demolition of buildings and site preparation activities were completed in 1986. Surface remedial action and disposal of contaminated materials began in 1988 and was completed in December 1990. All the radioactive materials from the original mill tailings piles, windblown and waterborne contamination, and debris from demolished mill structures were encapsulated in a disposal cell located over the existing tailing piles. The cell contains 2.25 million tons of contaminated material, with a total activity of 940 curies of radium-226. The disposal cell has a radon barrier cover and rock surface layer to control erosion.

Groundwater occupying 132 hectares (327 acres) beneath the site is contaminated with materials from the processing of ores to recover uranium and vanadium. Levels of molybdenum, nitrate, selenium, uranium, net gross alpha, and radium-226 and -228 activity have exceeded U.S. Environmental Protection Agency (EPA) standards (the maximum concentration limits) at least twice since 1990. High levels of sulfate also are present and, although sulfate is not a constituent included in EPA standards, its concentration in the ground water is high enough to cause a potential health risk. The plume of contamination extends approximately 460 meters (1,500 feet) downgradient from the site. The estimated amount of contaminated ground water at the Tuba City Site is



Tuba City Site

2.95 million cubic meters (3.8 million cubic yards). Groundwater is not withdrawn from the plume area. Water is taken from springs near Moenkopi Wash and from the wash itself, downgradient of the site. These withdrawal areas are all greater than 1.6 kilometers (1 mile) from the Tuba City Site.

DOE currently is conducting a groundwater restoration project, which combines a pump and treat alternative that uses an infiltration trench and extraction and injection wells with a treatment alternative that uses distillation. This method uses vertical wells for extraction and a combination of vertical injection wells and an infiltration trench for disposal of treated groundwater. Once the groundwater has been extracted, it is treated by distillation, also known as mechanical evaporation and recondensation. DOE expects this active groundwater remediation to continue through 2011.

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

Long-term stewardship activities began at the Tuba City Site in 1990, after the surface remedial action and disposal of the contaminated materials were completed. DOE is responsible for long-term stewardship activities and funding for the site. The long-term stewardship program maintains the safety and integrity of the disposal cell through periodic monitoring, inspections, and maintenance. The disposal cell is designed to provide long-term protection against future groundwater contamination at the site.

The Tuba City Site is located on land owned by the Navajo Nation, which controls land use within the site boundary and enforces land use restrictions. DOE will perform long-term stewardship activities under a U.S.

Nuclear Regulatory Commission (NRC) general license to maintain protectiveness and regulatory compliance. Access is restricted through the use of a fence with locked gates around the site. Warning signs are posted every 152 meters (500 feet) along the site boundary. DOE has obtained permanent right-to-access through a cooperative agreement with the Navajo Nation. Provisions of this agreement include restriction of public access and posting of appropriate warning signs, for which DOE is responsible. DOE maintains a 24-hour phone line for reporting concerns. Drilling and other intrusive activities are prevented within site boundaries. The Navajo Nation has enforcement authority under its cooperative agreement with DOE. This means that any access violations will be addressed in the Navajo Nation's judicial system.

DOE maintains and updates the specific records and reports required to document and evaluate long-term stewardship activities at the Tuba City Site. DOE submits an annual report to the NRC that documents the results of the annual site inspection, as required by NRC regulations. Site records are maintained in permanent storage at the DOE Grand Junction Office. Types of records maintained include characterization data, remedial action design, the site completion report, long-term monitoring plans, annual inspection reports, and monitoring data. Real property records are maintained by DOE's Albuquerque Operations Office in New Mexico. These documents are available to the public.

2.2 Specific Long-Term Stewardship Activities

Engineered Units

The Tuba City Site has one disposal cell that requires long-term surveillance and maintenance to ensure compliance with EPA standards. About 1.1 million cubic meters (1.4 million cubic yards) of contaminated low-level radioactive waste materials were disposed onsite in a disposal cell. Long-term surveillance activities at the disposal cell include annual inspections and a 10-year revegetation program. The disposal cell has a radon barrier cover and rock surface layer to control erosion. The cover has been designed in accordance with EPA's standards to remain effective for 200 to 1,000 years. DOE assumes that monitoring will continue indefinitely or until the cell demonstrates infiltration control.

Groundwater

DOE's Grand Junction Office is responsible for routine groundwater monitoring for compliance after active groundwater remediation has been completed. DOE assumes groundwater remediation will be completed in 2011 and that groundwater monitoring will continue indefinitely.

STAKEHOLDER INTERACTION

Community interaction has been extensive since the surface remedial action was completed in 1990. Frequent meetings with various agencies of the Navajo Nation and their representatives have occurred. Copies of the annual inspection report for this site are distributed to the local library and any stakeholder that requests one. The report is also published on the DOE Grand Junction Office website at www.doegjpo.com.

2.3 Regulatory Regime

Long-term stewardship of the Tuba City Site is governed by several regulations, including the *Uranium Mill Tailings Radiation Control Act of 1978*; the *Atomic Energy Act of 1954,* as amended; Environmental Protection Agency Groundwater Protection Standards, including Title 40, *Code of Federal Regulations,* Part 192, Subparts B and C - "Standards for Cleanup of Land and Buildings Contaminated with Residual Radioactive Materials from Inactive Uranium Processing Sites;" a cooperative agreement between DOE and the State of Arizona; a cooperative agreement between DOE and the Navajo Nation; and the *National Environmental Policy Act of 1969*, as amended.

2.4 Assumptions and Uncertainties

Because DOE is already conducting long-term stewardship activities at the Tuba City Site, and these activities are well known, DOE does not expect them to change dramatically. DOE assumes that routine groundwater monitoring for compliance will be required after active remediation has been completed in 2011. DOE also assumes that monitoring will continue for an unknown time period until data demonstrates that the cell is controlling infiltration. This monitoring cannot begin until the existing groundwater plume has been remediated. Moreover, DOE assumes that long-term stewardship of the Tuba City disposal cell will continue indefinitely.

3.0 Estimated Long-Term Stewardship Costs

Estimated costs for long-term stewardship activities at the Tuba City Site are identified in the table below. Long-term stewardship costs for the Tuba City Site are based on actual costs of conducting surveillance and maintenance activities, including groundwater monitoring at this site. The cost estimates reflect the current site agreements and monitoring frequencies. Costs for fiscal years (FY) 2001 through 2006 include prorated costs associated with decommissioning unnecessary monitoring wells at similar sites. For purposes of this report, long-term stewardship costs are shown until FY 2070; however, it is anticipated that long-term stewardship activities will be required in perpetuity.

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	***Amount***	***Year(s)***	***Amount***	***Year(s)***	***Amount***
FY 2000	$32,600	**FY 2008**	$24,400	**FY 2036-2040**	$172,500
FY 2001	$88,000	**FY 2009**	$24,400	**FY 2041-2045**	$171,900
FY 2002	$93,800	**FY 2010**	$24,400	**FY 2046-2050**	$172,500
FY 2003	$83,700	**FY 2011-2015**	$8,238,900	**FY 2051-2055**	$171,900
FY 2004	$94,400	**FY 2016-2020**	$10,355,900	**FY 2056-2060**	$172,500
FY 2005	$62,200	**FY 2021-2025**	$2,256,900	**FY 2061-2065**	$171,900
FY 2006	$63,300	**FY 2026-2030**	$171,200	**FY 2066-2070**	$172,500
FY 2007	$24,600	**FY 2031-2035**	$171,900		

4.0 Future Uses

Future use of the area beyond the disposal cell site boundary will likely be agricultural. Public access to the disposal cell will be restricted indefinitely by DOE.

For more information about the Tuba City Site, contact:

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or visit the Internet website at http://www.doegjpo.com

California

Long-Term Stewardship Site Highlights

Energy Technology Engineering Center (page 3)
Size Size - 36 hectares (90 acres)
Current Landlord - Boeing Canoga Park
Expected Start/End Years - unknown
Expected Future Landlord - Boeing Canoga Park

General Atomics (page 9)
Size Size - 49 hectares (120 acres)
Current Landlord - General Atomics
Expected Start/End Years -unknown
Expected Future Landlord - General Atomics

General Electric Vallecitos Nuclear Center (page 13)
Size Size - 640 hectares (1,600 acres)
Current Landlord - General Electric
Expected Start/End Years - unknown
Expected Future Landlord - General Electric

Laboratory for Energy Related Health Research (page 17)
Size Size - 6 hectares (15 acres)
Current Landlord - University of California at Davis
Expected Start Year - unknown
Expected Future Landlord - University of California at Davis

Lawrence Berkeley National Laboratory (page 21)
Major Activities - groundwater monitoring; access restrictions; fences; signage; and compliance record-keeping and reporting
Site Size - 82 hectares (200 acres)
Estimated Average Annual Cost FY 2005-2006 - $1,176,000

Lawrence Livermore National Laboratory - Main Site (page 37)
Major Activities - operation and maintenance of treatment systems; groundwater monitoring
Site Size - 263 hectares (651 acres)
Estimated Average Annual Cost FY 2000-2006 - n/a (costs begin in FY 2008)

Lawrence Livermore National Laboratory - Site 300 (page 79)
Major Activities - treatment facility operation and maintenance; groundwater monitoring; exposure control through risk and hazard management; long-term surveillance and maintenance of landfills; remediation optimization
Site Size - 2,860 hectares (7,067 acres)
Estimated Average Annual Cost FY 2000-2006 - n/a (costs begin in FY 2009)

Sandia National Laboratories - California (page 117)
Major Activities - groundwater monitoring; cell cover maintenance and monitoring; institutional and engineered controls
Site Size - 165 hectares (413 acres)
Start/End Years - 1999/in perpetuity
Estimated Average Annual Cost FY 2000-2006 - $84,000

Stanford Linear Accelerator Center (page 125)
Major Activities - groundwater monitoring; groundwater plume containment; institutional controls
Site Size - 172 hectares (426 acres)
Start/End Years - 2004-2062
Estimated Average Annual Cost FY 2003-2006- $ 500,000

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Sandia National Laboratories - California 117

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ENERGY TECHNOLOGY ENGINEERING CENTER[1]

1.0 SITE SUMMARY

1.1 Site Description and Mission

The Energy Technology Engineering Center (ETEC) is a former DOE research laboratory, currently in closure. ETEC is located within Area IV of the Santa Susana Field Laboratory, occupying 36 hectares (90 acres) of the 1,080-hectare (2,700-acre) site. The Santa Susana Field Laboratory is located in the Simi Hills of Ventura County, approximately 48 kilometers (30 miles) northwest of downtown Los Angeles, California. Boeing Canoga Park owns and operates the Santa Susana Field Laboratory. The site is being cleaned up to residential standards for both chemical and radiological contamination.

SITE HIGHLIGHTS

Total Site Area - 36 hectares (90 acres)
Current Landlord - Boeing Canoga Park
Expected Long-Term Stewardship Start-End Years
Expected Future Landlord - Boeing Canoga Park
Reason Not Subject to NDAA Requirements - DOE is not the owner of the site; the private owner is expected to be responsible for any potential long-term stewardship activities

The environmental restoration effort can be divided into three major activities: (1) decontamination and decommissioning of three former radiological facilities (the Radioactive Materials Handling Facility, Building 024 and Building 059 which housed the former Space Nuclear Auxiliary Power [SNAP] reactor systems), (2) decontamination and decommissioning of three, sodium facilities (the Sodium Components Test Installation, the Sodium Pump Test Facility, and the Hazardous Waste Management Facility), and (3) *Resource Conservation and Recovery Act* (RCRA) soil and groundwater remediation for chemical contamination. The radiological contamination in soil and groundwater is being addressed under the Atomic Energy Act (AEA). Under the RCRA Facility Investigation (soil and groundwater), there is the Sodium Disposal Facility (Building 886), about eight solid waste management areas under investigation, and the cleanup of onsite contaminated groundwater. DOE is responsible for overseeing facility decontamination and decommissioning and site remediation activities conducted by the land owner, Boeing Canoga Park.

ETEC's historic mission involved nuclear research and development for DOE's predecessor agency, the U.S. Atomic Energy Commission (AEC). In the mid-1950s, a part of Area IV was set aside for nuclear reactor development and testing – primarily related to the development of nuclear power plants and space power systems, using sodium and potassium as coolants. In the mid-1960s, the Energy Technology Engineering Center was established within Area IV as a DOE laboratory for the development of liquid metal heat transfer systems to support Office of Nuclear Energy Liquid Metal Fast Breeder Reactor program. The Rockwell International Hot

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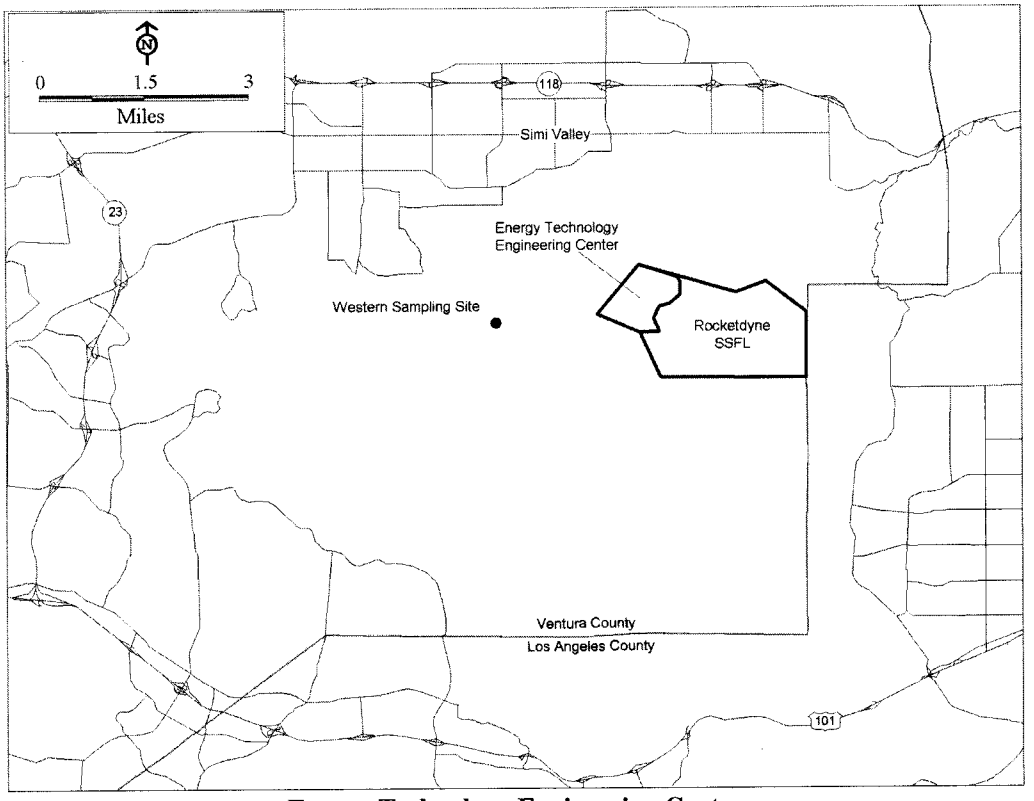
[1] This report is developed in response to a Congressional request in the Fiscal Year (FY) 2000 National Defense Authorization Act (NDAA). As requested by the Act, this report addresses current and anticipated long-term stewardship activities at each site or portion of a site by the end of calendar year 2006 ("Conference Report on S.1059, National Defense Authorization Act for Fiscal Year 2000," *Congressional Record,* August 5, 1999).

Based on current planning, the U.S. Department of Energy (DOE) is not expected to be responsible for long-term stewardship activities at the former Energy Technology Engineering Center. DOE does not own land at the site, and any necessary long-term stewardship activities are expected to be conducted by the private owner. Currently, DOE is responsible for overseeing stabilization and decommissioning activities and remediation of onsite contaminated groundwater and soils. This summary of the site is included to assist in documenting DOE's role at the site and potential long-term stewardship activities at the site in the future that may be conducted by a non-DOE entity. (See Section 2.1.2 of Volume I).

Laboratory, located in Building 20, was used for the agency's Office of Defense Programs, while various other facilities were used for other AEC research programs (e.g., the Systems for Nuclear Auxiliary Power program). These Area IV operations ended by mid-1970s, while the DOE Office of Nuclear Energy (now Office of Science) continued its onsite activities until the end of 1995. The contamination at the Energy Technology Engineering Center resulted from past operations in support of DOE and predecessor agency programs.

Presently, there are no ongoing DOE research activities at the Energy Technology Engineering Center. ETEC operations primarily focused on applied engineering and development of emerging energy technologies, including energy conservation and solar, geothermal, and fossil energy, for the private sector. DOE signed a contract in December 1998 with the current landlord Boeing Canoga Park, to complete cleanup in 2007. The contract calls for the transfer of all remaining facilities to the owner, who will then take responsibility for any required long-term stewardship activities. Upon the issuance of a Certification of Completion of the Corrective Measures Implementation by the State regulator, Boeing will assume responsibility for the operation and maintenance of the ETEC site-wide groundwater remediation system. In addition, Boeing has contractually agreed that once the Certificate is issued, it will not seek compensation for any environmental restoration activities it is required to undertake at the ETEC site unless: 1) those activities are necessitated by DOE funded work; and 2) the cumulative cost for such effort exceeds $600,000.



Energy Technology Engineering Center

1.2 Site Cleanup and Accomplishments

Cleanup activities at the Energy Technology Engineering Center include decontamination and decommissioning facilities, and remediation of contaminated groundwater and soils. Radiological contamination resulted from

research and development activities performed primarily in the 1960s. These activities included the operation of ten reactors and seven criticality test facilities, fuel fabrication, reactor and used fuel disassembly, small-scale laboratory work, and onsite storage of nuclear material. The onsite contamination of research buildings, existing and former waste management facilities, disposal units, soils, and groundwater is primarily from radionuclides and sodium. This contamination resulted from past research and development activities, and handling and disposal practices. All the reactors, reactor vessels, and associated fuel were removed in the 1970s. During 1974 to 1989, a decommissioning activities program removed more than 99 percent of the manmade radioactivity from site facilities. Since 1990, an estimated 10 curies of radioactivity remain on site, either as stored waste, or contained in activated or contaminated structures that are locked, fenced, and within a guarded perimeter.

DOE has decided to conduct an Environmental Assessment to assess the cumulative effects of the ongoing environmental restoration activities. Depending upon the results of the assessment, there will either be a Finding of No Significant Impact or the determination that an Environmental Impact Statement needs to be prepared. Most of the restoration activities that were in progress or were planned are on hold pending the result of the Environmental Assessment. Some limited activities, however, will continue. These include: allowable interim actions, such as the sodium burn pit interim action; routine surveillance and maintenance, such as painting, building repair; activities for health and safety reasons, such as finishing the demolishing of a building already initiated; and operations that must continue to comply with legal requirements, such as waste shipments and environmental sampling.

Facilities

There are three radiologically contaminated facilities that will undergo the decontamination and decommissioning process.

Building 059 formerly housed a SNAP reactor. Most of the contamination was removed in an earlier D&D phase in the 1990's.

The Snap Environmental Test Facility (SETF), Building 024, was used to operate and test SNAP reactors systems in the 1960's. The facility consisted of two concrete shielded underground cells that house the test reactors, an above grade high bay support area, a control room and engineering and administrative support offices. The aluminum cell liner, the concrete walls, and steel reinforcement bars of the reactor test cells were made radioactive by neutron activation. The induced radioactivity of the structure is greater than acceptable for unrestricted use criteria in the inner 30-40 inches of the walls, ceilings and floors of the two 4.9x4.9 meters (16x16 feet) wide by 5.8 meters (19 feet) deep underground test cells. These cells will have to be demolished and the radioactive waste packaged and shipped for disposal. The remainder of the facility is unsuitable for restoration. After demolition, the site will be backfilled, graded and revegetated. This activity is scheduled to be performed in FY2005.

The Radioactive Materials Handling Facility (RMHF), comprised of Buildings 021, 022, and 075, will be the last radiologically contaminated facility to undergo decommissioning because it currently supports onsite restoration activities. The facility contains a decontamination unit and serves as a temporary storage area for radioactive and mixed waste prior to offsite disposal. Therefore, the contamination at this facility is mainly from radioactive waste storage activities. Currently, there are 11 cubic meters (14 cubic yards) of transuranic waste, which is potentially mixed waste, stored in below-grade storage vaults at the Radioactive Materials Handling Facility. Plans are to have all the transuranic waste shipped offsite for intersite transfer or disposal at the Waste Isolation Pilot Plant by FY 2003. The Radioactive Materials Handling Facility closure and remediation of its surrounding areas are expected to be completed in FY 2005 under the Resource Conservation and Recovery Act (RCRA).

Currently, there are only three sodium facilities remaining that will be decontaminated and decommissioned: the

Sodium Components Test Installation (SCTI), the Sodium Pump Test Facility (SPTF), and the Hazardous Waste Management Facility (HWMF).

The SCTI was the largest facility of its type in the world. In operation for over 30 years, the facility was used to test a number of sodium cooled steam generators designed for nuclear service. The SCTI sodium system consists of over 1,300 meters (4,400 feet) of sodium loop piping, 1 to 26 inches in diameter, 5 tanks, 71 valves, 2 pumps and 16 miscellaneous components containing miles of additional piping including two large steam generators and two heat exchangers. The H-1 heater, for example, contains over 7,300 meters (24,000 feet) of sodium contaminated 1-inch diameter pipe. The SCTI is currently undergoing demolition and all of the sodium has been offloaded from the facility.

The SPTF has two circulating sodium loops with transient capability and was used to test large sodium pumps, valves and flowmeters. Piping consists of over 600 meters (2,000 linear feet) ranging in diameter from 1 inch to 36 inches. In addition, there are four tanks, 30 valves, three pumps, and eight miscellaneous components including two forced draft sodium to air coolers, each containing a serpentine tube bundle. The dismantlement of the SPTF will involve stripping of all support systems and insulation to provide access to the sodium loop for size reduction activities. Sodium piping will then be transported to the onsite cleaning station. Major components will require special procedures and approaches to assure safe disposition. After all the sodium and peripheral support systems and major components have been dispositioned, the facility structure will be demolished, foundations removed, site backfilled, and the area revegetated. Demolition of this facility is scheduled to start in FY2003.

The HWMF is currently undergoing closure under RCRA. The HWMF consists of two buildings: Building 029, a 74 sq. meters (800 sq. ft.) storage building, and Building 133, a 43 sq. meters (462 sq. ft.) treatment building. There have been no known spills at the storage facility but soil was found to have elevated pH in and around the treatment facility. The scope of the cleanup will be to remove the building structures and foundations and test surrounding soils to quantify the extent of contamination. Any contaminated soils will be removed and disposed of. The site will then be backfilled, graded to natural contours and revegetated.

SITE ACCOMPLISHMENTS

- Completed characterization of the perimeter of Area IV
- Removed more than 99 percent of manmade radioactivity from site facilities
- Completed decontamination and decommissioning at several former nuclear facilities
- Shipped 120 cubic meters (4,250 cubic feet) of low-level radioactive waste offsite
- Completed requirement to recycle 75% of the surplus sodium
- Building 020 Hot Laboratory, complete D&D
- Sodium Disposal Facility (Building 886) complete removal of first phase involving all radiologically contaminated soil
- Sodium Components Test Loop, complete D&D
- Liquid Metal Development Laboratory -1, complete D&D
- Liquid Metal Development Laboratory-2, complete D&D
- Large Leak Test Rig, complete D&D

ANTICIPATED SITE ACCOMPLISHMENTS BY 2007

- Decontaminate and decommission three facilities and clean to below free release levels per NRC regulations
- Cleanup all former radiologically contaminated facilities to free release levels for unrestricted use
- Complete demolition of the Sodium Components Test Installation Facility
- Complete shipping of all transuranic waste for offsite disposal by FY 2003
- Complete RCRA Facility Investigation (RFI) Implementation phase, which includes remediation of all solid waste management units (B056) and the installation of a groundwater cleanup technology
- Complete Environmental Assessment of the Energy Technology Center site
- Complete demolition of the Sodium Pump Test Facility

The Sodium Disposal Facility was contaminated from the onsite storage of radioactive materials, sodium,

mercury, and polychlorinated biphenyls. This facility has undergone extensive remediation. During the initial remediation phase, about 340 cubic meters (450 cubic yards) of mixed waste, 920 cubic meters (1,200 cubic yards) of hazardous waste, 7,600 cubic meters (10,000 cubic yards) of non-hazardous waste and 230 cubic meters (300 cubic yards) of low-level radioactive waste were shipped off-site. The Sodium Disposal Facility is now undergoing a RCRA closure. During this phase about 11 cubic meters (15 cubic yards) of hazardous waste and 6,900 cubic meters (9,000 cubic yards) of non-hazardous waste have been excavated.

The Solid Waste Management Units (SWMUs) were contaminated from past disposal activities. The SWMUs are part of the RCRA Facility Investigation process. The Corrective Measures Implementation phase of the RCRA Facility Investigation will be completed by 2006.

Groundwater

The contaminants that are currently present in the groundwater include residual volatile organic compounds (e.g., trichloroethylene), semi-volatile organic compounds, and tritium. The remediation strategy is not yet finalized; however, a groundwater pump-and-treat system is currently being implemented as an interim action. It is anticipated that the long-term groundwater strategy will be in place by 2006.

2.0 Potential Long-Term Stewardship Activities

It is anticipated that the primary source of residual groundwater contamination will be from trichloroethelyne. Long-term surveillance and monitoring activities in the post-decontamination and decommissioning phase will be conducted by DOE until State regulatory agencies grant release of the site for transfer to Boeing Canoga Park, which is expected to occur by 2007. Following transfer, Boeing Canoga Park has agreed to assume long-term surveillance under the terms of the contract with DOE. Furthermore, Boeing Canoga Park will be responsible for maintaining access controls and ensuring that appropriate future uses of the site are maintained. There will be no long-term monitoring and surveillance required for former radiologically contaminated facilities. All remaining former radiologically contaminated facilities will be decontaminated to unrestricted use levels and then demolished. Any building material not decontaminated to unrestricted use levels will be disposed of as radioactive waste.

3.0 Expected Future Uses and Site Responsibility

The Energy Technology Engineering Center is being cleaned up under the RCRA corrective action process. DOE plans to complete cleanup and revert control to Boeing Canoga Park by 2007. After decontamination and decommissioning of the site, intact facilities will be transferred to Boeing Canoga Park. Although the near-term use is likely to be industrial, the long-term use is yet to be determined. Therefore, the site will be remediated for residential use. Boeing Canoga Park is responsible for conducting all long-term stewardship activities at the site.

For additional information about the Energy Technology Engineering Center, please contact:

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Oakland Environmental Programs Division
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GENERAL ATOMICS[1]

1.0 SITE SUMMARY

1.1 Site Description and Mission

The General Atomics site contains a Hot Cell Facility that was used for 30 years to support DOE (and its predecessor agency) and commercial programs. The site is made up of two contiguous sites, the Main Site and the Sorrento Valley Area, that occupy approximately 49 hectares (120 acres), 21 kilometers (13 miles) north of downtown San Diego, California.

SITE HIGHLIGHTS

Total Site Area - 49 hectares (120 acres)
Current Landlord - General Atomics
Expected Long-Term Stewardship Start-End Years - Uncertain if any long-term stewardship will be required.
Expected Future Landlord - General Atomics
Reason Not Subject to NDAA Requirements - DOE is not expected to be responsible for long-term stewardship activities at the site. DOE does not own the site and the private owner is expected to be responsible for long-term stewardship activities at the site.

The Hot Cell Facility Decontamination and Decommissioning Project is the only DOE Environmental Management program at the site. The Hot Cell Facility, which is located on the Main Site, has been dismantled as part of site remediation activities. The facility was used for numerous post-irradiation examinations of nuclear fuels, structural materials, reactor dosimetry materials, and instrumentation. DOE-sponsored activities at the Hot Cell Facility primarily supported the High Temperature Gas Cooled Reactor and the Reduced-Enrichment Research Test Reactor programs. Such activities have left the Hot Cell Facility contaminated with mixed fission and activation products.

The Hot Cell Facility occupied Building 23 and an outdoor service yard on General Atomic's Main Site. The interior of Building 23 had approximately 690 square meters (7,400 square feet) of floor space, consisting of offices, three hot cells, an operating gallery, and hot and cold auxiliary areas. This facility was surrounded by a 4,342-square meter (46,740-square foot) fenced service yard that includes several concrete pads used for staging heavy equipment and transferring material in and out of the building. The remaining area of the service yard consisted of asphalt, soil, scattered small rocks, and disturbed vegetation. There was a small 37-square meter (400-square foot) metal ancillary building and four above-ground waste storage tanks. Other equipment included the high-efficiency particulate air ventilation filtration system, stack, and temporary storage areas. The yard is enclosed by a two-meter (seven-foot) high galvanized chain link fence. Currently, there are physical barriers and security personnel who control access into the yard.

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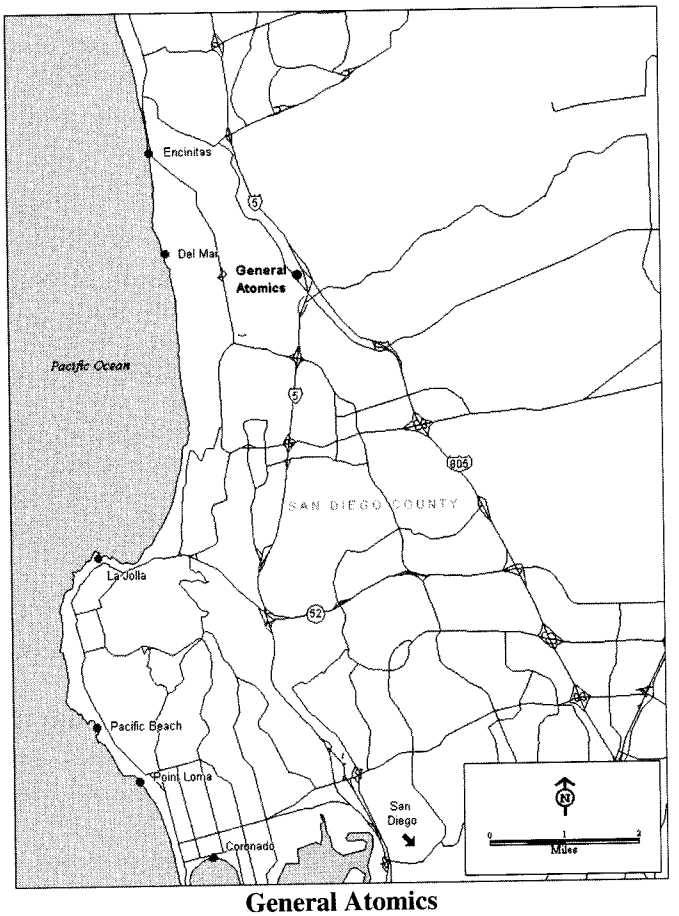
[1]This report is developed in response to a Congressional request in the Fiscal Year (FY) 2000 National Defense Authorization Act (NDAA). As requested by the Act, this report addresses current and anticipated long-term stewardship activities at each site or portion of a site by the end of calendar year 2006 ("Conference Report on S.1059, National Defense Authorization Act for Fiscal Year 2000," *Congressional Record,* August 5, 1999).

Based on current planning, the General Atomics site will not require long-term stewardship by the U.S. Department of Energy (DOE). DOE does not own property at this site and any necessary long-term stewardship activities will be conducted by the private owner. This site summary is provided to assist in documenting DOE's role at the site and potential long-term stewardship activities at the site in the future that may be conducted by a non-DOE entity. (See Section 2.1.2 of Volume I).



General Atomics

1.2 Site Cleanup and Accomplishments

The Hot Cell Facility and soils on the site were contaminated with mixed fission and activation products from past operations. Assessments of the Hot Cell Facility indicated that the walls, floors, cell penetrations (e.g., holes in the walls for utilities that can be sources of contamination leaks), the roof, and exterior walls were contaminated with radiological and/or hazardous contaminants (e.g., radionuclides, polychlorinated biphenyls, semi-volatile organic compounds, and metals). Core drilling results revealed the presence of minor subsurface soil contamination below the Hot Cell Facility. The soil cleanup limits were based on an unrestricted use scenario, as approved by the U.S. Nuclear Regulatory Agency (NRC). Groundwater at the Hot Cell Facility is approximately 91 meters (300 feet) below the ground surface and no groundwater contamination is detected beneath the Hot Cell Facility.

SITE ACCOMPLISHMENTS

- Site characterization completed 1995
- Hot Cell decontamination completed in 1997
- Hot Cell dismantlement completed in 1998
- Remediation of soil completed in 1999; approximately 2,700 cubic meters of low-level radioactive waste has been disposed of offsite
- Final site survey and closure report sent to regulators

ANTICIPATED SITE ACCOMPLISHMENTS BY 2006

- Obtain regulatory release of the site to unrestricted use in 2000
- Ship all irradiated fuel materials to the Idaho National Engineering and Environmental Laboratory for interim storage by 2005

DOE plans to complete all Hot Cell Facility remediation activities in 2000, excluding the shipment of about 0.065 metric tons of heavy metal (MTHM) of irradiated fuel materials (anticipated in 2005) to the Idaho National Engineering and Environmental Laboratory for interim storage. Remediation activities included the removal of all onsite soil contamination; offsite disposal of waste; decontamination; and dismantlement of the Hot Cell Facility. Site and facility characterization was completed in 1995, decontamination and decommissioning in 1997, and dismantlement in 1998. DOE will maintain responsibility at the site until all waste and irradiated fuel materials are disposed of offsite. Following cleanup, the site is expected to be released for unrestricted used by NRC and the State of California Department of Health Services.

2.0 POTENTIAL LONG-TERM STEWARDSHIP ACTIVITIES

Long-term surveillance and monitoring in the post-decontamination and decommissioning phase will be conducted by DOE until the Hot Cell Facility site is approved for release by the NRC and the State of California. General Atomics will be responsible for the Hot Cell Facility site upon regulatory release, including long-term stewardship activities if required.

3.0 EXPECTED FUTURE USES AND SITE RESPONSIBILITY

DOE will maintain responsibility at the site until all irradiated fuel materials are disposed of offsite. The Hot Cell Facility site is expected to be released by the NRC and the State of California for unrestricted use (as approved by NRC) in 2000. The current or future private owner/operator will determine the future use of this site.

For additional information about the General Atomics, please contact:

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GENERAL ELECTRIC VALLECITOS NUCLEAR CENTER[1]

1.0 SITE SUMMARY

1.1 Site Description and Mission

The General Electric Vallecitos Nuclear Center is a privately-owned commercial energy research facility operated by General Electric. The Center occupies approximately 640 hectares (1,600 acres) in Pleasanton, California (Alameda County). The site is located approximately 64 kilometers (40 miles) east of San Francisco and approximately 11 kilometers (7 miles) southwest of Livermore, California.

SITE HIGHLIGHTS

Total Site Area - 640 hectares (1,600 acres)
Current Landlord - General Electric
Expected Long-Term Stewardship Start-End Years - unknown
Expected Future Landlord - General Electric
Reason Not Subject to NDAA Requirements - DOE does not own the site; the private owner is expected to be responsible for any potential long-term stewardship activities

DOE's primary missions at the General Electric Vallecitos Nuclear Center include the cleanup of Hot Cell No. 4, located in the Radioactive Materials Laboratory in Building 102; subsequent certification that the Hot Cell No. 4 is free of transuranic contamination; and the decontamination and offsite disposal of the emission spectrograph (also referred to as the "glovebox").

In 1958, General Electric constructed four hot cells for postirradiation examination of uranium fuel and irradiated reactor components for the U.S. Government and the civilian nuclear power industry. These activities continued until 1965. All four hot cells are located in the Radioactive Materials Laboratory. However, Hot Cell No. 4 is the only cell that was used for the U.S. Government and for which DOE is responsible for remediation. The other three cells are used in support of General Electric's commercial activities. Between 1965 and 1967, Hot Cell No. 4 (used in support of the U.S. Atomic Energy Commission's (a predecessor agency to DOE) fast breeder reactor development programs) was decontaminated, equipped with a stainless steel liner to contain plutonium, and dedicated to the study of mixed oxide fuel rods. In 1978, Hot Cell No. 4 was placed in a standby condition, and Lawrence Livermore National Laboratory used it for six months in 1981 and 1982. Thereafter, the General Electric Vallecitos Nuclear Center used the cell for corporate business for less than ten days every year. In 1968, the General Electric Vallecitos Nuclear Center installed a glovebox for emission spectrographic analyses of mixed oxide fuel specimens for DOE. The glovebox is a 4.9-cubic meter (6.6-cubic yard) stainless steel enclosure located in the Analytical Chemistry Laboratory in Building 103. The glovebox was used until 1980.

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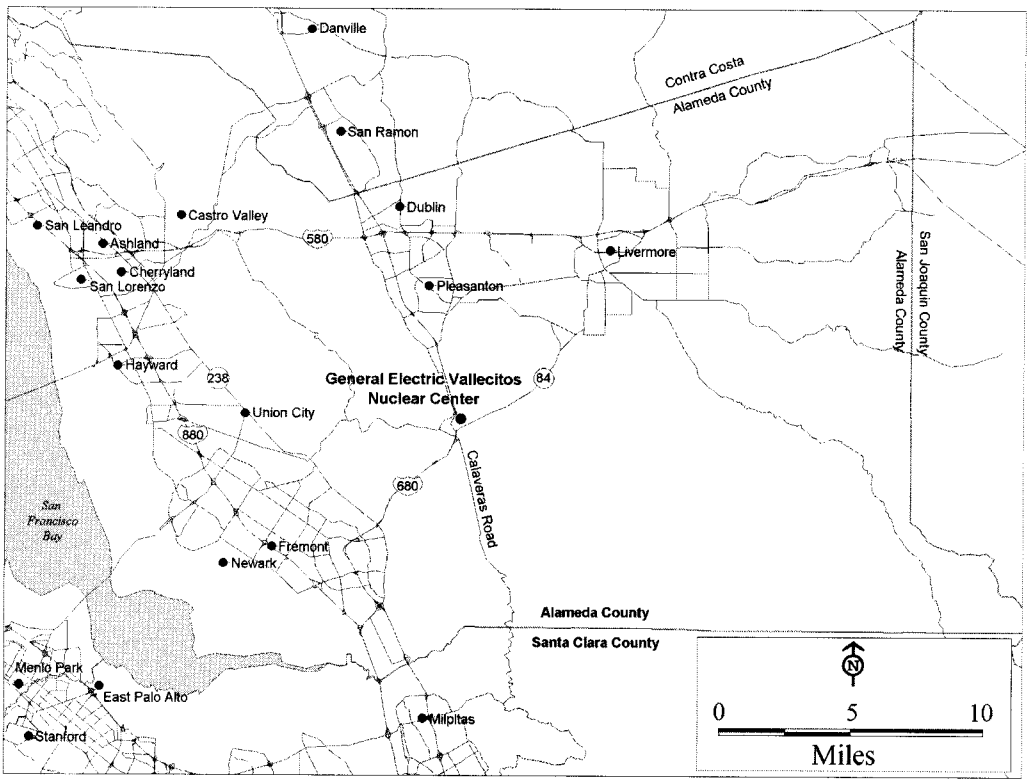
Based on current planning, the U.S. Department of Energy (DOE) is not expected to be responsible for long-term stewardship activities at the General Electric Vallecitos Nuclear Center. DOE does not own property at the site, and any necessary long-term stewardship activities will be conducted by the private owner. Currently, DOE is responsible for overseeing site remediation. This summary of the site is included to provide to assist in documenting the DOE role at the site and potential long-term stewardship activities at the site in the future that may be conducted by a non-DOE entity. (See Section 2.1.2 of Volume I).



General Electric Vallecitos Nuclear Center

1.2 Site Cleanup and Accomplishments

Past operations in support of DOE programs at this site resulted in contamination of only Hot Cell No. 4 and the emission spectrograph glovebox; therefore, these facilities are the only areas at the site where DOE currently has cleanup responsibility. It is expected that DOE's remediation of this site will be completed in 2008, following the last shipment of transuranic waste offsite. The site will then be under the complete management and responsibility of General Electric.

Characterization of the Hot Cell No. 4 and glovebox has not yet begun. Characterization will include radiological surveys to determine locations and concentrations of radioactive contamination. DOE will decontaminate the Hot Cell No. 4, remove alpha enclosures, and certify that the cell is free of transuranic contamination. After decontamination, the hot cell will be suitable for commercial use by General Electric. DOE will also decontaminate and oversee offsite disposal of the emission spectrograph (i.e., glovebox). Once the hot cell is turned over to General Electric and the glovebox is disposed of at an offsite location, DOE will have no further responsibilities at this site.

ANTICIPATED SITE ACCOMPLISHMENTS BY 2006

- Decontaminate Hot Cell No. 4
- Ship and dispose of approximately 20 cubic meters (26 cubic yards) of transuranic radioactive waste offsite

Cleanup activities are scheduled to occur over an extended period, with completion expected in 2008. Decontamination activities will generate two radioactive waste streams: (1) non-aqueous, remote-handled transuranic waste in the form of construction debris and equipment, and (2) non-aqueous, low-level radioactive

waste, also in the form of construction debris and equipment. Based on radiological surveys and site evaluations, it is estimated that the quantity of transuranic-contaminated waste materials to be removed during decontamination activities is approximately 20 cubic meters (26 cubic yards). It is also estimated that the removal of the steel liner will result in approximately 13 cubic meters (18 cubic yards) of low-level waste, conservatively assuming that mixed low-level radioactive and hazardous waste will not be generated from the decontamination activities.

The Hot Cell Facility is licensed by the U.S. Nuclear Regulatory Commission and California Department of Health Services. All decontamination and restoration activities must comply with the license requirements from both of these regulatory agencies.

2.0 Potential Long-Term Stewardship Activities

Because General Electric intends to continue using the Hot Cell and because of the nature of the contamination resulting from operations, it is anticipated that some type of long-term stewardship activities, such as monitoring, surveillance, and inspections, will be needed. General Electric will be responsible for these activities.

3.0 Expected Future Uses and Site Responsibility

General Electric will continue to use the site for industrial/commercial purposes following release of the Hot Cell No. 4. Once cleanup of Hot Cell No. 4 and the glovebox are complete, DOE will no longer have remediation responsibilities at the site. DOE is not expected to be responsible for the long-term stewardship at the site and, thus, will not maintain a presence at the site.

For additional information about the General Electric Vallecitos Nuclear Center, please contact:

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LABORATORY FOR ENERGY RELATED HEALTH RESEARCH[1]

1.0 SITE SUMMARY

1.1 Site Description and Mission

The Laboratory for Energy Related Health Research site is an inactive research facility where, for a period of 30 years, the U.S. Department of Energy (DOE) and its predecessor agency funded radiation-related studies using animals. The University of California at Davis owns the Laboratory for Energy Related Health Research, a six-hectare (15-acre) site located 2.4 kilometers (1.5 miles) south of the main campus of the University of California at Davis. The Laboratory for Energy Related Health Research facility consists of a main administration and office building, two animal hospitals, a specimen storage room, a laboratory and support building, underground septic and domestic tanks, waste storage facilities, three landfills, and outdoor dog pens. DOE had leased the Laboratory for Energy Related Health Research since 1958.

SITE HIGHLIGHTS

Total Site Area - 6 hectares (15 acres)
Current Landlord - University of California at Davis
Expected Long-Term Stewardship Start Year - 2006
Expected Future Landlord - University of California at Davis
Reason Not Subject to NDAA Requirements - DOE is not responsible for long-term stewardship at the site; the current owner, University of California at Davis, will be responsible for long-term stewardship activities at the site

Research at the Laboratory for Energy Related Health Research was conducted by the DOE Office of Energy Research (now the DOE Office of Science) and originally focused on the health effects of chronic exposures to radionuclides, using beagles to simulate radiation effects on humans. DOE terminated this research program in 1988, and the buildings were transferred to DOE's Environmental Management program in 1989 for cleanup and eventual transfer back to the University of California at Davis.

In 1990, DOE initiated site restoration activities, with emphasis on facility decontamination and the removal of onsite radioactive, chemical, and potential mixed sources, a process that is still ongoing. In May 1994, the U.S. Environmental Protection Agency (EPA) added the Laboratory for Energy Related Health Research, along with University of California at Davis landfills and burial trenches, to EPA's National Priorities List under the *Comprehensive Environmental Response, Compensation, and Liability Act*. DOE and the University of California at Davis signed a Memorandum of Understanding in 1997 that detailed the remediation responsibilities for each entity.

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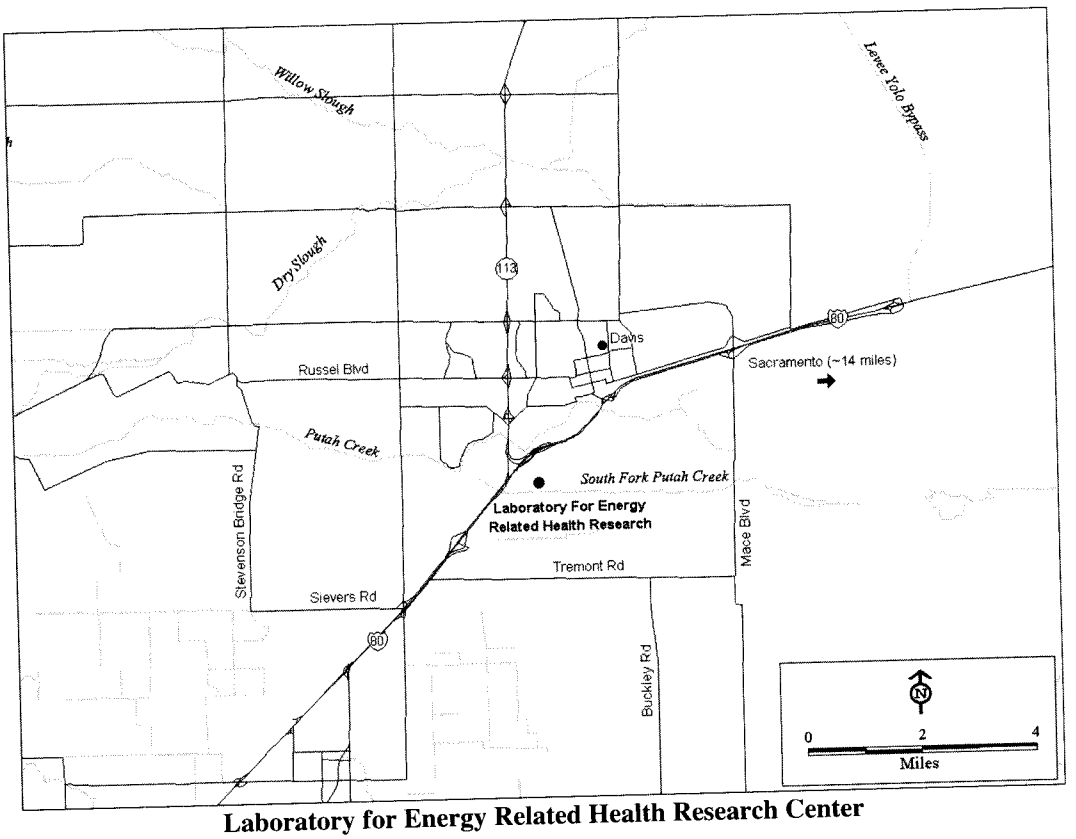
Based on current planning, the Laboratory for Energy Related Health Research site will not require long-term stewardship by DOE. Responsibility for the laboratory belongs to the University of California at Davis as a result of a 1997 Memorandum of Understanding between the U.S. Department of Energy (DOE) and the University. Any necessary long-term stewardship activities are expected to be conducted by the University. This site summary is included to provide to assist in documenting DOE's role at the site and potential long-term stewardship activities at the site in the future that may be conducted by a non-DOE entity. (See Section 2.1.2 of Volume I).



Laboratory for Energy Related Health Research Center

1.2 Site Cleanup and Accomplishments

SITE ACCOMPLISHMENTS

- Completed removal actions and remediated portions of the southwest trenches
- Closed RCRA storage facility

ANTICIPATED SITE ACCOMPLISHMENTS AS OF 2006

- Complete removal actions of radium and strontium treatment systems
- Complete removal actions of domestic tanks
- Remediate outdoor dog pens
- Complete cleanup by 2006

Under the Memorandum of Understanding between DOE and the University of California at Davis, each entity has agreed-upon cleanup responsibilities at different areas of the site. The University of California at Davis is responsible for remediation of the groundwater, radioactive waste burial trenches, and three landfills, as well as conducting all post-closure monitoring and long-term stewardship activities. DOE is responsible for the remediation of four operating units, including domestic tanks, burial trenches, radium and strontium treatment systems, and approximately 1.2 hectares (three acres) of outdoor dog pens, which are expected to be released under conditions consistent with land use. The burial trenches are located in the southwest corner of the site. The trenches received primarily low-level radioactive waste and laboratory wastes. The radium treatment system consisted of two septic tanks, a distribution box feeding three drywells, a leach trench, and associated distribution pipes. The strontium-90 treatment system consisted of nine "Imhoff" tanks and a leach field. The Imhoff system was used to treat approximately 200 to 500 gallons of waste per day prior to discharging it to the leach field. Although the final remedy has not been agreed upon, the CERCLA

Engineering Evaluation/Cost Analysis is complete and provides an analysis of the alternatives for the dog pens. All waste from the site will be shipped to offsite locations.

DOE expects to complete cleanup at areas of the site for which it is responsible by 2006, using a streamlined site cleanup approach that focuses on risk-based removal actions (through CERCLA Engineering Evaluation/Cost Analysis). At this point, it is unclear whether regulators will allow for a partial deletion of DOE areas from the EPA's National Priorities List once DOE has fulfilled its cleanup responsibilities.

Four buildings have already been decommissioned and decontaminated by DOE and released to the University of California at Davis for unrestricted use. Residual radioactive contamination at some of these onsite buildings/facilities have already been remediated to levels that meet guidelines established in DOE Orders (e.g. DOE Order 5400.1, *General Environmental Protection Requirements*) and NRC regulations for unrestricted use.

Two animal hospitals and the specimen storage room were decommissioned in 1994. Demolition of the Imhoff building was completed in 1995. A tank trailer was dismantled and shipped offsite for supercompaction in 1995. Decontamination of a building that housed a Cobalt 60 source, including verification by an independent contractor, was completed in 1996. Waste from these decommissioning activities consisted of low-level radioactive waste in the form of sludge, dry active waste, contaminated soils, and hazardous waste (e.g., asbestos, chemical waste, and biological waste). DOE estimates that decommissioning activities generated about 900 cubic meters (1,200 cubic yards) of low-level radioactive waste, 66 cubic meters (86 cubic yards) of low-level mixed waste, and 3 cubic meters (4 cubic yards) of hazardous waste. The site also had more than 500 outdoor dog pens that are assumed to be contaminated with radioactive materials. The final draft Engineering Evaluation and Cost Analysis provides the removal action alternatives for these dog pens.

The site also operated an interim-status Mixed Waste Storage Facility under a *Resource Conservation and Recovery Act* Part A Permit. This interim-status Mixed Waste Storage Facility was used to enable waste handling and loading from onsite environmental restoration activities and serve as a waste staging facility prior to shipment and disposal of waste offsite. The major waste streams from this storage facility have been characterized, packaged, and shipped to the Hanford Facility for disposal. No treatment of hazardous waste was conducted, or will be conducted, at the facility. The interim-status Mixed Waste Storage Facility was clean-closed in March 2000.

Materials contaminated with primarily radium and strontium have been removed from the southwest burial trenches. The removal actions to remediate the radium/strontium treatment system and domestic septic tank will be completed by 2002. DOE expects that no onsite engineered units will be left onsite. Remediation levels for radioactive contaminants in the soil are under negotiations to determine final soil cleanup levels. Cleanup levels for each contaminant will be based on CERCLA's 10^{-6} to 10^{-4} cancer risk.

2.0 Potential Long-Term Stewardship Activities

The University of California at Davis is responsible for all post-closure monitoring and long-term stewardship activities.

3.0 Expected Future Uses and Site Responsibility

It is expected that the land and the DOE-released facilities will remain part of the University of California at Davis campus. Remediation will be conducted to industrial reuse levels. The University will remain the site landlord and will continue to use the site as a research and teaching facility.

For additional information about the Laboratory for Energy Related Health Research, please contact:

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LAWRENCE BERKELEY NATIONAL LABORATORY

1.0 SITE SUMMARY

1.1 Site Description and Mission

Lawrence Berkeley National Laboratory is a multi-purpose research facility managed by the University of California for the U.S. Department of Energy (DOE). The 82-hectare (200-acre) Laboratory site is located in the Berkeley/Oakland hills adjacent to the Berkeley Campus of the University of California. The western three-quarters of the site are located in the City of Berkeley, and the eastern quarter is located in the City of Oakland. The Laboratory, which is about 3.2 kilometers (two miles) east of the San Francisco Bay, is bordered on the north by single family residences and on the west by multi-family dwellings, student residence halls, and commercial buildings.

LONG-TERM STEWARDSHIP HIGHLIGHTS

Major Long-Term Stewardship Activities - groundwater monitoring; access restrictions; fences; signage; and compliance record-keeping and reporting
Total Site Area - 82 hectares (200 acres)
**Estimated Volume of Residual Contaminants* - groundwater 3,785 cubic meters (4,950 cubic yards); soil unknown
Portions Requiring Long-Term Stewardship as of 2006 - 5
Average Annual Long-Term Stewardship Cost FY 2005-2006 - $1,176,000
Landlord - U.S. Department of Energy, Office of Science
*The estimated volume indicates only the known amounts of residual contaminants. For certain portions discussed for this site, exact volume is not known at this point. For specific discussions, please see Section 3.0.

Since the early 1930s, the University of California, the site owner, has leased Lawrence Berkeley National Laboratory to DOE (and its predecessor agencies) for a wide range of energy-related research activities, including research in nuclear and high-energy physics; accelerator research and development; materials research; and chemistry, geology, molecular biology, and biomedical research. As part of Lawrence Berkeley National Laboratory's energy research mission, DOE and its predecessor agencies have developed and operated national experimental facilities, including: three large accelerators (the Bevatron, the Super Heavy Ion Linear Accelerator, and the 88-inch Cyclotron), several small accelerators, the National Center for Electron Microscopy, and the Human Genome Center. These facilities also include a number of radiochemical laboratories, several large gamma irradiators, the National Tritium Labeling Facility, and the Advanced Light Source.

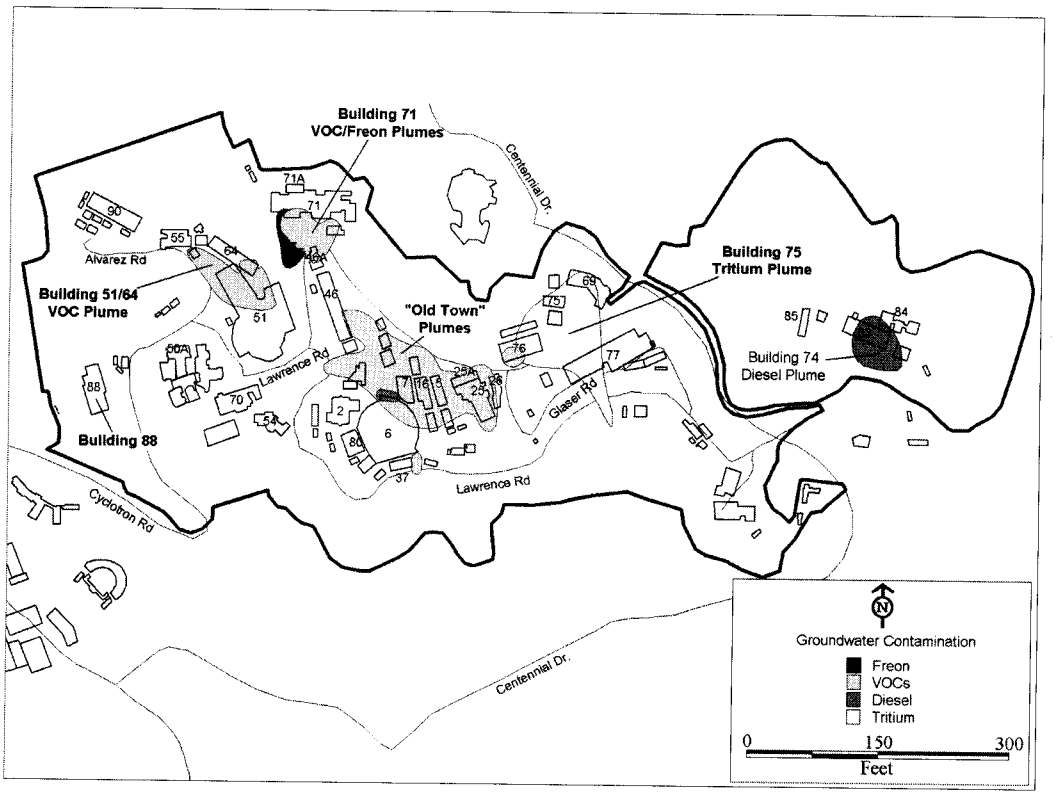
Lawrence Berkeley National Laboratory has an ongoing research mission and will continue to generate hazardous, radioactive, and mixed wastes. The mission of the Laboratory's environmental restoration program is to identify areas of soil and groundwater contamination that may have resulted from past releases of hazardous and radioactive waste to the environment, determine the sources and extent of contamination, and remediate contaminated areas, as required.

1.2 Site Cleanup and Accomplishments

Lawrence Berkeley National Laboratory expects to complete DOE's Environmental Program Mission cleanup in 2004.[1] The Laboratory is currently completing the *Resource Conservation and Recovery Act* (RCRA) Facility Investigation (RFI) phase of the RCRA Corrective Action Process. The objectives for the RFI are to identify the sources and define the extent of contamination. The RFI will be used as the basis for evaluating feasible

[1]The Bevalac facility and accelerator, which closed in 1993 and is awaiting decontamination and decommissioning, is not included in this report. The end state for this facility and accelerator is still in the planning phase and the extent, if any, of long-term stewardship is yet to be determined.

alternatives for site cleanup. DOE and the Laboratory will work with regulators and stakeholders to determine appropriate cleanup levels. Lawrence Berkeley National Laboratory assumes that the established cleanup levels will be consistent with the ongoing mission of the facility as a research laboratory.



Lawrence Berkeley National Laboratory

To meet cleanup levels, DOE will likely excavate and dispose of the contaminated soil or treat the soil in situ. DOE expects to remediate these site to levels that are below risk criteria for the anticipated future use of the site as a research laboratory. DOE will conduct a Corrective Measures Study to determine cleanup levels and final remediation technologies for soil contamination.

Currently, DOE is conducting interim corrective measures to prevent further migration of three groundwater plumes contaminated with volatile organic compounds and one groundwater plume contaminated with diesel compounds. The interim corrective measures consist of the extraction and treatment of contaminated groundwater that is discharged to sanitary sewers in compliance with the Laboratory's East Bay Municipal Utility District Treated Groundwater Discharge Permit. The treated groundwater discharge permit is renewed annually. Groundwater extraction and treatment systems may serve as the final treatment technologies for these groundwater plumes. A tritiated groundwater plume is also present at the site. DOE anticipates that tritiated groundwater will be allowed to naturally attenuate or will be extracted and treated onsite, as appropriate, if a feasible technology becomes available. DOE will conduct a Corrective Measures Study to determine cleanup levels and final remediation technologies for groundwater contamination.

There are no permanent waste disposal facilities onsite that will be the responsibility of DOE. All waste will ultimately be disposed of offsite. Disposition of all legacy waste, with the exception of transuranic waste, is

expected to be completed by FY 2003. Ongoing waste management activities at the site include operation of the new Hazardous Waste Handling Facility and the transport, limited treatment, storage, and offsite disposal of mixed radioactive (including transuranic) and hazardous waste.

SITE ACCOMPLISHMENTS

- No Further Action status granted for 132 out of a total of 163 release sites
- Completed Interim Corrective Measures:
  - Installation and operation of 7 groundwater treatment systems (over 83,270 cubic meters (109,000 cubic yards) of water treated and over 44 kg of chlorinated solvents removed)
  - Installation of two dual phase treatment systems (over 77 kg of total petroleum hydrocarbons removed)
  - Removal of main source (Building 7 Sump) for the Old Town Plume
  - Removal of over 900 cubic meters (1,300 cubic yards) of contaminated and hazardous soil
  - Removal of one abandoned above-ground liquid storage tank
- Clean closure of the former Hazardous Waste Handling Facility

ANTICIPATED SITE ACCOMPLISHMENTS AS OF FY 2006

- Complete site remediation in FY 2004
- Remediate contaminated areas for which corrective measures are required
- Continue to operate remediation technologies for which residual contamination requires long-term stewardship activities

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

LONG-TERM STEWARDSHIP GOALS

Long-term surveillance, maintenance, and groundwater treatment to protect human health and the environment, and prevent contamination from migrating offsite.

DOE is planning to conduct long-term surveillance, maintenance, and groundwater treatment through FY 2032. The University of California owns the entire Lawrence Berkeley National Laboratory site, and DOE assumes the University will continue to lease the property to DOE under a series of 50-year lease agreements. Currently, DOE's Office of Environmental Management expects to be responsible for conducting long-term stewardship activities. However, this responsibility may be transferred in the future, with funding, to the site landlord, the DOE Office of Science.

The Laboratory is a secured facility and access is restricted to employees and registered guests. Entrance to the facility requires passage through gates managed by security personnel. In addition to the above restrictions, institutional controls that are currently in place include: posting of signs where workers may be exposed to contamination; maintaining drums of contaminated soils awaiting analytical results in a secured enclosure; and locked groundwater monitoring well heads, with access restricted to authorized environmental restoration staff. Engineering controls include the operation of groundwater treatment systems. DOE assumes that the current institutional and engineered controls will remain in place, as appropriate, during implementation of long-term stewardship.

Long-term stewardship activities for soils will be better defined when soil remediation activities are completed. No long-term stewardship is required for the former waste handling facility since it was "clean closed" in accordance with RCRA requirements.

Groundwater monitoring activities at the Laboratory are closely coordinated with the regulatory oversight agencies, including the California Environmental Protection Agency Department of Toxic Substances Control, San Francisco Bay Regional Water Quality Control Board, City of Berkeley, and DOE. Long-term monitoring strategies for groundwater will be negotiated with the regulatory agencies. These agencies review and comment on the work plans prepared for all activities. Laboratory staff submit quarterly progress reports to these agencies and meets with them each quarter to review results of the previous quarter's activities. DOE expects that this coordination with the regulatory agencies will continue as long as monitoring is required.

Site records (administrative files, technical work plans and reports, analytical laboratory reports) are currently maintained by the Laboratory Environmental Restoration Program staff. Copies of technical reports are submitted to regulatory oversight agencies in compliance with RCRA corrective action requirements. Additionally, DOE maintains copies of technical reports in the Laboratory information repository (one located onsite and one located at the University of California at Berkeley public library). Original analytical laboratory reports are stored at the National Archives in San Bruno, California. During implementation of long-term stewardship, DOE assumes it will maintain these records in the information repository and then store them at the National Archives. Additionally, DOE maintains records in accordance with DOE Order 200.1, *Information Management Program*, requirements.

STAKEHOLDER INVOLVEMENT

Lawrence Berkeley National Laboratory's proactive public participation strategy is designed to inform interested stakeholders about environmental restoration and long-term stewardship activities. Public participation activities are conducted in accordance with RCRA requirements and DOE guidance. Public participation activities include: preparation of the Environmental Restoration Program Community Relations Plan to describe activities that the Laboratory will use to keep the public informed of environmental restoration progress and to provide for an open dialogue with the public on issues, preparation of fact sheets, establishment of information repositories, and providing updates of the progress of environmental activities on a quarterly basis to the City of Berkeley Environmental Advisory Commission. In compliance with the Corrective Action Process, the public will have an opportunity to comment on the remedial technologies to be selected for implementation. Public participation will be maintained in accordance with regulatory requirements and DOE guidance during implementation of long-term stewardship.

2.2 Assumptions and Uncertainties

DOE is currently completing the RCRA Facility Investigation Phase of the RCRA Corrective Action process for the Laboratory site and has not yet determined final cleanup alternatives. Restoration technologies will be evaluated and cleanup levels established in the Corrective Measures Study phase of the RCRA Corrective Actions process. DOE assumes that long-term stewardship requirements may require the ongoing operation of groundwater treatment systems which are currently conducted as part of DOE's cleanup program.

2.3 Estimated Site-Wide Long-Term Stewardship Costs

Estimated costs for long-term stewardship activities for the Laboratory are identified in the following table. Long-term stewardship costs are based upon historical costs incurred for conducting site-wide monitoring, maintenance, and operation of monitoring wells and water treatment systems; compliance reporting; and general program oversight. Long-term stewardship costs reflect only operation and maintenance costs, as indicated in the May 1998 Baseline for release sites identified as of this time frame. DOE determined long-term operation and maintenance costs on a site-wide basis and not specifically for portions. Therefore, portioning of costs is based upon the assumption that the greater percentages of costs will be associated with the Old Town Plume (approximately 40 percent), the Building 51/64 VOC Plume, and the Building 71 Freon/VOC Plume (55 percent of the cost will be evenly distributed between the latter two portions). Minimal annual long-term stewardship costs are assumed for the Building 75 Tritium Plume (approximately four percent) and the Building 88 Area portion (approximately one percent).

Site Long-Term Stewardship Costs by Fiscal Year (Constant Year 2000 Dollars)					
Year(s)	*Amount*	*Year(s)*	*Amount*	*Year(s)*	*Amount*
FY 2000	$0	**FY 2008**	$1,179,000	**FY 2036-2040**	$0
FY 2001	$0	**FY 2009**	$1,186,000	**FY 2041-2045**	$0
FY 2002	$0	**FY 2010**	$1,193,000	**FY 2046-2050**	$0
FY 2003	$0	**FY 2011-2015**	$6,079,000	**FY 2051-2055**	$0
FY 2004	$0	**FY 2016-2020**	$6,257,000	**FY 2056-2060**	$0
FY 2005	$1,172,000	**FY 2021-2025**	$6,444,000	**FY 2061-2065**	$0
FY 2006	$1,179,000	**FY 2026-2030**	$6,636,000	**FY 2066-2070**	$0
FY 2007	$1,186,000	**FY 2031-2035**	$2,625,000		

3.0 PORTION OVERVIEW

The Lawrence Berkeley National Laboratory consists of five portions that will require some long-term stewardship activities as of 2006. For purposes of this report, a "portion" is defined as a geographically contiguous and distinct area (which may involve residually contaminated facilities, engineered units, soil, groundwater, and/or surface water/sediment) for which cleanup, disposal, or stabilization will have been completed and long-term stewardship will be required as of 2006. Lawrence Berkeley National Laboratory will continue to have ongoing research activities while portions of the site are beginning long-term stewardship activities.

The remaining sections discuss "portions" of Lawrence Berkeley National Laboratory that will require long-term stewardship. The Lawrence Berkeley National Laboratory Site consists of five portions: (1) Building 51/64 VOC Plume; (2) Building 71 Freon/VOC Plume; (3) Building 75 Tritium Plume; (4) Building 88 Area; and (5) Old Town. Each portion is listed in Table 3-1, with accompanying discussion of cleanup and long-term stewardship activities in Sections 3.1 - 3.5. DOE anticipates that site long-term stewardship activities for these portions will continue until FY 2032.

Long-Term Stewardship Information		
Portion Name	*Long-Term Stewardship Start Year*	*Long-Term Stewardship End Year*
Bldg. 51/64 VOC Plume - Groundwater in this 0.8-hectare (2-acre) portion is contaminated with volatile organic compounds. Surface spills of solvents were the source of contamination for the Building 51/64 groundwater plume.	2005	2032
Bldg. 71 Freon/VOC Plume -This 0.8-hectare (2-acre) portion consists of two primary groundwater plumes: a plume of halogenated volatile organic compounds (solvents) and a plume of Freon compounds. The Building 71 plume is divided into two distinct units because each is associated with unique source(s); however, the area has been identified as a single site portion because the Building 71 VOC and Building 71 Freon plumes are geographically co-located.	2005	2032

Long-Term Stewardship Information		
Portion Name	***Long-Term Stewardship Start Year***	***Long-Term Stewardship End Year***
Bldg. 75 Tritium Plume-Building 75 houses the National Tritium Labeling Facility. Tritium is used in this facility to radioactively label pharmaceuticals for use in medical research. The facility is the source of tritium contamination for this 2.7 hectare (6.7-acre) plume portion. The tritium plume underlies the areas of Buildings 31, 75, 76, 77, and 78.	2005	2032
Bldg. 88 Area - This 2.3-square meter (25-square foot) portion of the site consists of the Building 88 Cyclotron Hydraulic Gate Unit, a hydraulic pump used for the main gate doors. Polychlorinated biphenyls were used in this unit prior to 1976, and there is soil contaminated with polychlorinated biphenyls underneath the floor of the building. The Building 88 Hydraulic Gate Unit is a distinct area of contamination with a defined source.	2005	2032
Old Town- This 3.4-hectare (8.4-acre) portion of the site contains the Old Town Plume, the Building 7 Diesel Plume, and the Building 37 volatile organic compound plume. The plumes are geographically co-located. This portion encompasses the first cyclotron and its support facilities constructed in the United States. Contaminants in this portion are varieties of industrial solvents and petroleum hydrocarbons.	2005	2032

3.1 Building 51/64 VOC Plume

The Building 51/64 VOC Plume is a single plume of contamination in the groundwater for which DOE has identified the primary source. Therefore, DOE identified this area of the site as a single portion.

The source of contamination of the Building 51/64 VOC Plume was the spillage of solvents on surface soils. DOE plans to excavate the primary contaminated soil source prior to undertaking any long-term stewardship activities. DOE will backfill the excavated area with gravel, install a well, and pump contaminated water from the well for treatment.

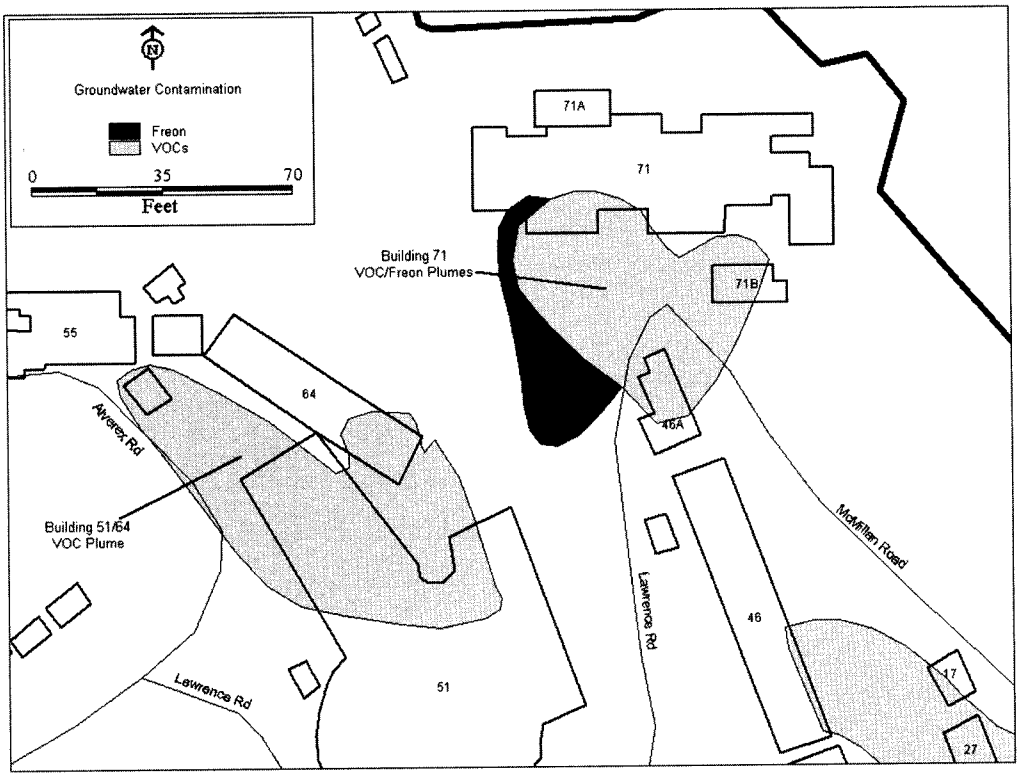
BUILDING 51/64 VOC PLUME HIGHLIGHTS

Major Long-Term Stewardship Activities - groundwater monitoring, recordkeeping
Portion Size - 0.8 hectare (2 acres)
Estimated Volume of Residual Contaminants - groundwater 3,785 cubic meters (4,950 cubic yards)
Long-Term Stewardship Start-End Years - 2005-2032
Average Annual Long-Term Stewardship Costs FY 2005-2006 - $323,000

The Laboratory is in the RCRA Facility Investigation phase of the RCRA Corrective Action process. Corrective action is being conducted under the RCRA Part B permit for the site. Final cleanup alternatives have not yet been developed for the Building 51/64 portion of the site. DOE will evaluate appropriate restoration technologies and will determine cleanup levels during the Corrective Measures Study phase of the Resource Conservation and Recovery Corrective Act Action process.

3.1.1 Groundwater

The plume of volatile organic compound-contaminated groundwater, the Building 51/64 VOC Plume, extends from the southeast corner of Building 64, under Buildings 64 and 51B. DOE estimates the volume of contaminated groundwater to be 3.7 million liters (1,000,000 gallons) or 3,785 cubic meters (4,950 cubic yards).



Building 51/64 VOC Plume and Building 71 VOC/Freon Plume

DOE defines this plume by the presence of 1,1,1-trichloroethane, 1,1-dichloroethane, 1,1-dichloroethene, tetrachloroethene, trichloroethene, and lower concentrations of other halogenated hydrocarbons. DOE detected the maximum total halogenated hydrocarbons in 1998 at a concentration of 822,400 micrograms per liter (µg/L) in a water sample from a boring in the plume source area.

Site regulators may set the Maximum Contaminant Levels for groundwater as the target cleanup levels. The final cleanup levels will be established in the Corrective Measures Study phase of the RCRA Corrective Action process.

Groundwater Long-Term Stewardship and Activities

Residual contamination associated with the principal contaminants of concern will require long-term stewardship activities, which are anticipated to include operation and maintenance of groundwater extraction and treatment systems for the volatile organic compound plume. DOE assumes the groundwater extraction and treatment systems will need to operate until FY 2032.

For this portion, DOE routinely prepares field monitoring reports, laboratory analytical reports, and technical progress reports, which DOE's Environmental Restoration Program currently maintains. Technical summaries of field activities and analytical results are presented in quarterly progress reports that are submitted to regulators and placed in the Laboratory's information repository on a quarterly basis. Record-keeping will continue during implementation of long-term stewardship activities. However, DOE will likely negotiate the frequency for preparing these reports for regulators and any additional record-keeping activities that may be required will likely be negotiated with regulators prior to commencing long-term stewardship activities. DOE assumes the

groundwater monitoring and treatment system for the area will remain in operation during long-term stewardship. However, this assumption is contingent upon completing the Corrective Measures Study and whether continued operation of these systems is selected as the appropriate remediation technology.

3.1.2 Estimated Long-Term Stewardship Costs for the Building 51/64 VOC Plume

Long-term stewardship costs for this portion are based upon a percentage of the historical costs incurred under the site's environmental remediation program for conducting site-wide monitoring, maintenance, and operation of monitoring wells and water treatment systems; compliance reporting; and general program oversight. These activities will continue as part of the site's long-term stewardship program when it begins in 2005.

Long-Term Stewardship Costs (Constant Year 2000 Dollars)							
FY 2000 - FY 2010	***FY 2011 - FY 2020***	***FY 2021 - FY 2030***	***FY 2031 - FY 2040***	***FY 2041 - FY 2050***	***FY 2051 - FY 2060***	***FY 2061 - FY 2070***	***Estimated Total***
$1,950,000	$3,393,000	$3,597,000	$1,444,000	$0	$0	$0	$10,384,000

3.2 Building 71 VOC/Freon Plume

BUILDING 71 VOC/FREON PLUME HIGHLIGHTS

Major Long-Term Stewardship Activities - groundwater monitoring
Portion Size - 0.8 hectare (2 acres)
Estimated Volume of Residual Contaminants - groundwater unknown
Long-Term Stewardship Start-End Years - 2005-2032
Average Annual Long-Term Stewardship Costs FY 2005-2006 -$ 323,000

The Building 71 VOC and Building 71 Freon plumes are geographically co-located plumes of groundwater contamination. Likely source areas have been defined. Therefore, DOE identified this area of the site a single site portion. The Building 71 Area is located near the northwestern boundary of the site. The surface topography near Building 71 slopes steeply to the south and southwest toward the Bevatron complex (Building 51). Undeveloped slopes covered with grass and trees occupy most of the area. The areas around the buildings are paved with concrete and asphalt. Prior to constructing Building 51, North Fork Strawberry Creek flowed east of Building 71 to the area north of Building 51, and from the west of the existing Blackberry Creek parking area. To allow building and road construction, a 48-inch concrete pipe was placed in the bottom of the creek and the channel was filled to the required elevation.

Bedrock in the Building 71 area is composed of the Moraga and Orinda Formations. A landslide block of Moraga volcanics forms much of the steep hillside south of Building 71 and overlies Orinda sediments. At other locations, the bedrock is overlain by colluvium, alluvium, and artificial fill. Groundwater generally flows from north to south or southwest, following the surface topography. The main water-bearing zones are the alluvial/colluvial deposits, the artificial fill and the Moraga volcanics and related landslide mass. These permeable deposits provide potential migration pathways for contaminants.

Permeable backfill material around the present and former storm drain and sanitary sewer lines also provide potential migration pathways. The source(s) of the Building 71 VOC plume have not been confirmed. However, releases of solvents from storm drains, sanitary sewers and water supply lines are likely sources. The source of the B71 Freon plume is most likely the result of past spills and releases through the sanitary sewer or storm drain associated with operation of a former linear accelerator cooling unit. The linear accelerator cooling unit is no longer operational.

The laboratory is currently implementing the RCRA Facility Investigation phase of the RCRA Corrective Action process. Corrective action is being conducted under the RCRA Part B permit for the Laboratory. Final cleanup alternatives have not yet been developed for the Building 71 portion of the site. The appropriate restoration technologies will be evaluated and cleanup levels established in the Corrective Measures Study phase of the RCRA process.

3.2.1 Groundwater

The principal contaminants of concern in groundwater for the Building 71 VOC plume are tetrachlorothene, trichloroethylene, cis-1,2-dichloroethene, 1,1-dichloroethene, 1,1-dichloroethane, and vinyl chloride. The principal contaminants of concern in groundwater for the Building 71 Freon plume are Freon compounds. The volume of residual contamination has not yet been determined. The Building 71 plume is defined by the presence of volatile organic compounds (halogenated hydrocarbons, predominantly tetrachloroethene, trichloroethene, cis-1,2-dichloroethane, 1,1-dichloroethene, 1,1,1-trichloroethane, and vinyl chloride). In July 1999, DOE detected the maximum concentration of total halogenated hydrocarbons (336.7 μg/L).

DOE also detected high concentrations of Freon-113 in groundwater south of Building 71 in 1993 and 1994. The source of Freon-113 was most likely past spills from the Linear Accelerator Cooling Unit located in Building 71. DOE detected Freon-113 at a maximum concentration of 8,984 micrograms per liter (μg/L) in August 1994.

Groundwater cleanup activities currently being conducted for this portion include operation and maintenance of the groundwater extraction and treatment system. Nearly 3,406 cubic meters (4,500 cubic yards) of water associated with the Building 71 Freon/VOC plume were treated in FY 1999. Contaminated groundwater from the plume is discharged continuously through five subhorizontal drains (hydraugers). Effluent from these hydraugers is collected and treated before being released under permit to the sanitary sewer. Site regulators may set the Maximum Contaminant Levels for groundwater as the target cleanup levels. However, the final cleanup levels will be established in the Corrective Measures Study phase of the RCRA Corrective Action process.

Groundwater Long-Term Stewardship Activities

For this portion, DOE routinely prepares field monitoring reports, laboratory analytical reports, and technical progress reports. These records are currently maintained by the DOE Environmental Restoration Program. Technical summaries of field activities and analytical results are presented in quarterly progress reports that are submitted to regulators and placed in the Laboratory's information repository on a quarterly basis.

Record-keeping will be continued during implementation of long-term stewardship activities. However, the frequency for preparing reports for submission to regulators and the requirement for additional record-keeping will be negotiated with regulators prior to commencing long-term stewardship activities. The groundwater extraction and treatment system will likely remain operational during long-term stewardship. DOE assumes that active treatment of the plume will continue until 2032. However, this assumption is contingent upon the completion of the Corrective Measures Study and whether continued operation of these systems are selected as the appropriate technologies for remediation.

3.2.2 Estimated Long-Term Stewardship Costs for the Building 71 Freon/VOC Plume

Long-term stewardship costs for this portion are based upon a percentage of the historical costs incurred under the site's environmental remediation program for conducting site-wide monitoring, maintenance, and operation of monitoring wells and water treatment systems; compliance reporting; and general program oversight. These activities will continue as part of the site's long-term stewardship program when it begins in 2005.

Long-Term Stewardship Costs (Constant Year 2000 Dollars)							
FY 2000 - FY 2010	*FY 2011 - FY 2020*	*FY 2021 - FY 2030*	*FY 2031 - FY 2040*	*FY 2041 - FY 2050*	*FY 2051 - FY 2060*	*FY 2061 - FY 2070*	*Estimated Total*
$1,950,000	$3,393,000	$3,597,000	$1,444,000	$0	$0	$0	$10,384,000

3.3 Building 75 Tritium Plume

BUILDING 75 TRITIUM PLUME HIGHLIGHTS

Major Long-Term Stewardship Activities - groundwater monitoring; institutional controls
Portion Size - 2.7 hectares (6.7 acres)
Estimated Volume of Residual Contaminants - groundwater unknown
Long-Term Stewardship Start-End Years - 2005-2032
Average Annual Long-Term Stewardship Costs FY 2005-2006 - $47,000

The Building 75 Tritium plume is a distinct area of groundwater contamination, with a defined source consisting of groundwater in the vicinity of Building 75, the National Tritium Labeling Facility. The Corporation Yard includes the area between Buildings 69 and 75. The bedrock geology at the Corporation Yard is composed predominantly of interlayered siltstones, claystones, and sandstones of the Orinda Formation. The Corporation Yard is at the head of a south trending drainage which is the source of Chicken Creek. The drainage was extensively altered during cut and fill activities associated with construction. South of Buildings 75A and 69, the Orinda Formation is now covered by artificial fill. The Moraga Formation outcrops on the slope to the north and west of the area. Water-level data generally indicate a southerly groundwater flow direction, probably toward Chicken Creek, following the topography. However, the hydrology is complex, and water levels may not define a consistent gradient direction over short distances.

The regulatory regime for the Building 75 tritium plume is DOE Order 5400.1, *General Environmental Protection Program*, DOE Order 5400.5, *Radiation Protection of the Public and the Environment*, and EPA tritium groundwater quality standards.

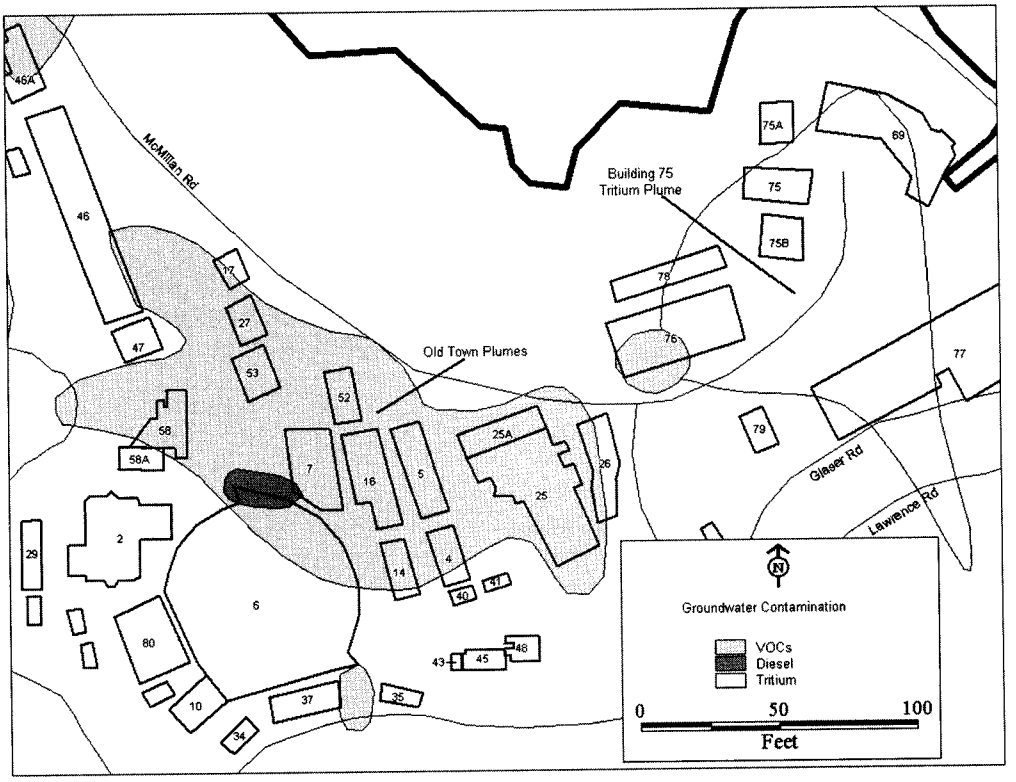
3.3.1 Groundwater

Tritium is the principal contaminant of concern in groundwater in the Building 75 area. The source of the tritium is the National Tritium Labeling Facility at Building 75. In January 1999, the maximum concentration of tritium in monitoring wells was 31,503 pCi/L. The drinking water standard for tritium is 20,000 pCi/L. DOE has detected tritium above the drinking water standard in only one monitoring well.

Groundwater Long-Term Stewardship Activities

DOE has not determined the remediation strategies, cleanup levels, and long-term stewardship requirements for the tritium contamination. Currently, DOE anticipates that there will be some type of long-term stewardship requirements specified by regulatory agencies; however, the actual type of requirements and duration for implementing long-term stewardship activities are not yet known. DOE anticipates that long-term stewardship requirements will likely continue until FY 2032.

For this portion, DOE routinely prepares field monitoring reports, laboratory analytical reports, and technical progress reports. Environmental Restoration Program currently maintains these records. DOE presents these technical summaries of field activities and analytical results in quarterly progress reports to regulators and places them in the Laboratory's information repository on a quarterly basis. Record-keeping will likely continue during implementation of long-term stewardship activities. However, the frequency for preparing reports for regulators



Building 75 Tritium Plume and "Old Town" VOC Plume

and the need for additional institutional controls will likely be negotiated with regulators prior to commencing long-term stewardship activities. There are currently no engineered controls for the Building 75 Tritium plume. DOE anticipates tritium contaminated groundwater will be allowed to naturally attenuate or will be treated on-site, as appropriate, in the event that a feasible technology becomes available to do so.

3.3.2 Estimated Long-Term Stewardship Costs for the Building 75 Tritium Plume

Long-term stewardship costs for this portion are based upon a percentage of the historical costs incurred under the site's environmental remediation program for conducting site-wide monitoring, maintenance, and operation of monitoring wells and water treatment systems; compliance reporting; and general program oversight. These activities will continue as part of the site's long-term stewardship program when it begins in 2005.

Long-Term Stewardship Costs (Constant Year 2000 Dollars)							
FY 2000 - FY 2010	***FY 2011 - FY 2020***	***FY 2021 - FY 2030***	***FY 2031 - FY 2040***	***FY 2041 - FY 2050***	***FY 2051 - FY 2060***	***FY 2061 - FY 2070***	***Estimated Total***
$283,000	$493,000	$523,000	$210,000	$0	$0	$0	$1,509,000

3.4 Building 88 Area

This approximately 2.3 square meter (2.8 square yard) portion of the site consists of the Building 88 Cyclotron Hydraulic Gate Unit, a hydraulic pump used for the main gate doors. (The Cyclotron is a particle accelerator used for medical research). Polychlorinated biphenyls were used in this unit prior to 1976, and soil underneath the floor of the building has been contaminated. The Building 88 Hydraulic Gate Unit is a distinct area of contamination with a defined source, and, as a result, DOE identified it as a single site portion.

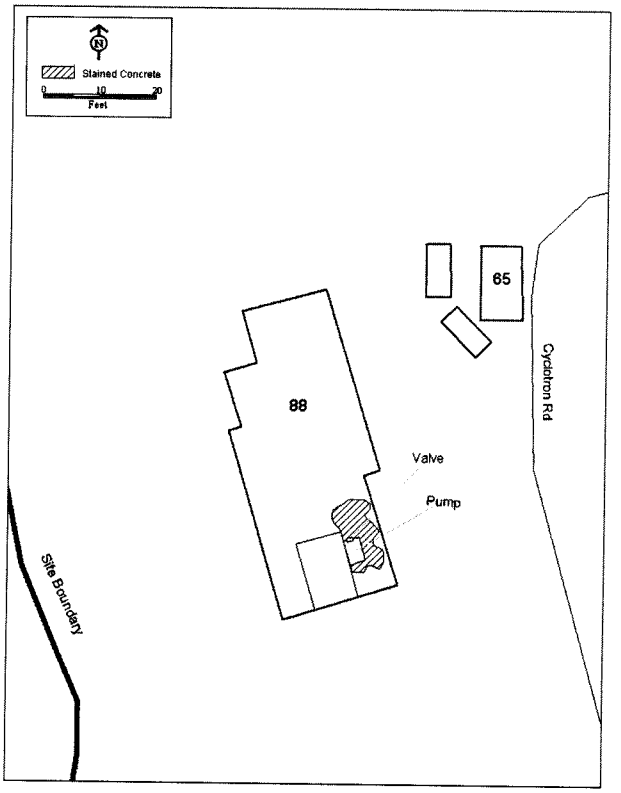
BUILDING 88 AREA HIGHLIGHTS

Major Long-Term Stewardship Activities - maintaining engineered and institutional controls
Portion Size - 2.3 square meters (2.8 square yards)
Estimated Volume of Residual Contaminants - soil unknown
Long-Term Stewardship Start-End Years - 2005-2032
Average Annual Long-Term Stewardship Costs FY 2005-2006 - $12,000

3.4.1 Soil

Soils contaminated with polychlorinated biphenyls exist underneath the floor of Building 88. DOE has not yet determined the volume of residual contamination for this area. Contamination appears to be restricted primarily to base sand and to the area beneath the unit. However, the Cyclotron is still active, and therefore, it is not possible to excavate any contaminated material beneath the unit.

The California Department of Toxic Substances Control granted approval for no further investigation for the Building 88 Area, with the requirement for the unit to be evaluated in the risk assessment for the Laboratory. The time frame of long-term stewardship is contingent upon the life of the 88 inch Cyclotron. In the event that the cyclotron facility is decommissioned, long-term stewardship requirements for the facility may be modified, or the contaminated soil may be removed. DOE assumes that the contaminated soil will not be excavated until after the 88 inch Cyclotron is no longer operating.



Building 88

Soil Long-Term Stewardship Activities

For this portion, DOE routinely prepares field monitoring reports, laboratory analytical reports, and technical progress reports have been prepared and are currently maintained by DOE Environmental Restoration Program. Technical summaries of field activities and analytical results are presented in quarterly progress reports that are submitted to regulators and placed in the LBNL information repository on a quarterly basis. Record-keeping will continue during implementation of long-term stewardship activities, which is expected to continue through FY 2032. The current institutional control for this portion consists of the posting of signs notifying workers of the presence of polychlorinated biphenyls soil contamination beneath the floor of the building. DOE anticipates that this institutional control will

remain during implementation of long-term stewardship activities.

3.4.2 Estimated Long-Term Stewardship Costs for Building 88

Long-term stewardship costs for this portion are based upon a percentage of the historical costs incurred under the site's environmental remediation program for conducting site-wide monitoring, maintenance, and operation of monitoring wells and water treatment systems; compliance reporting; and general program oversight. These activities will continue as part of the site's long-term stewardship program when it begins in 2005.

Long-Term Stewardship Costs (Constant Year 2000 Dollars)							
FY 2000 - FY 2010	***FY 2011 - FY 2020***	***FY 2021 - FY 2030***	***FY 2031 - FY 2040***	***FY 2041 - FY 2050***	***FY 2051 - FY 2060***	***FY 2061 - FY 2070***	***Estimated Total***
$72,000	$122,000	$130,000	$52,000	$0	$0	$0	$376,000

3.5 Old Town

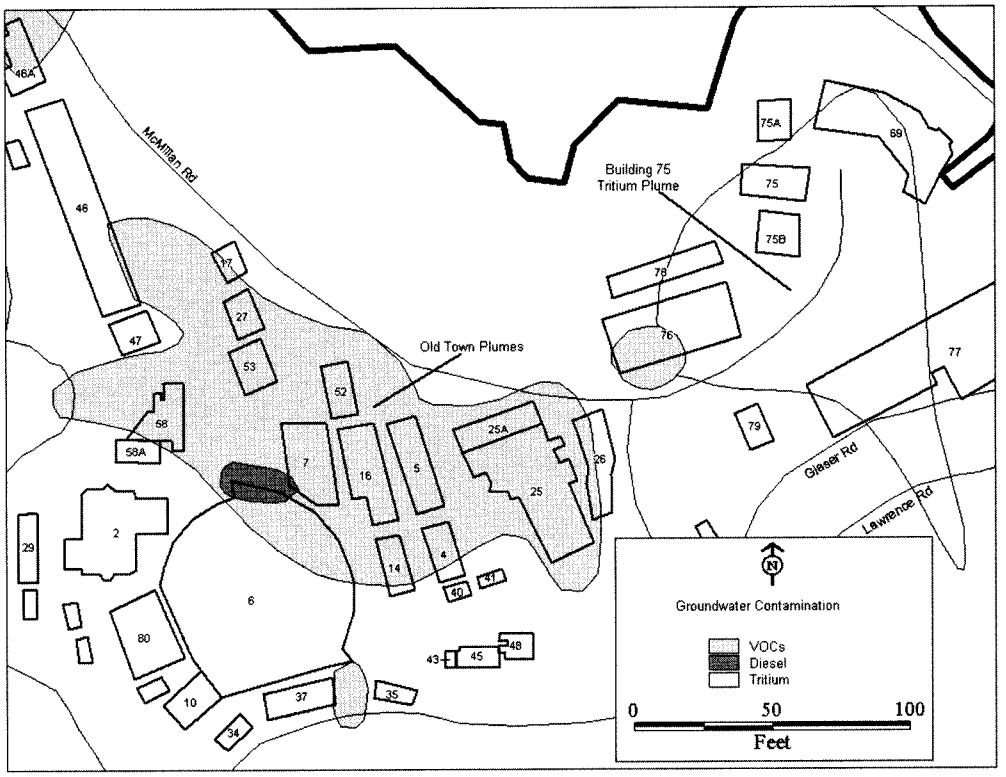
OLD TOWN HIGHLIGHTS

Major Long-Term Stewardship Activities - groundwater monitoring and treatment
Portion Size - 3.4 hectares (8.4 acres)
Estimated Volume of Residual Contaminants - groundwater unknown
Long-Term Stewardship Start-End Years - 2005-2032
Average Annual Long-Term Stewardship Costs FY 2005-2006 - $471,000

This 3.4 hectare (8.4 acre) portion contains the Old Town Plume, the Building 7 Diesel Plume, and the Building 37 volatile organic compound plume. The plumes are geographically co-located; therefore, the plumes have been combined into a single site portion. The Old Town portion includes the first cyclotron built in the United States, along with its support facilities. Contaminants in this portion are varieties of industrial solvents and petroleum hydrocarbons. Both soil and groundwater have been extensively impacted. DOE has excavated the main source for soil contamination and plans to remediate the soil prior to commencing long-term stewardship activities. The solvent-contaminated groundwater plume is formed from a mixture of at least three independent plumes with different mixes of contaminants. The petroleum hydrocarbon plume is a result of an old, leaking underground storage tank, which has been removed. This plume overlaps with a portion of the solvent plume. The Old Town and Building 7 Diesel Plumes each have a distinct area of contamination with defined source(s). The Building 37 plume may be an extension of the Old Town Plume; the plume's source has not been confirmed.

The Old Town area is in the central portion of the Laboratory. The surface topography generally slopes westward, with an abrupt increase in slope angle toward Buildings 58 and 46. Most of the area is covered with buildings or is paved with asphalt or concrete. The slope to the west and north of Building 53 is covered with grass and trees, allowing surface recharge to groundwater. The area is underlain by bedrock of the Moraga and Orinda Formations. Artificial fill and landslide deposits, composed predominantly of Moraga Formation material, overlie bedrock in some locations, particularly in the northwestern part of the area. A former tributary of the North Fork Strawberry Creek, currently covered by artificial fill, extends northwest from Building 7 to the southern end of Building 58.

The fractured volcanic rocks and related landslide masses of the Moraga Formation constitute the principal water-bearing zones in this area. These units provide the principal pathway for contaminant migration. The Moraga Formation is underlain by relatively low permeability sedimentary rocks of the Orinda Formation that impede the vertical and lateral flow of contaminants in the groundwater. In the Building 37 area, the surface



Building 75 Tritium Plume and "Old Town" VOC Plume

topography is relatively flat in the developed area around Building 6, but slopes steeply southward towards Strawberry Creek along the southern facility boundary where Building 37 is located. Sedimentary rocks of the Orinda Formation, probably landslide deposits, underlie the northern portion of Building 6. Bedrock at the plume location is composed of Orinda Formation and Great Valley rocks. The bedrock is generally overlain by artificial fill. South of Building 37, in the Strawberry Creek drainage basin, Great Valley group bedrock is overlain by colluvium and alluvium. Groundwater primarily flows through Moraga volcanic rocks westward from the Building 7 area toward Building 58 and northeast from Building 53 toward Building 46. In the Building 37 area, the Great Valley and Orinda rocks are the main water-bearing zones. Monitoring wells are screened within both formations. Groundwater generally flows south toward Strawberry Creek.

LBNL is in the RCRA Facility Investigation phase of the RCRA Corrective Action process. Final cleanup alternatives have not yet been developed for the Old Town portion of the site. The appropriate restoration technologies will be evaluated and cleanup levels established in the Corrective Measures Study phase of the RCRA process.

3.5.1 Groundwater

Groundwater contamination in this portion is caused by leaching of contaminants due to previous releases of the contaminants to the soil. The principal contaminants of concern in groundwater are carbon tetrachloride, 1,1-dichloroethane, 1,2-dichloroethane, 1,1-dichloroethene, cis-2-dichloroethene, tetrachlorothene, and trichloroethylene.

Underlying the area of Buildings 7, 53, 27, and 58A and the slope west of Building 53, the Old Town VOC plume

is the most extensive plume at LBNL. The plume is defined by the presence of tetrachloroethene, trichloroethene, and lower concentrations of other halogenated hydrocarbons, including 1,1-dichloroethene, cis-1,2-dichloroethene, 1,1-dichloroethane, 1,2-dichloroethane, 1,1,1-trichloroethane, 1,1,2-trichloroethane, carbon tetrachloride, and vinyl chloride, several of which are products of tetrachloroethene and trichloroethene degradation. DOE detected the maximum concentration of total halogenated hydrocarbons (298,100 µg/L) in 1995 in a split groundwater sample collected from a well monitoring the Old Town VOC plume. The contaminants primarily consisted of tetrachloroethene (190,000 µg/L), trichloroethene (100,000 µg/L), and carbon tetrachloride (8,100 µg/L).

The Building 37 volatile organic compound plume is defined by the presence of halogenated hydrocarbons, primarily tetrachloroethene and trichloroethene in two groundwater monitoring wells. There has been a decreasing trend in volatile organic compound concentrations detected in these two wells since January 1994, when pumping groundwater for plume management was initiated. The maximum concentration of total halogenated hydrocarbons detected in wells monitoring the plume in 1998 was 8.9 µg/L.

Building 7E is a former underground storage tank site where aromatic hydrocarbons have been detected. The Building 7 Diesel plume is the result of release from the storage tank under Building 7E , which was removed in 1989. The tank under Building 7E reportedly stored kerosene. The groundwater plume (Building 7 Diesel Plume) is located north of Building 6.

The presence of the maximum volatile organic compound concentrations north of Building 7 suggests that the primary source of the Old Town volatile organic compound plume was an abandoned sump located between Buildings 7 and 7B. The sump was discovered and its contents were removed in 1992. The sump was removed in 1995 after underground utility lines that crossed the sump were relocated. Relatively high concentrations of halogenated hydrocarbons detected in groundwater samples from monitoring wells west of Building 16, east of Building 52, and west of Building 25A indicated that other, less significant source areas of groundwater contamination exist. The sources of the contamination detected in those wells have not been identified. The contaminated groundwater from these unidentified sources flows westward, where it intermixes with the main Old Town plume.

DOE has implemented interim corrective measures for this portion, which consist of source control and prevention of further migration of the plumes. In some cases, contaminated water is extracted from wells and treated. DOE also installed deep trenches to control the source area for the Old Town plume. Contaminated water is pumped from the deep trenches, which limits further migration of the plume. These systems require daily inspection, weekly maintenance, and bi-weekly sampling and analysis. Over 5,677 cubic meters of groundwater associated with the Old Town plume were treated in FY 1999. In addition, DOE has installed three groundwater collection trenches and a dual phase (groundwater and soil vapor) extraction and treatment system to control the plume.

Regulators may set the Maximum Contaminant Levels for groundwater as the target cleanup levels. The appropriate restoration technologies will be evaluated and the final cleanup levels will be established in the "corrective measures study" phase of the RCRA Corrective Action process.

Groundwater Long-Term Stewardship Activities

Residual contamination associated with the principal contaminants of concern will require long-term stewardship activities, which are anticipated to include continued operation and maintenance of the groundwater extraction and treatment system for the area. DOE assumes that the groundwater extraction and treatment systems for the Old Town volatile organic compound plume will require operation until FY 2032. It is anticipated that requirements for long-term stewardship for the Building 7 diesel plume and the Building 37 volatile organic

compound plume may be completed prior to FY 2032.

For this portion DOE routinely prepares field monitoring reports, laboratory analytical reports, and technical progress reports are routinely prepared. These records are currently maintained by DOE's Environmental Restoration Program staff. Technical summaries of field activities and analytical results are presented in quarterly progress reports that are submitted to regulators and placed in the Laboratory's information repository on a quarterly basis. It is anticipated that these activities will continue during the implementation of long-term stewardship. However, the frequency for preparing reports for submission to regulators and the need for additional record-keeping requirements will likely be negotiated with regulators prior to commencing long-term stewardship activities. The groundwater extraction and treatment system for the area will likely remain in place during long-term stewardship. However, this assumption is contingent upon the completion of the Corrective Measures Study and whether continued operation of these systems are selected as the appropriate technologies for remediation.

3.5.2 Estimated Long-Term Stewardship Costs for Old Town

Long-term stewardship costs for this portion are based upon a percentage of the historical costs incurred under the site's environmental remediation program for conducting site-wide monitoring, maintenance, and operation of monitoring wells and water treatment systems; compliance reporting; and general program oversight. These activities will continue as part of the site's long-term stewardship program when it begins in 2005.

Long-Term Stewardship Costs (Constant Year 2000 Dollars)							
FY 2000 - FY 2010	***FY 2011 - FY 2020***	***FY 2021 - FY 2030***	***FY 2031 - FY 2040***	***FY 2041 - FY 2050***	***FY 2051 - FY 2060***	***FY 2061 - FY 2070***	***Estimated Total***
$2,840,000	$4,935,000	$5,233,000	$2,100,000	$0	$0	$0	$15,108,000

4.0 FUTURE USES

The University of California owns the site and will likely continue leasing this property to DOE under a series of 50-year lease agreements for operation as a research laboratory. DOE anticipates that cleanup levels for the site will reflect its ongoing industrial use as a research laboratory. DOE will be responsible for conducting all long-term stewardship activities at the Laboratory.

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LAWRENCE LIVERMORE NATIONAL LABORATORY - LIVERMORE SITE

1.0 SITE SUMMARY

1.1 Site Description and Mission

Lawrence Livermore National Laboratory is a multi-disciplinary research and development laboratory focused on national defense. Lawrence Livermore National Laboratory is composed of two non-contiguous sites, the Lawrence Livermore National Laboratory–Livermore Site (also know as Main Site) and the Lawrence Livermore National Laboratory–Site 300. Both sites are located approximately 80 kilometers (50 miles) east of San Francisco, and the Livermore Site is approximately 27 kilometers (17 miles) northwest of Site 300. Sandia National Laboratories (California) resides just across the street to the south from the Livermore Site. (The Livermore Site is the subject of this site summary – the Site 300 is covered in a separate site summary.)

LONG-TERM STEWARDSHIP HIGHLIGHTS

Major Long-Term Stewardship Activities - operation and maintenance of treatment systems; groundwater monitoring
Total Site Area - 263 hectares (651 acres)
**Estimated Volume of Residual Contaminants* - soil 1.0 million cubic meters (1.3 million cubic yards); groundwater 16 million cubic meters (20 million cubic yards)
All 12 Portions have release sites that are in long-term stewardship[1]
Average Annual Long-Term Stewardship Cost FY 2000-2006 - n/a (costs begin in FY 2008)[2]
Landlord - U.S. Department of Energy, Office of Defense Programs
*The estimated volume indicates only the known amounts of residual contaminants. For certain portions discussed for this site, exact volume is not known at this point. For specific discussions, please see Section 3.0.

The Livermore Site is a 263-hectare (651-acre) site located approximately 4.8 kilometers (three miles) east of downtown Livermore, California. Including the buffer zone, the total site area is about 320 hectares (800 acres). It occupies approximately 2.6 square kilometers (one square mile) of relatively flat terrain in the southeastern portion of Livermore Valley, with residential subdivisions adjacent to the western site boundary that are separated by a city roadway. Two intermittent streams, the Arroyo Seco and the Arroyo Las Positas, traverse the site. Groundwater contamination, resulting from past U.S. Navy operations, follows Arroyo Seco offsite toward a residential neighborhood.

The Livermore Site was initially used as a U.S. Navy flight training base and an engine overhaul facility. Transition from Naval operations to scientific research began in 1950, when the U.S. Atomic Energy Commission (AEC), a predecessor agency to the U.S. Department of Energy (DOE), authorized the construction of a materials-testing accelerator facility at the site. Under the AEC, the site became a weapons design and basic physics research laboratory. In 1952, the site was established as a separate part of the University of California Radiation Laboratory, Livermore Site (predecessor of the Lawrence Livermore National Laboratory) as a facility for nuclear weapons research.

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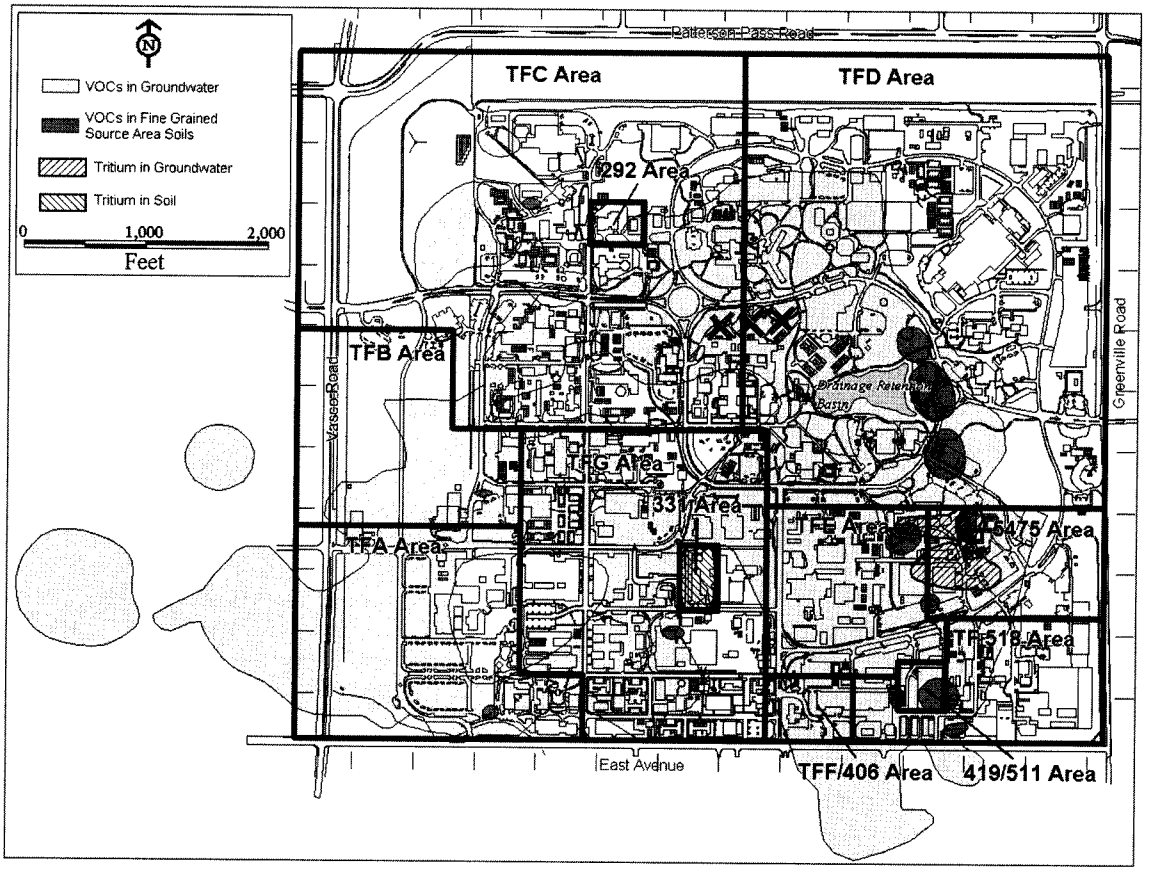
[1] The Livermore Site has 12 portions which contain a total of 122 release sites. A portion is the equivalent of a subproject or Treatment Facility. A release site is defined as a unique location in the soil where a contaminant release has occurred or is suspected to have occurred. A portion may have more than 1 release site. All closed release sites are currently in long-term stewardship. However, the entire portions (subprojects) containing those release sites are not entirely in long-term stewardship because cleanup activities have not been completed for the entire portion.

[2] For FY2000 -2007 long-term stewardship costs can not be separately identified because the environmental restoration activities at Livermore Site are managed on a subproject area, i.e., portion, in order to accommodate the regulatory cleanup process and ensure consistency with local DOE project management and accounting systems. Long-term stewardship costs are not reported from FY 2000 through FY 2007 since costs are not reported at the release site level. It should also be noted that the costs associated with the long-term stewardship and maintenance of release sites are a minor part of the operable unit, and or portion.



Lawrence Livermore National Laboratory - Livermore Site

DOE and the University of California jointly operate both the Lawrence Livermore National Laboratory–Livermore Site and the Lawrence Livermore National Laboratory–Site 300. The current mission of the Lawrence Livermore National Laboratory is research, testing, and development for nuclear weapons and security, energy, the environment, and biomedicine. Over the years, the Laboratory's mission has broadened to meet other national needs, such as enhancing economic competitiveness and science education. The DOE Office of Defense Programs, the site landlord, currently has an ongoing research mission and is expected to operate the site as a controlled access research facility for the foreseeable future. DOE also assumes that the Office of Defense Programs will continue to be responsible for all landlord activities and associated costs.

1.2 Site Cleanup Plans and Accomplishments

Past operations at the Livermore Site, which involved the handling and storage of hazardous materials, resulted in the release and subsequent migration of contaminants into the soil and groundwater. The major contaminants are volatile organic compounds, primarily trichloroethylene. The Livermore Site was placed on the National Priorities List by the U.S. Environmental Protection Agency (EPA) in 1987. By the end of 2007, DOE will have in place all remediation facilities required for long-term stewardship activities at the Livermore Site.

Petroleum hydrocarbons were chemicals of concern at the site. However, subsequent cleanup allowed the regulatory agencies to grant No Further Action status for the fuel hydrocarbons. Tritium has been detected in

two onsite areas at concentrations above the drinking water standard. To date, DOE has identified only one source of tritium contamination, a leak from a tank at Building 292 in 1991. DOE closed the building, except for the office space.

The Livermore Site's primary remediation efforts are directed at contaminated soil and groundwater and, once cleanup is complete, the decommissioning and decontamination of soil and groundwater treatment facilities. To more effectively manage the site cleanup, and based on the nature and extent of onsite contamination and hydrogeologic considerations, DOE assigned all releases to one of 12 areas, or portions:

- Treatment Facility A
- Treatment Facility B
- Treatment Facility C
- Treatment Facility D
- Treatment Facility E
- Treatment Facility F/406
- Treatment Facility G
- Treatment Facility 518
- Treatment Facility 5475
- Building 331 Area
- Building 419/511
- Building 292 Area

SITE ACCOMPLISHMENTS

- Began operation and maintenance of groundwater extraction and treatment systems
- Developed and implemented "smart pump-and-treat" to maximize plume capture and contaminant removal
- Completed active remediation for fuel hydrocarbons in vapor at Treatment Facility F; with regulatory approval, DOE shutdown the facility
- Established hydraulic capture along western site margin
- Implemented Engineered Plume Collapse strategy (1997) to reduce long-term cleanup by isolating the source areas
- Tested and implemented in-situ catalytic reductive dehalogenation to remediate volatile organic compounds (VOCs) in groundwater containing tritium
- Completed excavation of 4 disposal pits containing debris
- Disposed of about 2,300 cubic meters (3,000 cubic yards) of contaminated soil containing VOCs and radionuclides (East Taxi Strip 1982-1983)
- DOE has completed cleanup at 87 release sites and long-term stewardship activities are being conducted (see table on the following page)
  - Excavated and removed 11,000 cubic meters (14,000 cubic yards) of soil and debris and 160 capacitors (East Traffic Circle 1984-1985)
  - Removed 300 cubic meters (400 cubic yards) of residual PCB contaminated soil (East Traffic Circle 1999)
  - Removed 112 buried capacitors containing PCBs (NIF construction site 1997)
- Long-term stewardship activities are being conducted at all 12 portions for at least one release site
- Completed Record of Decision and Five-Year Review Process (the first National Laboratory to do so)
- Developed a hydrostratigraphic unit analysis approach to characterize the Livermore Site for implementing the strategy detailed in the Record of Decision
- Constructed a data-calibrated, 3D groundwater flow and contaminant transport model to simulate subsurface behavior in the Livermore Basin
- Pumped and treated 1 billion gallons of contaminated groundwater

BY 2006 LIVERMORE SITE WILL HAVE:

- Implemented electro-osmosis to clean up fine-grained soil and vadose areas with relatively high levels of contamination
- Operated existing systems for treatment of groundwater and vapor, and completed construction of nearly all facilities

BY 2008 LIVERMORE SITE WILL HAVE:

- Long-term stewardship activities will be conducted at all release sites and all 12 portions

Portion	*Release Sites Where Cleanup Has Been Completed and Require Long-Term Stewardship (87)*	*Portion*	*Release Sites Where Cleanup Has Been Completed and Require Long-Term Stewardship (87)*
Treatment Facility A	- Arroyo Seco Area Storm Drain Outlet 3a - Arroyo Seco Area Storm Drain Outlet 3b - Arroyo Seco Area Transformer	***Treatment Facility G***	- Building 212 Area Acid Dip Station-SWMU 157 - Building 212 Area Drum Rack - Building 212 Area Drum Rack - Building 212 Area Drum Racks - Building 212 Area Plating Shop - Building 212 Area Sumps-SWMU 156 - Building 212 Area Transformer - Building 321 Area Degreaser in Gravel Sump-SWMU 435 - Building 321 Area Dry Well - Building 321 Area Ion Exchange Plant Overflow - Building 321 Area Locations of PCE Drums - Building 321 Area Locations of PCE Drums - Building 321 Area Machine Shop Spills - Building 321 Area Pain and Plating Area - Building 321 Area Plating Shop Chemical Storage - Building 321 Area Plating Shop Spills - Building 321 Area Plating Shop Sump - Building 321 Area Radiation - Building 321 Area Storm Drain - Building 321 Area Storm Drain-SWMU 463 - Building 321 Area Underground Tanks-SWMU 432-434 - Tank 239-D1U1 - Tank 231-R2U1 - Tank 241-R1U1 - Tank 321-I1U1 - Tank 321-I1U2 - Tank 321-I1U3 - Tank 322
Treatment Facility B	- Building 141 Area Dumping of Oils and Solvents - Building 141 Area Gasoline Tank - Building 141 Area Open Storm Sewer - Building 141 Area Plating Shop Sump-SWMU 50-51 - Building 141 Area Storage Area - Building 141 Area Unlined Drainage Ditch - Building 141 Area Waste Water Retention-SWMU 44-49 - Tank 141		
Treatment Facility C	- Arroyo Las Positas Area - Building 298 Area - Building 361 Area - Building 191 Area - Building 293 Area - Chromium Study Area - MW-501 Area - West Traffic Circle Area Fire Training Areas (SWMU) - Tank 161-R1U1 - Tank 298		
Treatment Facility D	- Building 571 Area - Drainage Retention Basin Area - East Gate Drive Area - National Ignition Facility - Northeast Boundary Area - Northern Boundary Area	***Treatment Facility 518***	- Building 514 Area 5-Gallon Glass Carboys - Building 514 Area Drum Rack - Building 514 Area Evaporation Pit-SWMU 725-728 - Building 514 Area Solvent and Oil Spills - Building 514 Area TCE and Diesel Spills - Building 514 Area Treatment Tanks-SWMU 706-713 - Building 514 Area Drum Rack - Building 518 Area Drum Rack Spills - Building 518 Area Solvent Spill - Building 612 Area Acid Spill - Building 612 Area Miscellaneous Transport Equipment - SWMU 754 - Old Salvage Yard - Tank 514-R3U1
Treatment Facility E	- Building 543 - Eastern Landing Area Underground Tanks - Eastern Landing Material Storage Area Oil and Chemical Spills - Eastern Landing Material Transformers - Eastern Landing Material Transformers		
Treatment Facility F/406	- Building 406 Area - Gas Pad Area - Tank 401-D1U1 - Tank 401-D2U1 - Tank 401-D3U1 - Tank 401-D4U1 - Tank 402-G1U1 - Tank 402-G2U1 - Tank 411-D1U1	***Treatment Facility 5475***	- East Taxi Strip Area Disposal Pits - East Taxi Strip Area Disposal Pits
		Building 331 Area	- Building 331
		Building 419/511	
		Building 292 Area	- Building 292 - Tank 292 - R1U1

DOE expects that all soil remediation systems will be in place by 2006. The remediation of volatile organic compound-contaminated soil will be conducted using soil vapor extraction. DOE will remediate contaminants in the unsaturated zone only if it is predicted that they would cause concentrations above a maximum concentration level if allowed to migrate into the groundwater. DOE expects that approximately six hectares (14 acres) of the soil will still have residual tritium and volatile organic compound contamination following

remediation. The residual soil contamination is not expected to exceed pre-determined, risk-based cleanup standards, but is expected to exceed background levels.

By the end of 2007, DOE expects that approximately 38 groundwater remediation systems will be in place. DOE's ongoing investigations are focused on identifying all remaining sources of groundwater contamination. DOE plans to begin operating all groundwater treatment facilities by 2007. The goals of groundwater remediation are to remove contaminant mass, reduce contaminant concentrations, and contain the migration of the plumes. These treatment facilities will extract contaminated groundwater and use air-stripping, granular activated carbon, or catalytic reductive dehalogenation to remove volatile organic compounds. The treated groundwater can then be released to recharge basins or seasonal water courses or can be reused onsite, upon meeting pre-determined discharge standards. DOE will continue to operate pump-and-treat systems until cleanup levels are achieved.

The groundwater remediation standards, described in the Record of Decision for this site (under the *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA), are set to the lower of either the Federal or State of California's Maximum Contaminant Levels (MCLs) allowed in drinking water. Groundwater cleanup is considered to be complete when all samples from all monitor wells remain below MCLs for two years. DOE expects that remedial objectives will be achieved in some areas prior to others and that remediation will then cease in some areas prior to others. After concurrence with the regulatory agencies that cleanup is complete, all treatment system hardware will be decontaminated, dismantled, and salvaged, and most of the Lawrence Livermore National Laboratory extraction wells and piezometers will be sealed and abandoned.

Groundwater in areas contaminated with tritium will require continued monitoring. Tritium-contaminated groundwater will be remediated through monitored natural attenuation. The primary groundwater contamination at the Livermore Site is a 3.6-square kilometer (1.4-square mile) trichloroethylene-contaminated plume that threatens private wells and the municipal water supply wells of the nearby city of Livermore. Private wells within the plume have been closed and their users are provided with a public water supply. The plume is not expected to affect the municipal wells. Each of these systems is discussed below.

DOE has implemented a variety of effective groundwater cleanup strategies that have accelerated cleanup at the Livermore Site. These include the application of the Engineered Plume Collapse strategy, use of Hydrostratigraphic Units to characterize the geologic formations underlying the site, and use of different size portable treatment units to meet a variety of needs.

The Engineered Plume Collapse strategy consists of a systematic and aggressive cleanup approach. First, the source areas (i.e., areas where the contamination originated and still remains in high concentrations in the fine-grained sediments, such as silt and clay) are hydraulically isolated by pumping groundwater from wells surrounding the source area. This stops contaminant contribution from the source area into the downgradient (distal) groundwater plume and allows rapid groundwater plume cleanup in the distal area. New technologies are then applied to the source areas to remove volatile organic compounds from the fine-grained sediment. The next new technology scheduled to be implemented at the Livermore Site is electro-osmosis, which uses an electrical current to induce groundwater movement in fine-grained sediments to an extraction well, where contaminated groundwater can then be removed and treated.

Hydrostratigraphic units (HSU) at the Livermore Site represent various layers of coarse-grained sediments (i.e., sand and gravel) that are interconnected, allowing groundwater to freely flow through the subsurface. Seven distinct HSUs (HSU-1 through HSU-7) have been identified at the Livermore Site -- HSU-1 starts at the ground surface, and each subsequent HSU occurs at a deeper depth, with HSU-7 being the deepest. Generally, groundwater in an individual HSU only flows within that HSU and does not cross over into other HSUs. HSU analysis allows the correlation of a groundwater contaminant plume to the origin of the contamination. An area

where the contamination originated and still remains in clay and silt sediments is called a "source area." Grouping contaminant plumes into HSUs has allowed DOE to conduct a comprehensive and more cost-effective cleanup by better targeting contaminated groundwater plumes and by placing groundwater extraction wells at optimum locations to meet cleanup objectives faster.

To reduce costs and to expedite the groundwater cleanup, an ingenious series of portable treatment units were conceived, designed, and constructed at the Livermore Site to be more effective in optimizing contaminant mass removal. These units, in descending order of cost, are: a Portable Treatment Unit (PTU) that uses an air stripper to remove volatile organic compounds and ion exchange to remove metals, if needed; a smaller skid-mounted version, called a Miniature PTU; a skid-mounted unit using granular activated carbon to remove volatile organic compounds; and a Solar-Powered Water Activated Carbon Treatment unit (SWAT) that uses granular activated carbon. This approach to "using the right technology at the right time" is cost-effective and will continue to be the strategy used toward site cleanup.

At the time of the CERCLA five-year review for the Livermore Site, the regulators and community recognized that cleanup was well ahead of schedule. As agreed with the regulatory agencies, community, and other Stakeholders, the priorities of moving toward site cleanup are to first stop migration of contaminant plumes offsite, followed by cleanup in the interior of the site. The highest priority is to achieve western margin hydraulic capture of the plumes since they are moving offsite toward residential areas. In September 1996, hydraulic capture of the entire western plume margins of the Livermore Site was achieved. This was then followed by achieving hydraulic capture of the entire southern plume margins. The current focus of remediation is on interior plumes and source areas, while continuing to maintain western and southern margin hydraulic control.

Currently, the Livermore Site has treated over 3.7 million cubic meters (4.8 million cubic yards) of groundwater. Offsite contamination is being effectively pulled back onto the Livermore Site, and groundwater contamination onsite is being pulled back toward the source areas. Innovative technologies are being applied to clean up the source areas, which are crucial to achieving site cleanup. Currently 87 of the 120 release sites are in long-term stewardship.

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

SITE LONG-TERM STEWARDSHIP GOALS

By the end of 2007 all portions will require long-term stewardship activities. The overarching goals will be to maintain and operate required remediation systems to meet cleanup goals, ensure protection of human health and the environment, and ensure beneficial uses of natural resources.

It is expected that by 2007, all remedial activities will be completed for the entire site and the entire site will require long-term stewardship activities. The site will be maintained by DOE (the Office of Environmental Management or the Office of Defense Programs) through 2025, at which time DOE will prepare a petition to delist the Livermore Site from the National Priorities List in accordance with the provisions of CERCLA. Subsequently, DOE assumes that long-term stewardship activities will be the responsibility of the landlord; these activities will include maintenance and operation of the required remediation systems to meet cleanup goals and ensure the protection of human health and the environment, and beneficial uses of natural resources.

While the Livermore Site is not expected to complete the cleanup of the entire site by 2007, many of long-term stewardship key operational components have already been initiated concurrent with the active, compliant cleanup program described above. Similarly, several administrative and institutional controls and surveillance/maintenance programs that currently exist will be maintained to support the overarching long-term stewardship foals of maintain and operating required remediation systems and ensuring that selected remedies will remain protective of human health and the environment, and restore beneficial uses of natural resources.

Long-term stewardship activities include or will include, but are not limited to, the following: (1) facility operation and maintenance of treatment systems; (2) continued regulatory interactions and compliance; (3) groundwater monitoring and wellfield operations and maintenance; (4) three-dimensional modeling as a cost-effective means to estimate future volatile organic compounds concentrations and risk to human health and the environment, optimize remediation, evaluate the effectiveness of cleanup, and relay the progress of cleanup to the stakeholders; (5) maintaining the data information system that is required to support planning, collecting, tracking, verifying, validating, reporting, interpreting, and using the data; and (6) program management.

Long-term stewardship activities for groundwater are anticipated to be fully in place by 2008. Long-term stewardship activities have already begun for 87 release sites. Long-term stewardship activities are expected to be required until at least 2070. Tritium contamination will be monitored until it has decayed in place to ensure that it is does not migrate offsite. Facility structures and contamination controls will be maintained to prevent exposures to workers and the general public.

The following administrative and institutional controls are already in place at the Livermore Site and are expected to be maintained until at least 2070: access is restricted and controlled by fencing and by a full-time security force; building occupancy and land use is controlled by the Livermore Site management; additional access controls are enforced in areas outside of regular work areas; a safety briefing, which covers access requirements and areas of contamination, is required of all personnel working at the Livermore Site; there are no drinking water wells on site, and any new water supply wells of any kind are subject to review, with environmental considerations in mind; and Operational Safety Plans are required for all construction activities, including checks for hazardous materials and sensitive species.

In addition, several record-keeping activities are required for the Livermore Site. These include maintaining the Administrative Record for the selection of response actions to be conducted at the site, in accordance with Title 40 Code of Federal Regulations (CFR), Subchapter J (Superfund Program), Part 300 (National Oil and Hazardous Substances Pollution Contingency Plan); treatment facility permit and monitoring program reporting and documentation; compliance monitoring plans; and post-closure monitoring reporting and documentation. Reports documenting groundwater monitoring program activities are submitted to regulatory agencies and are maintained at the site.

The Administrative Record must be maintained throughout the life of the CERCLA process. The Administrative Record contains all documents and correspondence that have a bearing on the CERCLA decision-making process, including, but not limited to: documents published to relay information to the public on remedial actions or removal actions (e.g., community relations plans, proposed plans, fact sheets); decision documents (e.g, Action Memoranda and Records of Decision); and post-decision documentation of progress and changes to the remedial action after the Record of Decision is finalized (e.g., explanation of significant differences and five-year reviews). The Record is updated as new project information is available and is made available to the public.

Documentation and, in some cases, reporting are required by the following regulatory permits or requirements: National Pollutant Discharge Elimination System Permits; Substantive Requirements for Wastewater Discharge issued by the California Regional Water Quality Control Board; Monitoring and Reporting Programs issued by the California Regional Water Quality Control Board; and Bay Area Air Quality Management District air permits.

A Compliance Monitoring Plan has been prepared for the Livermore Site as part of the post-Record of Decision CERCLA process. The plan describes the procedures for monitoring groundwater and vadose zone remediation, managing data, and documenting and reporting remedial activities and results in order to assess progress toward meeting remedial objectives. The data collected to comply with the requirements of the plan is maintained in a database throughout the life of the remedial action until agreed upon cleanup goals are achieved.

STAKEHOLDER INVOLVEMENT

DOE's Oakland Operations Office and Lawrence Livermore National Laboratory have actively participated in discussions and meetings, coordinated activities, and reached agreement on future land use with the local community, regulators, and other interested stakeholders.

DOE's Oakland Operations Office and Lawrence Livermore National Laboratory have prepared a Community Relations Plan to meet the following objectives:

- Provide accurate and timely information to interested members of the community.
- Provide for an open dialogue on site cleanup issues among DOE's Oakland Operations Office, Lawrence Livermore National Laboratory, and the public, and factor community concerns into the ongoing environmental investigation.
- Continue to work closely with the neighbors of the Lawrence Livermore National Laboratory site.
- Be responsive to the special information needs of elected officials, agency representatives, and interested members of the public, including the environmental and peace activists.
- Seek to increase the level of understanding in the community with regard to the Lawrence Livermore National Laboratory site cleanup plans.
- Inform employees about all cleanup activities being planned and conducted at the site before information is released to the press and public.
- Respond to changes in community concerns and interest levels. Reviews of the objectives and the methods described in the Community Relations Plan are conducted regularly to assure the objectives are being met.

Stakeholders have been involved in environmental restoration decisions through the Community Working Group since its formation in 1989. Tri-Valley Communities Against a Radioactive Environment has also held a Technical Assistance Grant from the U.S. Environmental Protection Agency for many years, and representatives meet quarterly with DOE, regulatory agencies, and Lawrence Livermore National Laboratory staff to discuss ongoing planned cleanup actions. The local community is also provided, and will continue to be provided, information by way of local repositories and newsletters.

Technology Development and Deployment

Future technology development and deployments may use the Savannah River Site's Purge Water Management System to monitor groundwater during long-term stewardship. Long-term monitoring may also incorporate Savannah River's toolbox to detect Dense Nonaqueous Phase Liquids and Hanford's cone penetrometer that provides real-time in situ concentrations.

2.2 Assumptions and Uncertainties

At a minimum, long-term stewardship activities will be performed by DOE's Office of Environmental Management through 2025, at which time DOE plans to file a petition to delist the Livermore Site from the National Priorities List. After 2025, DOE will continue to ensure maintenance and operation of required remediation systems to meet cleanup goals and ensure protection of human health, the environment, and beneficial uses of natural resources.

The accuracy of the estimated extent of onsite contamination (i.e., area, volume, and mass) varies throughout the site. The target contaminant used to project cleanup schedules was trichloroethylene; other contaminants were not considered. Cleanup schedules were also estimated based on average concentrations and flow rates chosen to be representative of the true three-dimensional distribution of contaminants in the subsurface. The cleanup end date was determined based on when an individual plume is projected to reach the target cleanup standard

predicted by fitting an exponential model of concentration versus time. In some cases, rates of concentration decline in individual wells were used instead of the exponential model. Only dissolved mass estimates and concentrations were used in the calculations, and dense non-aqueous phase liquids were not included as part of these cleanup estimates.

Cost estimates for long-term stewardship were based on the following assumptions: the only costs applicable during stewardship are those associated with treatment facility operation (including wellfield optimization and management) and maintenance, groundwater monitoring, and regulatory and community interaction. These assumptions most notably exclude the drilling of monitoring and extraction wells, the construction of new treatment facilities, and the decontamination and decommissioning of treatment facilities and wells. Furthermore, the costs of operating treatment facilities and the costs for groundwater monitoring are the same as those that were estimated for the FY 2000 Revised (February 29, 2000) Work Plan submittal.

Cost estimates for long-term stewardship were also based on the assumption that environmental regulations will not become more stringent and that no additional contamination sources or other contaminated areas that are difficult to remediate will be found in the future. The following assumptions were used in developing work scope, schedule and cost information:

- Costs for decontamination and dismantlement of the treatment systems, as well as costs to seal and abandon wells and piezometers, have not been included.
- The scope and cost of decontamination and dismantlement of the treatment systems, as well as costs to seal and abandon wells and piezometers, will be addressed in the future site-specific long-term stewardship plan, the contingency plan, and the long-term stewardship baseline.
- The cost of operating treatment facilities and the cost for groundwater monitoring is the same as was estimated for the FY 2000 Revised (Feb. 29, 2000) Work Plan submittal.
- The cost of operating a treatment facility is independent of location within the Livermore Site.
- After the last plume in a portion has reached cleanup levels, groundwater monitoring will continue for two years to ensure no rebound occurs. DOE assumes that no rebound will be detected during this period and all activities cease at the end of the monitoring period.
- The Project Management and Program Support costs to be allocated to long-term stewardship are proportional to FY 2000 long-term stewardship activity costs divided by the total of FY 2000 costs less the project management and program support costs.
- The cost of operating an ion exchange unit is the same as operating a mini-treatment unit.
- The target contaminant used to project cleanup schedules was trichloroethylene (TCE); other contaminants were not considered.
- Only dissolved mass estimates and concentrations were used; if any dense non-aqueous phase liquid (DNAPL) exists, it was not included as part of these cleanup estimates. Application of innovative technologies (e.g., electro-osmosis) will be effective in remediating contaminant source areas.
- Should any of the assumptions regarding level of contaminants, location of source of contaminants, or funding change, DOE will revise the baseline.

2.3 Estimated Site-Wide Long-Term Stewardship Costs

Long-term stewardship costs for the Livermore Site are identified in the table below. Costs are mainly attributable to: (1) groundwater and soil vapor treatment facility operation and maintenance; (2) regulatory interactions and compliance; (3) wellfield operation and maintenance; (4) remediation optimization; (5) maintaining the data information systems; and (6) program management. For FY2000-2007 long-term stewardship costs can not be separately identified because the environmental restoration activities at Livermore Site are managed on a subproject area, i.e., portion, basis to accommodate the regulatory cleanup process and ensure consistency with local DOE project management and accounting systems. Long-term stewardship costs are not reported from FY 2000 through FY 2007 since costs are not captured at the release site level. It should also be noted that the costs associated with the long-term stewardship and maintenance of release sites are a minor part of the operable unit, and or portion. Costs in this report are identified and based on the time frame in which an entire portion will transition from the active, ongoing cleanup phase to a long-term stewardship mode.

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	*Amount*	*Year(s)*	*Amount*	*Year(s)*	*Amount*
FY 2000	$n/a	**FY 2008**	$8,677,000	**FY 2036-2040**	$1,924,000
FY 2001	$n/a	**FY 2009**	$8,385,000	**FY 2041-2045**	$1,194,000
FY 2002	$n/a	**FY 2010**	$7,683,000	**FY 2046-2050**	$702,000
FY 2003	$n/a	**FY 2011-2015**	$28,127,000	**FY 2051-2055**	$446,000
FY 2004	$n/a	**FY 2016-2020**	$15,604,000	**FY 2056-2060**	$259,000
FY 2005	$n/a	**FY 2021-2025**	$9,427,000	**FY 2061-2065**	$100,000
FY 2006	$n/a	**FY 2026-2030**	$5,173,000	**FY 2066-2070**	$25,000
FY 2007	$n/a	**FY 2031-2035**	$3,034,000		

3.0 PORTION OVERVIEW

To effectively manage the site cleanup, and based on the hydrogeologic characteristics and the nature and extent of onsite contamination, all release sites are assigned to one of 12 portions, or subproject areas. For the purposes of this report, a "portion" is a geographically contiguous and distinct area (which may involve residually contaminated facilities, engineered units, soil, groundwater, and/or surface water/sediment) for which cleanup, disposal, and or stabilization will have been completed and long-term stewardship will be required as of 2008. (Note: For most sites addressed in this report, the date is 2006 for having begun long-term stewardship, per Congressional language in the "Conference Report on S.1059, National Defense Authorization Act for Fiscal Year 2000," *Congressional Record,* August 5, 1999. However, because of the extent of long-term stewardship activities for this site, and the closeness in timeframe, this site is included in this report.)

The site portions include: Treatment Facility A, Treatment Facility B, Treatment Facility C, Treatment Facility D, Treatment Facility E, Treatment Facility F/406, Treatment Facility G; Treatment Facility 518; Treatment Facility 5475, Building 331 Area, Building 419/511, and Building 292 Area. These 12 portions, also known as "subproject areas," are identified in the table below, with accompanying discussion of cleanup and long-term stewardship activities in Sections 3.1 through 3.12.

The objectives of the subprojects are to prevent the further migration of groundwater contaminants to offsite

locations; to remediate contaminated groundwater to MCLs allowed in drinking water, as specified in the CERCLA Record of Decision and the Compliance Monitoring Plan; and to remediate the contaminant source areas. These remediation objectives are expected to be fulfilled by operating the treatment facilities and attendant wellfields located in each portion or subproject area. Each portion will complete remediation according to different schedules. Cleanup at each portion includes the continuous monitoring of the groundwater quality, data analysis and representation, and flow and transport predictive modeling. The results of these data analyses are used in making decisions for managing the flow rates from the extraction wellfield and for modifying the operation of the wellfield and treatment facilities.

Furthermore, in order to better target the areas of contamination and install efficient extraction well networks, the alluvial sediments in this site have been mapped into seven hydrostratigraphic units. Hydrostratigraphic units are defined as sedimentary sequences whose permeable layers show evidence of hydraulic connection, i.e., there is evidence of groundwater flow within permeable layers in individual hydrostratigraphic units.

Portion	*Long-Term Stewardship Start Year**	*Entire Portion Cleanup Completion Year***	*Long-Term Stewardship End Year*
Treatment Facility A	1990	2001	2032
Treatment Facility B	1990	2007	2062
Treatment Facility C	1990	2006	2020
Treatment Facility D	1991	2006	2067
Treatment Facility E	1990	2006	2057
Treatment Facility F/406	1989	1997	2019
Treatment Facility G	1989	2001	2017
Treatment Facility 518	1990	2007	2022
Treatment Facility 5475	1993	2006	2072
Building 331 Area	1998	1998	2070
Building 419/511	2006	2007	2063
Building 292 Area	1998	1998	2070

*Represents date when completion of assessment and remedial action for at least one release site within a portion that could require long-term stewardship activities is done and/or operation of treatment systems on a portion-specific basis that will remediate release site(s) to allow eventual long-term stewardship activities to commence is initiated.

**Represents date when all release sites for an entire portion will have been assessed and completed and all groundwater treatment systems and other remedial actions will be in place and operational according to remedies and cleanup standards promulgated in the Final ROD.

3.1 Treatment Facility A

Treatment Facility A conducts onsite environmental restoration activities and is located in the southwest corner of the Livermore Site, bounded on the east by the Treatment Facility G area and on the north by the Treatment Facility B area and Mesquite Road. The southern boundary of the Treatment Facility A area extends about 0.4 kilometer (.25 mile) south of East Avenue, and the western boundary extends about 1.6 kilometers (one mile) to the west of the property boundary, primarily along Arroyo Seco.

Treatment Facility A, which began operating in 1989, is the oldest operating groundwater treatment system at the Livermore Site and has been successful in pulling offsite contaminated groundwater plumes back toward the site. For this portion, DOE is treating a plume approximately 40 hectares (98 acres) of which about 23 hectares (56 acres) are located offsite. Remediation objectives are expected to be met by operating Treatment Facility A and a solar-powered treatment unit (SWAT-7), along with the attendant wellfields.

TREATMENT FACILITY A HIGHLIGHTS

Major Long-Term Stewardship Activities - groundwater monitoring; pump and treat
Portion Size - 27 hectares (67 acres)
Estimated Volume of Residual Contaminants - soil 2,700 cubic meters (3,600 cubic yards); groundwater 3.6 million cubic meters (4.7 million cubic yards)
Long-Term Stewardship Start-End Years - 1990-2032
Average Annual Long-Term Stewardship Costs FY 2000-2006 - n/a (costs begin FY 2008)

3.1.1 Soil

DOE estimates that 0.1 hectare (0.2 acre), overlying 2,700 cubic meters (3,600 cubic yards) of contaminated soil, encompasses this portion. The contaminants of concern are volatile organic compounds, primarily tetrachloroethylene in HSU-1 (which consists of interbedded sand, silt, clay and gravel).

DOE will remediate contaminants in the unsaturated zone only if it is predicted that they would cause concentrations above MCLs if allowed to migrate into the groundwater. If needed, volatile contaminants in the unsaturated zone will be removed by extracting them in vapor, and treating them onsite. Atmospheric emissions from treatment systems will comply with Bay Area Air Quality Management District standards that limit effluent air emissions containing volatile organic compounds to 10 parts per million. Unsaturated zone remediation will be complete when modeling shows that contaminants will no longer migrate to groundwater in concentrations that will cause contamination above a maximum concentration level. DOE will collect sediment or soil samples to confirm that cleanup objectives are met.

Soil Long-Term Stewardship Activities

DOE has a moderate- to high-level understanding of the source of contamination and the area of affected soil. Long-term stewardship activities include groundwater monitoring to determine if unsaturated soil contamination is adversely impacting groundwater quality to concentrations above MCLs. DOE assumes that no active soil vapor treatment system will be required in this area. Long-term stewardship for the completed release sites at Treatment Facility A include: regulatory interactions and compliance, wellfield operation and maintenance, maintaining the data information system, and program management. Many of these activities will continue once cleanup of the entire Treatment Facility portion is complete.

Treatment Facility A Release Sites Cleaned Up That Require Long-Term Stewardship Activities

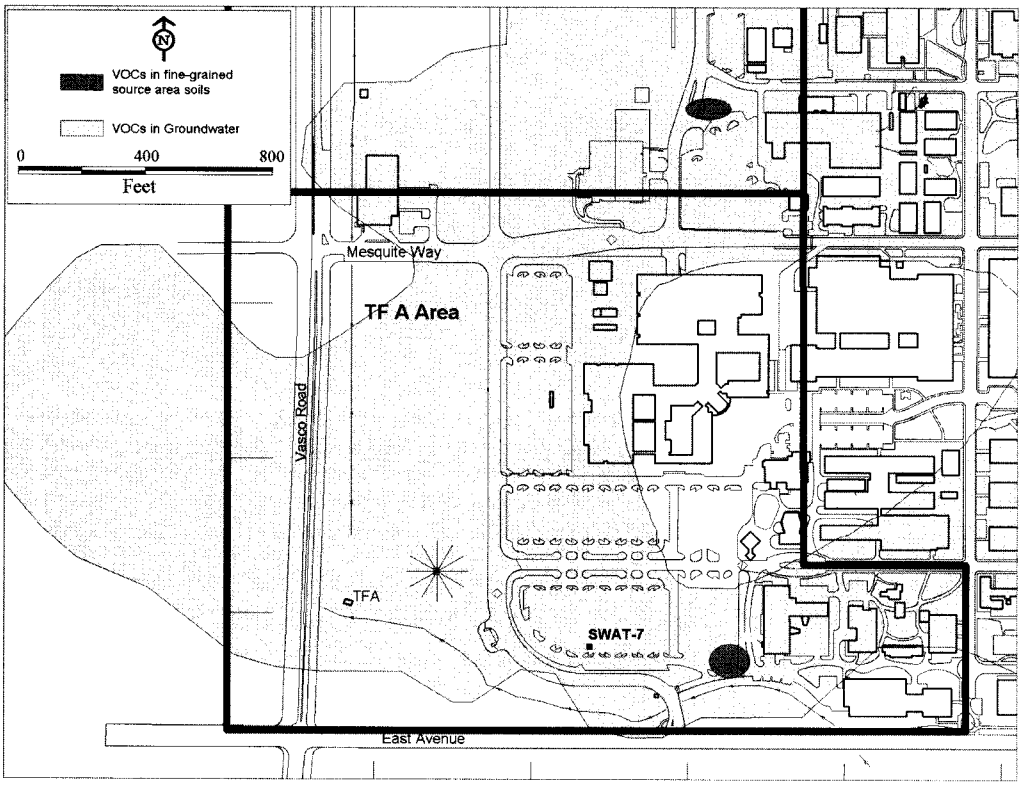
- Arroyo Seco Area Storm Drain Outlet 3a
- Arroyo Seco Area Storm Drain Outlet 3b
- Arroyo Seco Area Transformer

Release Sites Expected to Be Cleaned Up By 2006 and Expected to Require Long-Term Stewardship Activities

- Arroyo Seco Xylene and Toluene Spills
- Arroyo Seco Above-Grounde Retention Tanks
- Arroyo Seco Area Solvents - SWMU 4-5
- Arroyo Seco Storm Drain Outlet 3a
- Arroyo Seco Storm Drain Outlet 3c
- Arroyo Seco Storm Drain Outlet 3d
- Arroyo Seco Storm Sewer Discharge Area TCE Spill

3.1.2 Groundwater

Approximately 40 hectares (98 acres), overlying 3.6 million cubic meters (4.7 million cubic yards) of contaminated groundwater, encompass this portion. DOE has conducted onsite source characterization and collected sufficient data to accurately define the extent of the groundwater contamination. Sources of onsite contamination include local storm drain outlets, spills into the Arroyo Seco, above ground retention tanks, and a transformer rupture. Treatment Facility A was constructed to prevent volatile organic compounds from



Treatment Facility A

migrating further downgradient toward municipal water supply wells to the west and agricultural wells and private domestic wells to the south. Depth to groundwater is about 20 meters (75 feet) and the groundwater flows to the west and northwest.

The contaminants of concern are volatile organic compounds, primarily tetrachloroethylene and, to a lesser extent, 1,1-dichoroethylene in hydrostratigraphic units HSU-1B, HSU-2, and HSU-3A. Groundwater plumes in all three hydrostratigraphic units extend to offsite locations toward a residential neighborhood to the west of the site. These contaminants are generally confined to 20 meters (75 feet) below the ground surface.

DOE will continue to pump groundwater containing volatile organic compounds from the subsurface and treat it using air stripping or granular activated carbon. DOE will also continue to operate two groundwater facilities until cleanup standards are reached and DOE will continue to pull back the groundwater contamination toward the site. By the end of 1999, DOE treated over 2.46 million cubic meters (3.2 million cubic yards) of groundwater, removing about 123 kilograms (271 pounds) of volatile organic compounds. DOE expects that these groundwater remediation activities will reduce volatile organic compounds concentrations to meet target cleanup levels (i.e., the lower of either the Federal or State of California MCLs allowed in drinking water) by 2030.

Groundwater Long-Term Stewardship Activities

Long-term stewardship activities for Treatment Facility A will include: (1) facility operation and maintenance of treatment systems; (2) continued regulatory interactions and compliance; (3) groundwater monitoring and wellfield operation and maintenance; (4) three-dimensional modeling as a cost-effective means to estimate future volatile organic compounds concentrations and risk to human health and the environment, optimize remediation,

evaluate the effectiveness of cleanup, and relay the progress of cleanup to the stakeholders; (5) maintaining the data information system that is required to support planning, collecting, tracking, verifying, validating, reporting, interpreting, and using the data; and (6) program management.

3.1.3 Estimated Long-Term Stewardship Costs for Treatment Facility A

Costs applicable during stewardship for Treatment Facility A are those associated with treatment facility operation (including wellfield optimization and management) and maintenance, groundwater monitoring, and regulatory and community interaction. See Section 2.2, Assumptions and Uncertainties, for a complete listing of assumptions used in developing the cost estimate for this portion. For Treatment Facility A, DOE also based the end state on the assumption that operating the Treatment Facility A pipelines is eight percent of the FY 2000 operating cost.

Long-Term Stewardship Costs (Constant Year 2000 Dollars)							
FY 2000 - FY 2010	***FY 2011 - FY 2020***	***FY 2021 - FY 2030***	***FY 2031 - FY 2040***	***FY 2041 - FY 2050***	***FY 2051 - FY 2060***	***FY 2061 - FY 2070***	***Estimated. Total***
$1,119,000	$1,892,000	$683,000	$28,000	$0	$0	$0	$3,722,000

3.2 Treatment Facility B

Treatment Facility B is located along Vasco Road on the western edge of the Livermore Site, about 0.4 kilometer (0.25 mile) north of Mesquite Way. Treatment Facility B conducts environmental restoration activities in the central portion of the western edge of the Livermore Site. Work in this area also includes hot-spot remediation in the Treatment Facilities B and C areas. The area is bounded on the east by the Treatment Facilities D and E areas, on the south by the Treatment Facility A area and Mesquite Road, and on the north by the Treatment Facility C area and Westgate Drive. The western boundary of this portion extends about 0.8 kilometer (0.5 mile) to the west of the property boundary, even though groundwater contamination does not extend that far offsite in this area.

TREATMENT FACILITY B HIGHLIGHTS

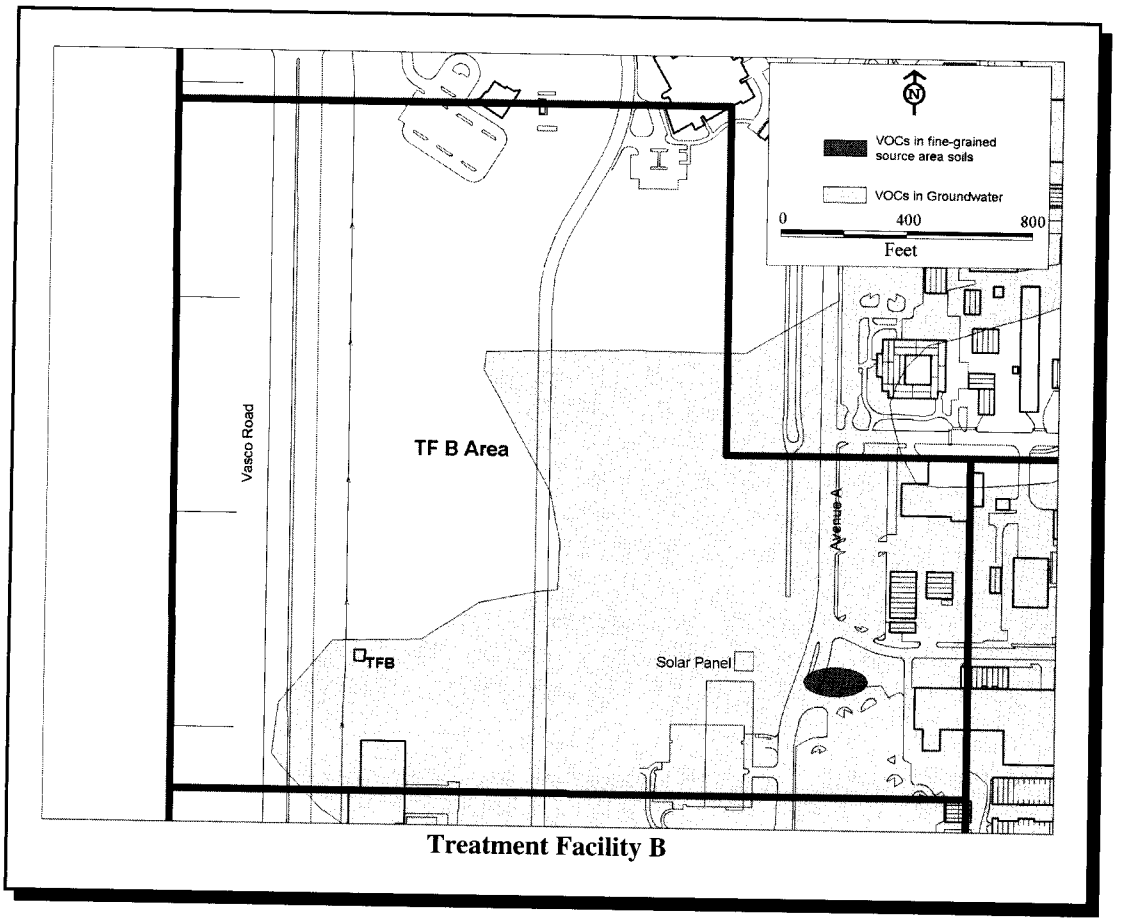
Major Long-Term Stewardship Activities - surveillance and maintenance; groundwater monitoring; pump and treat
Portion Size - 16 hectares (40 acres)
Estimated Volume of Residual Contaminants - soil 3,000 cubic meters (4,000 cubic yards); groundwater 1.14 million cubic meters (1.49 million cubic yards)
Long-Term Stewardship Start-End Years - 2008-2062
Average Annual Long-Term Stewardship Costs FY 2000-2006 - n/a (costs begin in FY 2008)

Treatment Facility B is the second oldest operating groundwater treatment system at the Livermore Site. DOE has been successful in pulling distal portions of groundwater plumes back toward the site since the facility began operating in 1990. There are distinct sources of contamination in this area originating from local dumping of oils and solvents, open storm sewer lines, drainage ditches, plating shop sumps, and possible leakage from prior tanks. Therefore, the constituents in the groundwater plume treated by Treatment Facility B differ from those found in the adjacent Treatment Facility A location. DOE expects

Treatment Facility B Cleaned up Release Sites That Require Long-Term Stewardship Activities

- Building 141 Area Dumping of Oils and Solvents
- Building 141 Area Gasoline Tank
- Building 141 Area Open Storm Sewer
- Building 141 Area Plating Shop Sump-SWMU 50-51
- Building 141 Area Storage Area
- Building 141 Area Unlined Drainage Ditch
- Building 141 Area Waste Water Retention-SWMU 44-49
- Tank 141-R3U1

to meet remediation objectives by operating Treatment Facility B and its attendant wellfields.



3.2.1 Soil

Approximately 0.1 hectare (0.24 acre), overlying 3,000 cubic meters (4,000 cubic yards) of contaminated soil, encompasses this portion. The contaminants of concern are volatile organic compounds, primarily trichloroethylene. This medium was separated based on the distinct sources of contamination in this area from local dumping of oils and solvents, open storm sewer lines, drainage ditches, plating shop sumps, and possible leaks from old tanks.

DOE will remediate contaminants in the unsaturated zone only if it is predicted that they would cause concentrations above MCLs if allowed to migrate into the groundwater. If needed, volatile contaminants in the unsaturated zone will be removed by extracting them in vapor, which will be treated onsite. Atmospheric emissions from treatment systems will comply with Bay Area Air Quality Management District standards that limit effluent air emissions containing volatile organic compounds to 10 parts per million. Unsaturated zone remediation will be complete when modeling shows that contaminants will no longer migrate to groundwater and create concentrations in the groundwater above MCLs.

Soil Long-Term Stewardship Activities

Long-term stewardship activities include groundwater monitoring to determine if unsaturated soil contamination is adversely impacting groundwater quality to concentrations above MCLs. A soil vapor treatment system may be required in this area to help clean up the Treatment Facility B and C hotspots. Long-term stewardship

activities for soil in the eight completed release sites and eventually the entire portion include: (1) facility operation and maintenance, (2) regulatory interactions and compliance, (3) wellfield operation and maintenance, (4) remediation optimization, (5) maintaining the data information system, and (6) program management.

3.2.2 Groundwater

DOE estimates that 11 hectares (27 acres), overlying 1.14 million cubic meters (1.49 million cubic yards) of contaminated groundwater, encompass this portion. The contaminants of concern are volatile organic compounds, primarily trichloroethylene and, to a lesser extent, tetrachloroethylene, 1,1-dichoroethylene, carbon tetrachloride, chloroform, 1,1-dichoroethane, and Freon 113. Hexavalent chromium is also a contaminant of concern as it seasonably exceeds its discharge limit of 22 parts per billion and, therefore, necessitates seasonal treatment. The contaminants of concern are found in hydrostratigraphic units HSU-1B and HSU-2. Groundwater plumes in both hydrostratigraphic units, though undergoing treatment by the Treatment Facility B extraction wellfield, extend offsite toward a residential neighborhood to the west of the site.

DOE will continue to pump groundwater containing volatile organic compounds from the subsurface and treat it using air stripping. One groundwater facility will continue to operate until cleanup standards are reached. DOE also will operate a source area remediation facility. The groundwater contamination will continue to be pulled back toward the site. Through the end of 1999, DOE treated over 430,000 cubic meters (560,000 cubic yards) of groundwater, removing about 38 kilograms (84 pounds) of volatile organic compounds. Groundwater remediation activities will reduce volatile organic compounds concentrations to meet the lower of either the Federal or State of California MCLs allowed in drinking water. DOE expects that such target cleanup levels will be achieved by 2060.

Groundwater Long-Term Stewardship Activities

Long-term stewardship activities will include: (1) facility operation and maintenance of treatment systems; (2) continued regulatory interactions and compliance; (3) groundwater monitoring and wellfield operation and maintenance; (4) three-dimensional modeling as a cost-effective means to estimate future volatile organic compounds concentrations and risk to human health and the environment, optimize remediation, evaluate the effectiveness of cleanup, and relay the progress of cleanup to the stakeholders; (5) maintaining the data information system that is required to support planning, collecting, tracking, verifying, validating, reporting, interpreting, and using the data; and (6) program management.

3.2.3 Estimated Long-Term Stewardship Costs for Facility B

Costs applicable during stewardship for Treatment Facility B are those associated with treatment facility operation (including wellfield optimization and management) and maintenance, groundwater monitoring, and regulatory and community interaction. See Section 2.2, Assumptions and Uncertainties, for a complete listing of assumptions used in developing the cost estimate for this portion. For Treatment Facility B, DOE also based the end state on the assumption that operating the Treatment Facility B pipelines is 12 percent of the FY 2000 operating cost.

Long-Term Stewardship Costs (Constant Year 2000 Dollars)							
FY 2000 - FY 2010	***FY 2011 - FY 2020***	***FY 2021 - FY 2030***	***FY 2031 - FY 2040***	***FY 2041 - FY 2050***	***FY 2051 - FY 2060***	***FY 2061 - FY 2070***	***Estimated Total***
$1,778,000	$3,344,000	$1,372,000	$461,000	$192,000	$79,000	$1,000	$7,227,000

3.3 Treatment Facility C

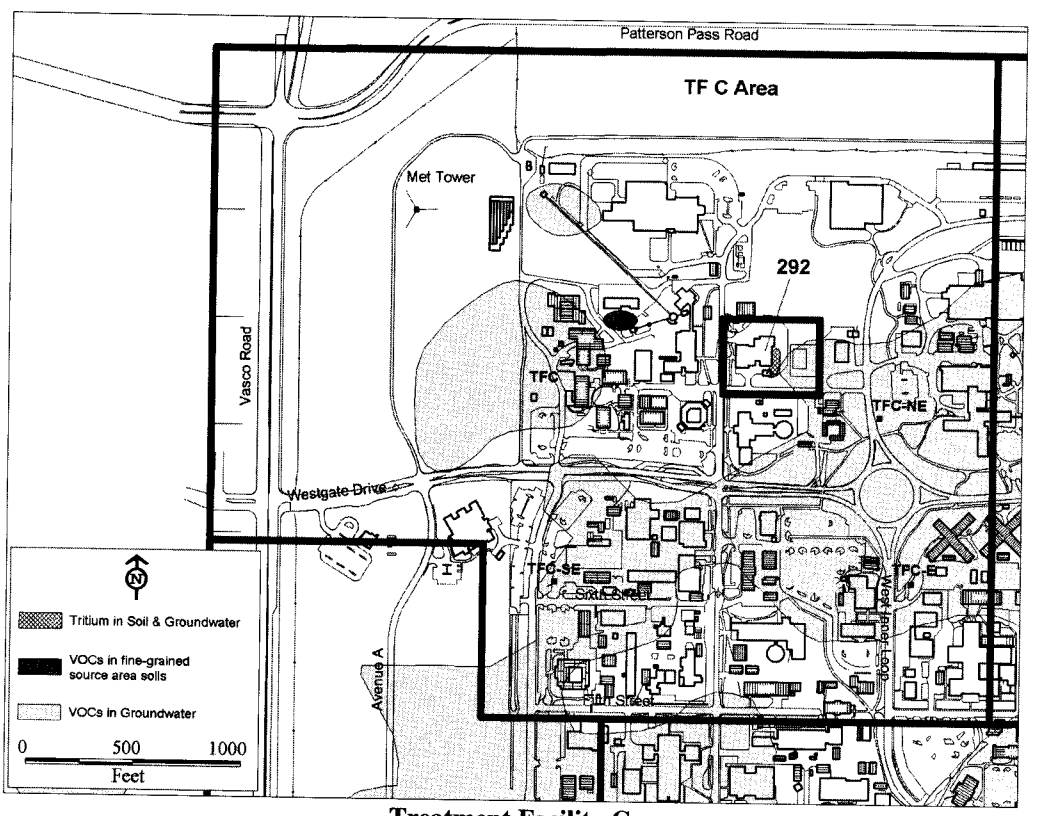
The Treatment Facility C area supports environmental restoration activities in the northwest part of the Livermore Site. This 89- hectare (220-acre) area is bounded on the east by the Treatment Facility D area and on the south by the Treatment Facility B area and Westgate Road. The western boundary extends beyond Vasco Road. The northern boundary extends beyond Arroyo Las Positas.

> ***TREATMENT FACILITY C HIGHLIGHTS***
>
> *Major Long-Term Stewardship Activities* - groundwater monitoring; pump and treat
> *Portion Size* - 89 hectares (220 acres)
> *Estimated Volume of Residual Contaminants* - soil 3,700 cubic meters (4,900 cubic yards); groundwater 3.05 million cubic meters (4.0 million cubic yards)
> *Long-Term Stewardship Start-End Years* - 1990-2020
> *Average Annual Long-Term Stewardship Costs FY 2000-2006* - n/a (costs begin in FY 2008)

Treatment Facility C is the fourth oldest operating groundwater treatment system at the Livermore Site that has been successful in pulling distal portions of the plumes back toward the site since it began operating in 1993. The sources of contamination in this portion include significant quantities of hazardous materials that were released around Building 191; surface discharge of water from a cooling tower in Building 293; dumping of hazardous materials into an open storm sewer and swamp; and possible releases from underground tanks. Remediation objectives are expected to be met by operating Treatment Facility C; portable treatment units TFC-SE, TFC-E, TFC-NE; and their attendant wellfields.

3.3.1 Soil

DOE estimates that 0.12 hectare (0.3 acre), overlying 3,700 cubic meters (4,900 cubic yards) of contaminated



Treatment Facility C

soil, encompasses this portion. The contaminants of concern are volatile organic compounds, primarily tetrachloroethylene and trichloroethylene. Soil contamination is primarily in HSU-1B, which consists of interbedded sand, silt, clay and gravel. DOE believes soil contamination was caused by past releases from buildings, cooling tower discharges, underground tank leaks, and dumping into an open sewer and swamp.

Treatment Facility C Cleaned up Release Sites That Require Long-Term Stewardship Activities

- Arroyo Las Positas Area
- Building 298 Area
- Building 361 Area
- Building 191 Area
- Building 293 Area
- Tank 161-R1U1
- Chromium Study Area
- MW-501 Area
- West Traffic Circle Area Fire Training Areas (SWMU)
- Tank 298-*R1U1*

Release Sites Expected to Be Cleaned Up By 2006 and Expected to Require Long-Term Stewardship Activities

- West Traffic Circle Area Open Storm Sewer Drainage
- West Traffic Circle Area Swamp

Soil Long-Term Stewardship Activities

DOE has a moderate level of understanding of the source of contamination in the area of affected soil. Long-term activities include groundwater monitoring to determine if unsaturated soil contamination is adversely impacting groundwater quality to concentrations above MCLs. DOE assumes that no active soil vapor treatment system will be needed in this area. Long-term stewardship activities for soil at the 12 completed release site and eventually for the entire Treatment Facility C Area include: (1) regulatory interactions and compliance, (2) wellfield operation and maintenance, (3) maintaining the data information system, and (4) program management.

3.3.2 Groundwater

DOE estimates that 44 hectares (110 acres), overlying 3.05 million cubic meters (4.0 million cubic yards) of contaminated groundwater, encompasses this portion. The contaminants of concern are volatile organic compounds and hexavalent chromium. DOE has detected hexavalent chromium, with a concentration of approximately 30 parts per billion, in the groundwater. This metal also is found naturally in the soils in the vicinity.

Groundwater contamination plumes that extend westward toward Vasco Road are found primarily in hydrostratigraphic units HSU-1B and HSU-2 and consist of volatile organic compounds, primarily tetrachloroethylene and trichloroethylene, and, to a lesser extent, 1,1-dichoroethylene and chloroform.

DOE will continue to pump groundwater containing volatile organic compounds from the subsurface and treat it using air stripping. Four groundwater facilities will continue to operate until cleanup standards are reached. Through the end of 1999, DOE treated over 320,000 cubic meters (410,000 cubic yards) of groundwater, removing about 32 kilograms (70 pounds) of volatile organic compounds. Groundwater remediation activities will reduce volatile organic compounds concentrations to meet the lower of either the Federal or State of California MCLs allowed in drinking water. DOE expects to achieve these target cleanup levels by 2018.

Groundwater Long-Term Stewardship Activities

Long-term stewardship activities will include: (1) facility operation and maintenance of treatment systems; (2) continued regulatory interactions and compliance; (3) groundwater monitoring and wellfield operating and maintenance; (4) three-dimensional modeling as a cost-effective means to estimate future volatile organic compounds concentrations and risk to human health and the environment, optimize remediation, evaluate the effectiveness of cleanup, and to relay the progress of cleanup to the stakeholders; (5) maintaining the data information system that is required to support planning, collecting, tracking, verifying, validating, reporting, interpreting, and using the data; and (6) program management.

3.3.3 Estimated Long-Term Stewardship Costs for Facility C

Costs applicable during stewardship for Treatment Facility C are those associated with treatment facility operation (including wellfield optimization and management) and maintenance, groundwater monitoring, and regulatory and community interaction. See Section 2.2, Assumptions and Uncertainties, for a complete listing of assumptions used in developing the cost estimate for this portion.

Long-Term Stewardship Costs (Constant Year 2000 Dollars)							
FY 2000 - FY 2010	***FY 2011 - FY 2020***	***FY 2021 - FY 2030***	***FY 2031 - FY 2040***	***FY 2041 - FY 2050***	***FY 2051 - FY 2060***	***FY 2061 - FY 2070***	***Estimated Total***
$1,725,000	$2,628,000	$0	$0	$0	$0	$0	$4,353,000

3.4 Treatment Facility D

The Treatment Facility D area includes environmental restoration activities in the northeastern quadrant of the Livermore Site, north of the Drainage Retention Basin. This 101-hectare (250-acre) area is bounded on the east and north by the site boundary, on the south by Treatment Facility 5475 and Treatment Facility E areas, and on the west by the Treatment Facility C area. Work in this area also includes source area remediation activities being conducted at the East Traffic Circle, Treatment Facility D hotspots, and the Helipad.

TREATMENT FACILITY D HIGHLIGHTS

Major Long-Term Stewardship Activities - groundwater monitoring; pump and treat
Portion Size - 101 hectares (250 acres)
Estimated Volume of Residual Contaminants - soil 300,000 cubic meters (390,000 cubic yards); groundwater 3.49 million cubic meters (4.56 million cubic yards)
Long-Term Stewardship Start-End Years - 1991-2067
Average Annual Long-Term Stewardship Costs FY 2000-2006 - n/a (costs begin in FY 2008)

There are distinct sources of contamination in this area from the unpaved aprons flanking the runways of the Livermore Naval Air Station. The area also contained landfills and disposal pits. Plume characteristics and composition differ from adjacent locations.

Treatment Facility D Cleaned up Release Sites That Require Long-Term Stewardship Activities

- Building 571 Area
- Drainage Retention Basin Area
- East Gate Drive Area
- National Ignition Facility
- Northeast Boundary Area
- Northern Boundary Area

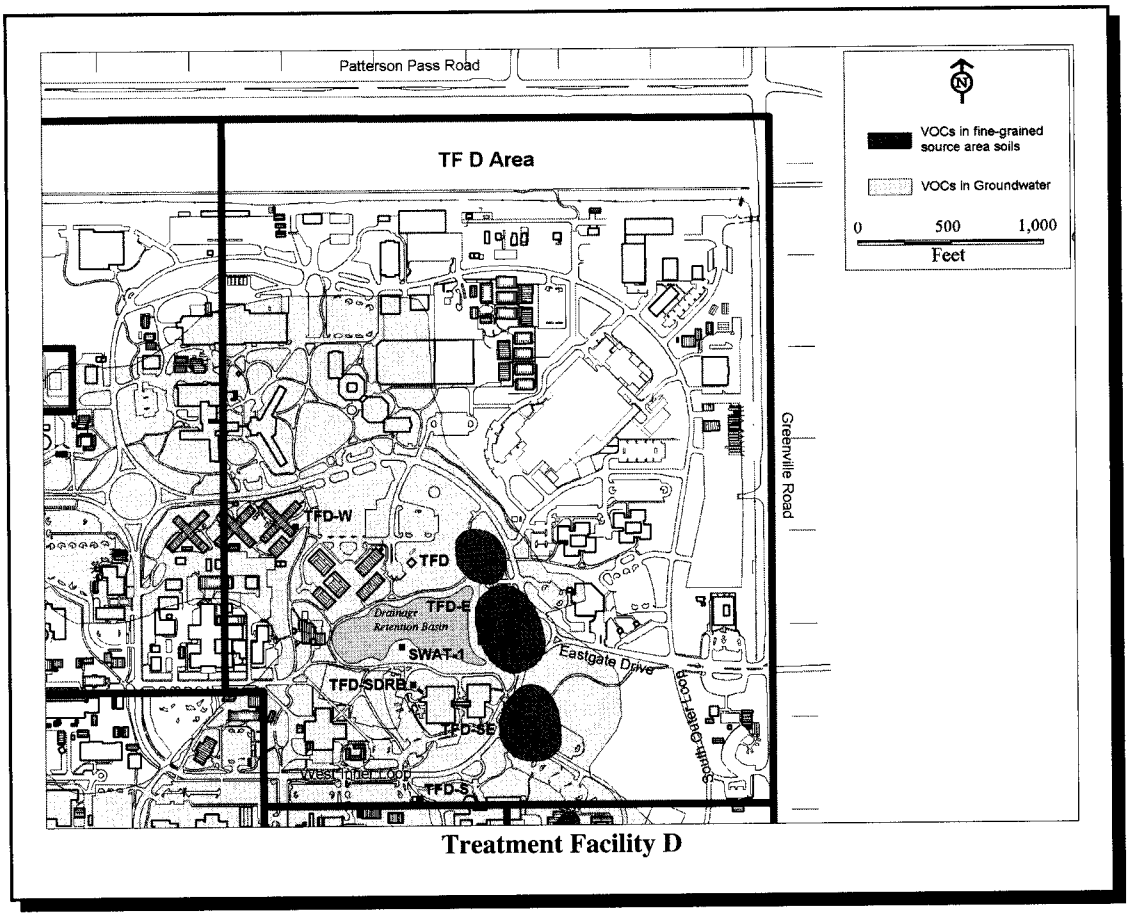
Release Sites Expected to Be Cleaned Up By 2006 and Expected to Require Long-Term Stewardship Activities

- Building 490
- East Traffic Circle Area
- Helipad
- Livermore Site Ground Water Project

3.4.1 Soil

Approximately 2.5 hectares (six acres), overlying 300,000 cubic meters (390,000 cubic yards) of contaminated soil, encompass this portion. The contaminants of concern are volatile organic compounds, primarily trichloroethylene. Soil contamination is primarily in HSU-1B and 2. HSU-1B is a 9- to 15-meter (30- to 50-foot) thick interval of interbedded sand, silt, and gravel. HSU-2 consists predominately of low-permeability silt, clay, and sand with laterally discontinuous interbeds of sand and sandy gravel. DOE believes the sources of soil contamination are due to past landfills and unpaved aprons flanking the old runways of the Livermore Naval Air Station.

DOE will remediate source areas by deploying electro-osmosis (at the East Traffic Circle, Treatment Facility D



Treatment Facility D

hotspots, and the Helipad) to remove volatile organic compounds from the fine-grained sediments. Past soil excavation and removal activities include the East Traffic Circle Landfill in 1984 and 1985, polychlorinated biphenyls capacitors from the National Ignition Facility construction site in 1997, and polychlorinated biphenyls-contaminated soil from the East Traffic Circle in 1999.

Soil Long-Term Stewardship Activities

Long-term stewardship activities include groundwater monitoring to determine if unsaturated soil contamination is adversely impacting groundwater quality to concentrations above MCLs. In addition to the previous removal action and release site completion. DOE will remediate source area soils by deploying electro-osmosis to remove volatile organic compounds from the fine-grained sediments, combined with a soil vapor extraction system for the coarser grained unsaturated soils.

3.4.2 Groundwater

Approximately 45 hectares (111 acres), overlying 3.49 million cubic meters (4.56 million cubic yards) of contaminated groundwater, encompass this portion. Groundwater in this portion is fairly well characterized, such that areas of contaminated groundwater are well understood. The contaminants of concern are volatile organic compounds, namely (in order of highest average concentration) trichloroethylene, trichlorofluoromethane (Freon 11), tetrachloroethylene, 1,2-dichloroethane, carbon tetrachloride, 1,1-dichoroethylene, chloroform, 1,1-dichloroethane, Freon 113, and 1,2-dichoroethylene. These exist in hydrostratigraphic units HSU-2, HSU-3A, HSU-3B, HSU-4, and HSU-5. Six volatile organic compounds exceed the respective MCLs allowed in drinking water: trichloroethylene, tetrachloroethylene, 1,2-dichloroethane, carbon tetrachloride,

1,1-dichoroethylene, and Freon 11. Hexavalent chromium has also been detected, but at concentrations that are currently under the MCLs and water discharge limits. Groundwater contaminant plumes in the hydrostratigraphic units listed above currently remain onsite.

Groundwater treatment facilities are currently extracting and treating contaminated groundwater, using either a fixed facility, a portable treatment unit, a miniature portable treatment unit, or solar-powered treatment units. The fixed facility, portable treatment units, and miniature portable treatment units use air strippers to remove volatile organic compounds from the groundwater, whereas the solar-powered treatment units use granular activated carbon. DOE will install four source area groundwater treatment systems, using electro-osmosis, and operate these systems until cleanup goals are met. Through 1999, Treatment Facility D remediation operations have cumulatively treated about 700,000 cubic meters (900,000 cubic yards) of groundwater by removing over 235 kilograms (518 pounds) of volatile organic compounds.

DOE will continue to pump groundwater containing volatile organic compounds from the subsurface and treat it using air stripping, granular activated carbon, or catalytic reductive dehalogenation. DOE will operate seven groundwater facilities and four source area remediation systems until cleanup standards are reached. Groundwater remediation activities will reduce volatile organic compounds concentrations to meet the lower of either the Federal or State of California MCLs allowed in drinking water. DOE expects that such target cleanup levels will be achieved by 2065.

Groundwater Long-Term Stewardship Activities

Long-term stewardship activities will include: (1) facility operation and maintenance of treatment systems; (2) continued regulatory interactions and compliance; (3) groundwater monitoring and wellfield operation and maintenance; (4) three-dimensional modeling as a cost-effective means to estimate future volatile organic compounds concentrations and risk to human health and the environment, optimize remediation, evaluate the effectiveness of cleanup, and to relay the progress of cleanup to the stakeholders; (5) maintaining the data information system that is required to support planning, collecting, tracking, verifying, validating, reporting, interpreting, and using the data; and (6) program management.

3.4.3 Estimated Long-Term Stewardship Costs for Treatment Facility D

Costs applicable during stewardship for Treatment Facility D are those associated with treatment facility operation (including wellfield optimization and management) and maintenance, groundwater monitoring, and regulatory and community interaction. See Section 2.2, Assumptions and Uncertainties, for a complete listing of assumptions used in developing the cost estimate for this portion.

Long-Term Stewardship Costs (Constant Year 2000 Dollars)							
FY 2000 - FY 2010	***FY 2011 - FY 2020***	***FY 2021 - FY 2030***	***FY 2031 - FY 2040***	***FY 2041 - FY 2050***	***FY 2051 - FY 2060***	***FY 2061 - FY 2070***	***Estimated Total***
$7,676,000	$14,509,000	$4,664,000	$1,686,000	$679,000	$280,000	$61,000	$30,555,000

3.5 Treatment Facility E

The Treatment Facility E area includes environmental restoration activities in the central eastern area of the Livermore Site. This 16.5-hectare (41-acre) area is bounded by the Treatment Facility D area on the north, the Treatment Facility 406 area on the south, the Treatment Facility G area on the west, the Treatment Facility 5475 area on the east, and Buildings 419/511 and Treatment Facility 518 on the southeast. Work in this area also

includes source area remediation activities being conducted at the East Taxi Strip Area and at the Treatment Facility E Hotspot.

Sources of contamination include the Eastern Landing Mat area, underground tanks, oil and chemical spills, dismantling of transformers, and unlined drainage ditches. Remediation objectives will be achieved by Treatment Facility E at the East, Southwest, Northwest, Southeast, and West locations and their respective attendant wellfields.

TREATMENT FACILITY E HIGHLIGHTS

Major Long-Term Stewardship Activities - groundwater monitoring; pump and treat
Portion Size - 16.5 hectares (41 acres)
Estimated Volume of Residual Contaminants - soil 140,000 cubic meters (185,000 cubic yards); groundwater 1.93 million cubic meters (2.52 million cubic yards)
Long-Term Stewardship Start-End Years - 1990-2057
Average Annual Long-Term Stewardship Costs FY 2000-2006 - n/a (costs begin in FY 2008)

3.5.1 Soil

Approximately 0.6 hectare (1.5 acres), overlying 140,000 cubic meters (185,000 cubic yards) of contaminated soil, encompasses this portion. The contaminants of concern are volatile organic compounds, primarily trichloroethylene. HSU-1 is a 9- to 15- meter (30- to 50-foot)-thick interval of interbedded sand, silt, and gravel. HSU-2 consists predominately of low-permeability clayey silt, silty clay, and clayey sand with laterally discontinuous interbeds of sand and sandy gravel. DOE believes the sources of soil contamination are due to past landfills and unpaved aprons flanking the old runways of the Livermore Naval Air Station. DOE has characterized and identified the areas of contaminated soil. DOE will remediate the East Taxi Strip and Treatment Facility E hotspots by deploying electro-osmosis to remove volatile organic compounds from the fine-grained sediments, combined with a soil vapor extraction system for the coarser-grained unsaturated soils.

Treatment Facility E Cleaned Up Release Sites That Require Long-Term Stewardship Activities

- Building 543
- Eastern Landing Area Underground Tanks
- Eastern Landing Material Storage Area Oil and Chemical Spills
- Eastern Landing Material Transformers
- Eastern Landing Material Transformers

Release Sites Expected to Be Cleaned Up By 2006 and Expected to Require Long-Term Stewardship Activities

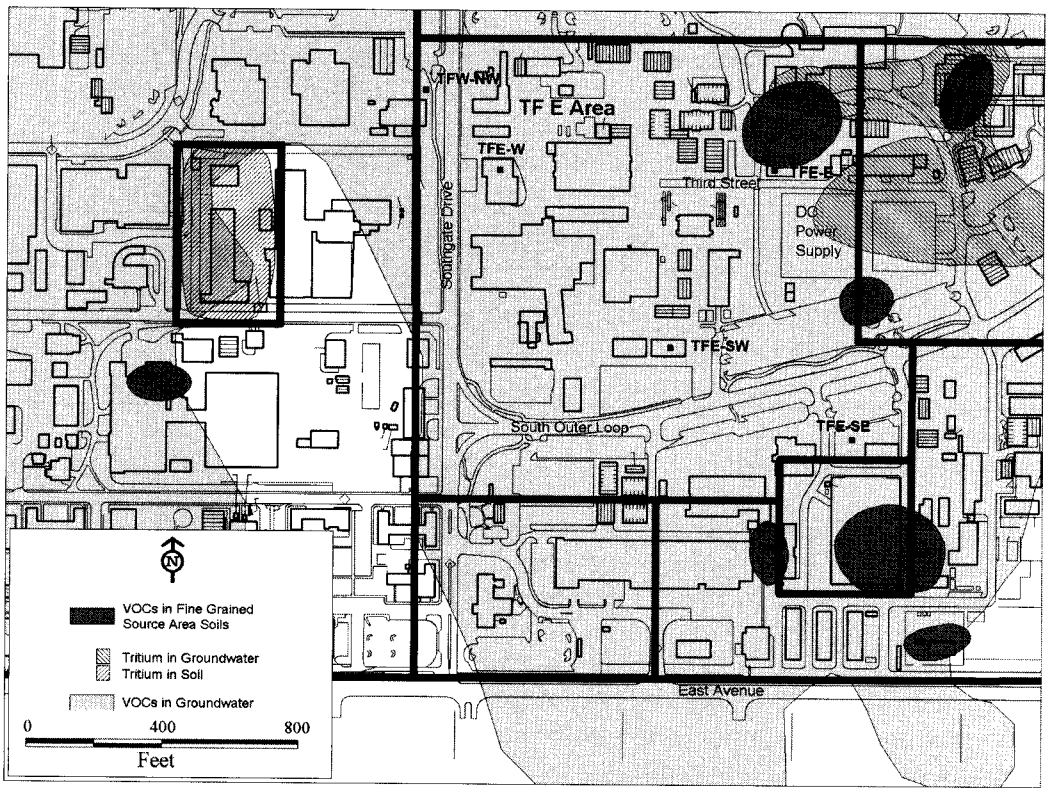
- Unlined Drainage Ditch 4A
- Unlined Drainage Ditch 4D

Soil Long-Term Stewardship Activities

Long-term stewardship activities include groundwater monitoring to determine if unsaturated soil contamination is adversely impacting groundwater quality to concentrations above MCLs. Long-term stewardship activities also include: (1) facility operation and maintenance, (2) regulatory interactions and compliance, (3) wellfield operation and maintenance, (4) remediation optimization, (5) maintaining the data information system, and (6) program management.

3.5.2 Groundwater

Approximately 17 hectares (42 acres), overlying 1.93 million cubic meters (2.52 million cubic yards) of contaminated groundwater, encompass this portion. The contaminants of concern are volatile organic compounds, primarily trichloroethylene, tetrachloroethylene, and 1,1-dichoroethylene. These volatile organic compounds occur in hydrostratigraphic units HSU-2, HSU-3A, HSU-3B, HSU-4, and HSU-5. Groundwater plumes in these five hydrostratigraphic units extend west to southwest toward the Treatment Facility G and



Treatment Facility E

Treatment Facility 406 areas. All groundwater plumes remain on site. DOE will remediate source area soils at the East Taxi Strip and Treatment Facility E hotspots by deploying electro-osmosis to remove volatile organic compounds from the fine-grained sediments, combined with a soil vapor extraction system for the coarser-grained unsaturated soils. Through the end of 1999, DOE had removed about 72 kilograms (159 pounds) of volatile organic compound mass from the groundwater.

Groundwater treatment facilities continue to extract and treat contaminated groundwater in this portion. DOE has located extraction wells in the Treatment Facility E area to hydraulically capture and treat volatile organic compounds in accordance with the Engineered Plume Collapse strategy. Four groundwater facilities and two source area remediation systems will continue to operate until cleanup standards are reached. The groundwater remediation standards, described in the CERCLA Record of Decision, are set to the lower of either the Federal or the State of California's MCLs allowed in drinking water. DOE expects to achieve these target levels by 2055.

Groundwater Long-Term Stewardship Activities

Long-term stewardship activities will include: (1) facility operation and maintenance of treatment systems; (2) continued regulatory interactions and compliance; (3) groundwater monitoring and wellfield operating and maintenance; (4) three-dimensional modeling as a cost-effective means to estimate future volatile organic compounds concentrations and risk to human health and the environment, optimize remediation, evaluate the effectiveness of cleanup, and to relay the progress of cleanup to the stakeholders; (5) maintaining the data information system that is required to support planning, collecting, tracking, verifying, validating, reporting, interpreting, and using the data; and (6) program management.

3.5.3 Estimated Long-Term Stewardship Costs for Treatment Facility E

Costs applicable during stewardship for Treatment Facility E are those associated with treatment facility operation (including wellfield optimization and management) and maintenance, groundwater monitoring, and regulatory and community interaction. See Section 2.2, Assumptions and Uncertainties, for a complete listing of assumptions used in developing the cost estimate for this portion.

Long-Term Stewardship Costs (Constant Year 2000 Dollars)							
FY 2000 - FY 2010	***FY 2011 - FY 2020***	***FY 2021 - FY 2030***	***FY 2031 - FY 2040***	***FY 2041 - FY 2050***	***FY 2051 - FY 2060***	***FY 2061 - FY 2070***	***Estimated Total***
$4,451,000	$8,323,000	$2,770,000	$1,021,000	$306,000	$52,000	$0	$16,923,000

3.6 Treatment Facility F/406

The Treatment Facility F/406 area is a 3.2-hectare (nine-acre) facility that conducts environmental restoration activities adjacent to East Avenue at the Gasoline Spill Area in the southern portion of the Livermore Site.

Fuel hydrocarbon leaks from onsite tanks have led to volatile organic compound contamination in the groundwater. Contaminated groundwater plumes containing volatile organic compounds extend offsite about 230 meters (750 feet) south of East Avenue. DOE expects to meet remediation objectives by operating Treatment Facility 406, Treatment Facility 406-Northwest, and attendant wellfields.

In August 1995, the regulatory agencies concurred that vadose remediation at Treatment Facility F had successfully recovered the majority of the fuel hydrocarbons in the vadose zone, and that there was greatly diminished efficiency in continuing active remediation. The regulatory agencies also agreed that remediation efforts had met or exceeded cleanup goals in the site's CERCLA Record of Decision and that remediation of the vadose zone was complete.

TREATMENT FACILITY F/406 HIGHLIGHTS

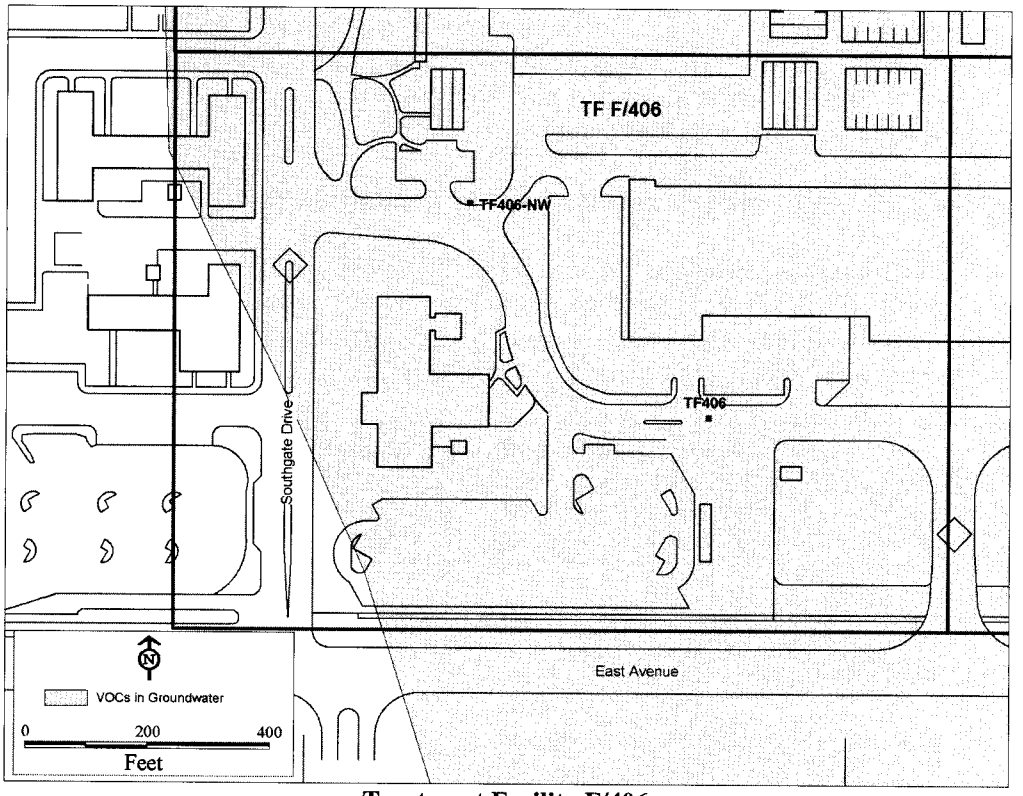
Major Long-Term Stewardship Activities - groundwater monitoring; pump and treat
Portion Size - 3.6 hectares (9 acres)
Estimated Volume of Residual Contaminants - groundwater 370,000 cubic meters (480,000 cubic yards)
Long-Term Stewardship Start-End Years - 1989-2019
Average Annual Long-Term Stewardship Costs FY 2000-2006- n/a (costs begin in FY 2008)

Treatment Facility F/406 Cleaned up Release Sites That Require Long-Term Stewardship Activities

- Building 406 Area
- Gas Pad Area
- Tank 401-D1U1
- Tank 401-D2U1
- Tank 401-D3U1
- Tank 401-D4U1
- Tank 402-G1U1
- Tank 402-G2U1
- Tank 411-D1U1

In December 1995, the Treatment Facility F groundwater treatment system for fuel hydrocarbons was damaged by wind and rain. The regulatory agencies agreed to a temporary shutdown of Treatment Facility F until the damaged equipment could be replaced. During the shutdown, DOE/LLNL prepared an application for Containment Zone for the fuel hydrocarbons, and in October 1996, the regulators confirmed completion of active remedial action for the fuel hydrocarbons-impacted groundwater and granted No Further Action status.

There is no unsaturated soil contamination in the TF406 portion requiring remediation.



Treatment Facility F/406

3.6.1 Groundwater

Approximately 3.5 hectares (nine acres), overlying 370,000 cubic meters (480,000 cubic yards) of contaminated groundwater, encompass this portion. The contaminants of concern in this area were originally fuel hydrocarbons, toluene, benzene, xylene, ethylene dibromide, and small concentrations of chlorinated volatile organic compounds, such as trichloroethylene, 1,2-dichloroethene, chloroform, tetrachloroethylene, carbon tetrachloride, trichlorotrifluoroethane, 1,1-dichloroethene, and 1,1,1-trichloroethane.

Volatile organic compounds are found in hydrostratigraphic units HSU-2, HSU-3, HSU-4, and HSU 5, and extend offsite about 229 meters (750 feet) south of East Avenue. The groundwater remediation standards, described in the Record of Decision, are set to the lower of either the Federal or the State of California's MCLs allowed in drinking water and DOE expects to achieve these levels by 2017. Through the end of 1999, DOE removed four kilograms (nine pounds) of volatile organic compounds from the groundwater. DOE will continue to pump groundwater containing volatile organic compounds from the subsurface and treat it using air stripping or granular activated carbon. DOE will operate two groundwater facilities until cleanup standards are reached.

In October 1996, the regulators confirmed completion of active remedial action for the fuel hydrocarbons-impacted groundwater, and granted No Further Action status.

Groundwater Long-Term Stewardship Activities

Long-term stewardship activities will include: (1) facility operation and maintenance of treatment systems; (2) continued regulatory interactions and compliance; (3) groundwater monitoring and wellfield operation and

maintenance; (4) three-dimensional modeling as a cost-effective means to estimate future volatile organic compounds concentrations and risk to human health and the environment, optimize remediation, evaluate the effectiveness of cleanup, and to relay the progress of cleanup to the stakeholders; (5) maintaining the data information system that is required to support planning, collecting, tracking, verifying, validating, reporting, interpreting, and using the data; and (6) program management.

3.6.2 Estimated Long-Term Stewardship Costs for Treatment Facility F/406

Costs applicable during stewardship for Treatment Facility F/406 are those associated with treatment facility operation (including wellfield optimization and management) and maintenance, groundwater monitoring, and regulatory and community interaction. See Section 2.2, Assumptions and Uncertainties, for a complete listing of assumptions used in developing the cost estimate for this portion.

Long-Term Stewardship Costs (Constant Year 2000 Dollars)							
FY 2000 - FY 2010	***FY 2011 - FY 2020***	***FY 2021 - FY 2030***	***FY 2031 - FY 2040***	***FY 2041 - FY 2050***	***FY 2051 - FY 2060***	***FY 2061 - FY 2070***	***Estimated Total***
$2,054,000	$1,688,000	$0	$0	$0	$0	$0	$3,742,000

3.7 Treatment Facility G

Treatment Facility G area includes environmental restoration activities in the central south region of the Livermore Site. This 44.5-hectare (110-acre) area is bounded on the north by Treatment Facility C and Treatment Facility D, on the east by the Treatment Facility 406 area, on the south by East Avenue, and on the west by Treatment Facility A and Treatment Facility B.

TREATMENT FACILITY G HIGHLIGHTS

Major Long-Term Stewardship Activities - groundwater monitoring; pump and treat
Portion Size - 44.5 hectares (110 acres)
Estimated Volume of Residual Contaminants - soil 3,800 cubic meters (5,000 cubic yards); groundwater 2.55 million cubic meters (3.34 million cubic yards)
Long-Term Stewardship Start-End Years - 1989-2019
Average Annual Long-Term Stewardship Costs FY 2000-2006 - n/a (costs begin in FY 2008)

Sources of contamination include floor drains, drum racks, potential release of solvents from maintenance machine shops, mercury reclaimer release, suspected spills from a plating shop, potential release of leaking storage tanks, sumps, and ruptured transformers near Buildings 212 and 321.

3.7.1 Soil

Approximately 0.1 hectare (0.3 acre), overlying 3,800 cubic meters (5,000 cubic yards) of contaminated soil, encompasses this portion. However, given that there are very few boreholes or monitoring wells in the area for contamination characterization, the source of the existing contamination is not adequately understood. The contaminants of concern are volatile organic compounds, namely, trichloroethylene and tetrachloroethylene. Although the extent of contamination is not fully understood because of the lack of soil sampling to adequately characterize this portion, DOE assumed that no active soil vapor treatment system would be needed for this portion.

Soil Long-Term Stewardship Activities

Long-term stewardship activities include groundwater monitoring to determine if unsaturated soil contamination

Treatment Facility G Cleaned up Release Sites That Require Long-term Stewardship Activities

- Building 212 Area Acid Dip Station-SWMU 157
- Building 212 Area Drum Rack
- Building 212 Area Drum Rack
- Building 212 Area Drum Racks
- Building 212 Area Plating Shop
- Building 212 Area Sumps-SWMU 156
- Building 212 Area Transformer
- Building 321 Area Degreaser in Gravel Sump-SWMU 435
- Building 321 Area Dry Well
- Building 321 Area Ion Exchange Plant Overflow
- Building 321 Area Locations of PCE Drums
- Building 321 Area Locations of PCE Drums
- Building 321 Area Machine Shop Spills
- Building 321 Area Pain and Plating Area
- Building 321 Area Plating Shop Chemical Storage
- Building 321 Area Plating Shop Spills
- Building 321 Area Plating Shop Sump
- Building 321 Area Radiation
- Building 321 Area Storm Drain
- Building 321 Area Storm Drain-SWMU 463
- Building 321 Area Underground Tanks-SWMU 432-434
- Tank 239-D1U1
- Tank 231-R2U1
- Tank 241-R1U1
- Tank 321-I1U1
- Tank 321-I1U2
- Tank 321-I1U3
- Tank 322-R1U1

Release Sites Expected to Be Cleaned Up By 2006 and Expected to Require Long-Term Stewardship Activities

- Building 212 Area Acid Dip Station
- Building 212 Area Maintenance Machine Shop
- Building 212 Mercury Reclaimer
- Building 212 Area Storage Tanks
- Treatment Facility G Area

is adversely impacting groundwater quality to concentrations above MCLs. Long-term stewardship activities for Treatment Facility G soil also include: regulatory interactions and compliance, wellfield operation and maintenance, maintaining the data information system, and program management.

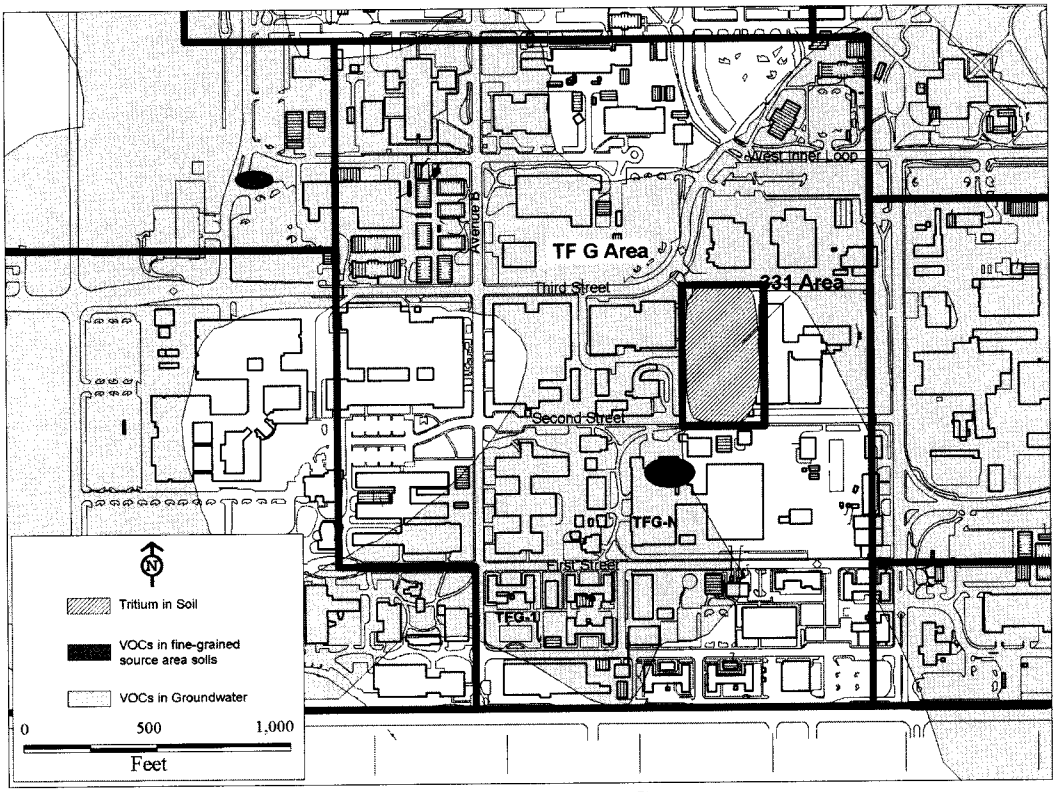
3.7.2 Groundwater

Approximately 31 hectares (77 acres), overlying 2.55 million cubic meters (3.34 million cubic yards) of contaminated groundwater, encompass this portion. The contaminants of concern are volatile organic compounds (VOCs), namely, trichloroethylene, tetrachloroethylene, chloroform, and to a lesser extent, 1,1-dichoroethylene and carbon tetrachloride. In addition, low concentrations (approximately nine parts per billion) of hexavalent chromium are in the groundwater. The contaminants of concern are found in hydrostratigraphic units HSU-1B and HSU-2. The groundwater remediation standards, described in the Record of Decision, are set to the lower of either the Federal or State of California's MCLs allowed in drinking water and DOE expects to reach these target levels by 2015. Through the end of 1999, DOE removed 1.8 kilograms (four pounds) of volatile organic compound mass from the groundwater in this portion.

DOE will continue to pump groundwater containing volatile organic compounds from the subsurface and treat it using air stripping and/or granular activated carbon. Two groundwater facilities (TFG-N and TFG-1) will continue to operate until cleanup standards are reached.

Groundwater Long-Term Stewardship Activities

Long-term stewardship activities will include: (1) facility operation and maintenance of treatment systems; (2) continued regulatory interactions and compliance; (3) groundwater monitoring and wellfield operating and maintenance; (4) three-dimensional modeling as a cost-effective means to estimate future volatile organic compounds concentrations and risk to human health and the environment, optimize remediation, evaluate the



Treatment Facility G

effectiveness of cleanup, and to relay the progress of cleanup to the stakeholders; (5) maintaining the data information system that is required to support planning, collecting, tracking, verifying, validating, reporting, interpreting, and using the data; and (6) program management.

3.7.3 Estimated Long-Term Stewardship Costs for Treatment Facility G

Costs applicable during stewardship for Treatment Facility G are those associated with treatment facility operation (including wellfield optimization and management) and maintenance, groundwater monitoring, and regulatory and community interaction. See Section 2.2, Assumptions and Uncertainties, for a complete listing of assumptions used in developing the cost estimate for this portion.

Long-Term Stewardship Costs (Constant Year 2000 Dollars)							
FY 2000 - FY 2010	***FY 2011 - FY 2020***	***FY 2021 - FY 2030***	***FY 2031 - FY 2040***	***FY 2041 - FY 2050***	***FY 2051 - FY 2060***	***FY 2061 - FY 2070***	***Estimated Total***
$640,000	$515,000	$0	$0	$0	$0	$0	$1,155,000

3.8 Treatment Facility 518

> ***TREATMENT FACILITY 518 HIGHLIGHTS***
>
> *Major Long-Term Stewardship Activities* - groundwater monitoring; pump and treat
> *Portion Size* - 15 hectares (37 acres)
> *Estimated Volume of Residual Contaminants* - soil 170,000 cubic meters (220,000 cubic yards); groundwater 370,000 cubic meters (480,000 cubic yards)
> *Long-Term Stewardship Start-End Years* - 1990-2022
> *Average Annual Long-Term StewardshipCosts FY 2000-2006* - n/a (costs begin in FY 2008)

The Building 518 area occupies 15 hectares (37 acres) in the southeast quadrant of the Livermore Site. The area consists of one vapor extraction system, two groundwater treatment facilities, and attendant wellfields. Treatment Facility 518 conducts environmental restoration activities to prevent further migration of groundwater contaminants; remediate contaminated groundwater to levels below the MCLs allowed in drinking water, as specified in the CERCLA Record of Decision; and clean up the contaminant source areas. Specific remediation activities include the operation and maintenance of the vapor and groundwater extraction and treatment systems; compliance sampling and documentation for the treatment facilities; monitoring of wellfield sampling, analysis, and data evaluation; and performing passive soil vapor extraction in the Building 518 area. Sources of contamination include accidental spills at a solvent storage area adjacent to Building 518 that have led to releases of volatile organic compounds and other contaminants.

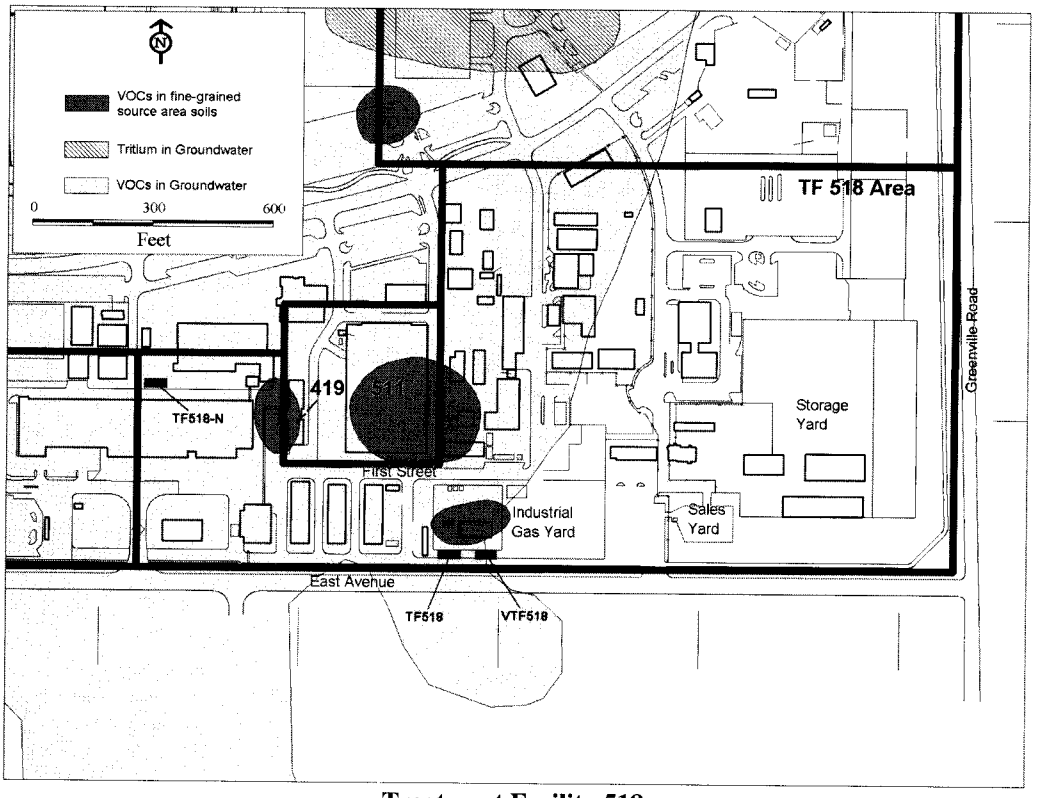
3.8.1 Soil

Approximately 0.52 hectare (1.3 acres), overlying 170,000 cubic meters (220,000 cubic yards) of contaminated soil, encompass this portion. Sources of soil contamination originated mainly from accidental spills that occurred in a solvent storage area adjacent to Building 518, including leaks from 0.02 cubic meter carboys, an evaporation pit, and tanks and releases from drums and an old salvage yard. The contaminants found in the soil include volatile organic compounds, such as trichloroethylene, 1,1-dichloroethylene, tetrachloroethylene, and minimal concentrations of Freon compounds, carbon tetrachloride, and methylene chloride in HSU-1. HSU-1 is an 18- to 21-meter (60- to 70-foot) thick interval of interbedded silt, gravel, sand and clay.

> ***Treatment Facility 518 Cleaned up Release Sites That Require Long-Term Stewardship Activities***
>
> - Building 514 Area 5-Gallon Glass Carboys
> - Building 514 Area Drum Rack
> - Building 514 Area Evaporation Pit-SWMU 725-728
> - Building 514 Area Solvent and Oil Spills
> - Building 514 Area TCE and Diesel Spills
> - Building 514 Area Treatment Tanks-SWMU 708-713
> - Building 514 Area Drum Rack
> - Building 518 Area Drum Rack Spills
> - Building 518 Area Solvent Spill
> - Building 612 Area Acid Spill
> - Building 612 Area Miscellaneous Transport Equipment -SWMU 754
> - Tank 514-R3U1
>
> ***Release Sites Expected to Be Cleaned Up By 2006 and Expected to Require Long-Term Stewardship Activities***
>
> - Building 612 Area Remaining Surface Area/SWMU 753
> - Building 612 Area Waste Evaporation Area
> - New Salvage Yard
> - Old Salvage Yard

Soil Long-Term Stewardship Activities

Long-term stewardship activities include groundwater monitoring to determine if unsaturated soil contamination is adversely impacting groundwater quality to concentrations above MCLs. DOE will continue to operate a soil vapor treatment system until modeling indicates that there is no longer a threat to groundwater. Through 1999, DOE has removed about 147 kilograms (324 pounds) of volatile organic compounds from the soil vapor. As a result of further investigations, DOE discovered high volatile organic compound concentrations in the vadose zone, which may require additional soil vapor treatment.



Treatment Facility 518

3.8.2 Groundwater

Approximately 6.1 hectares (15 acres), overlying 370,000 cubic meters (480,000 cubic yards) of contaminated groundwater, encompass this portion. There are distinct sources of groundwater contamination in this area from Buildings 511, 514, 518, and 612 that include leaks from 0.2 cubic meter carboys, an evaporation pit, tanks and releases from drums. Accidental spills at the solvent storage area adjacent to Building 518 resulted in the release of volatile organic compounds, primarily trichloroethylene, 1,1-dichloroethylene, and tetrachloroethylene, and lower concentrations of Freon compounds, carbon tetrachloride, and methylene chloride. These contaminants are found mainly in the first water-bearing zone (HSU-5). The groundwater remediation standards, described in the CERCLA Record of Decision, are set to the lower of either the Federal or State of California's MCLs allowed in drinking water. DOE expects to achieve these target levels by 2020.

DOE will continue to pump groundwater containing volatile organic compounds from the subsurface and treat it using air stripping and/or granular activated carbon. DOE will operate two groundwater facilities (TF518 and TF518-N) until cleanup standards are reached.

Groundwater Long-Term Stewardship Activities

Long-term stewardship activities will include: (1) facility operation and maintenance of treatment systems; (2) continued regulatory interactions and compliance; (3) groundwater monitoring and wellfield operation and maintenance; (4) three-dimensional modeling as a cost-effective means to estimate future volatile organic compounds concentrations and risk to human health and the environment, optimize remediation, evaluate the effectiveness of cleanup, and to relay the progress of cleanup to the stakeholders; (5) maintaining the data

information system that is required to support planning, collecting, tracking, verifying, validating, reporting, interpreting, and using the data; and (6) program management.

3.8.3 Estimated Long-Term Stewardship Costs for Treatment Facility 518

Costs applicable during stewardship for Treatment Facility 518 are those associated with treatment facility operation (including wellfield optimization and management) and maintenance, groundwater monitoring, and regulatory and community interaction. See Section 2.2, Assumptions and Uncertainties, for a complete listing of assumptions used in developing the cost estimate for this portion.

Long-Term Stewardship Costs (Constant Year 2000 Dollars)							
FY 2000 - FY 2010	***FY 2011 - FY 2020***	***FY 2021 - FY 2030***	***FY 2031 - FY 2040***	***FY 2041 - FY 2050***	***FY 2051 - FY 2060***	***FY 2061 - FY 2070***	***Estimated Total***
$514,000	$709,000	$868,000	$0	$0	$0	$0	$2,091,000

3.9 Treatment Facility 5475

The Treatment Facility 5475 area includes environmental restoration activities in the central-eastern portion of the Livermore Site. The area is adjacent to the Treatment Facility E area to the west, the Treatment Facility D area to the north, and Treatment Facility 518 to the south.

The contaminants of concern include chlorinated volatile organic compounds, specifically trichloroethylene, chloroform, tetrachloroethylene, 1,1-dichloroethylene, 1,2-dichloroethane, and carbon tetrachloride. In addition, tritium has been detected in the soil and groundwater. Former waste disposal pits and evaporation ponds located in the area are the major sources of contamination in this portion. These former waste disposal pits are responsible for the highest measured concentrations of volatile organic compounds in groundwater at the Livermore Site, with total volatile organic compound concentrations exceeding 30,000 parts per billion in some areas. Other sources of contamination in this area include unlined drainage ditches and a liquid waste storage area.

The Treatment Facility 5475 area is the only portion in the Livermore Site that has both tritium and volatile organic compounds contamination. Furthermore, this portion represents a significant source of ongoing roundwater contamination; thus, as part of the Engineered Plume Collapse strategy, this area qualifies as a key target area for source area cleanup and containment. However, the presence of tritium as a

TREATMENT FACILITY 5475 HIGHLIGHTS

Major Long-Term Stewardship Activities - groundwater monitoring
Portion Size - 12 hectares (30 acres)
Estimated Volume of Residual Contaminants - soil 99,000 cubic meters (130,000 cubic yards); groundwater 370,000 cubic meters (480,000 cubic yards)
Long-Term Stewardship Start-End Years - 1993-2072
Average Annual Long-Term Stewardship Costs FY 2000-2006 - n/a (costs begin FY 2008)

Treatment Facility 5475 Cleaned up Release Sites That Require Long-Term Stewardship Activities

- East Taxi Strip Area Disposal Pits
- East Taxi Strip Area Evaporation Pond

Release Sites Expected to Be Cleaned Up By 2006 and Expected to Require Long-Term Stewardship Activities

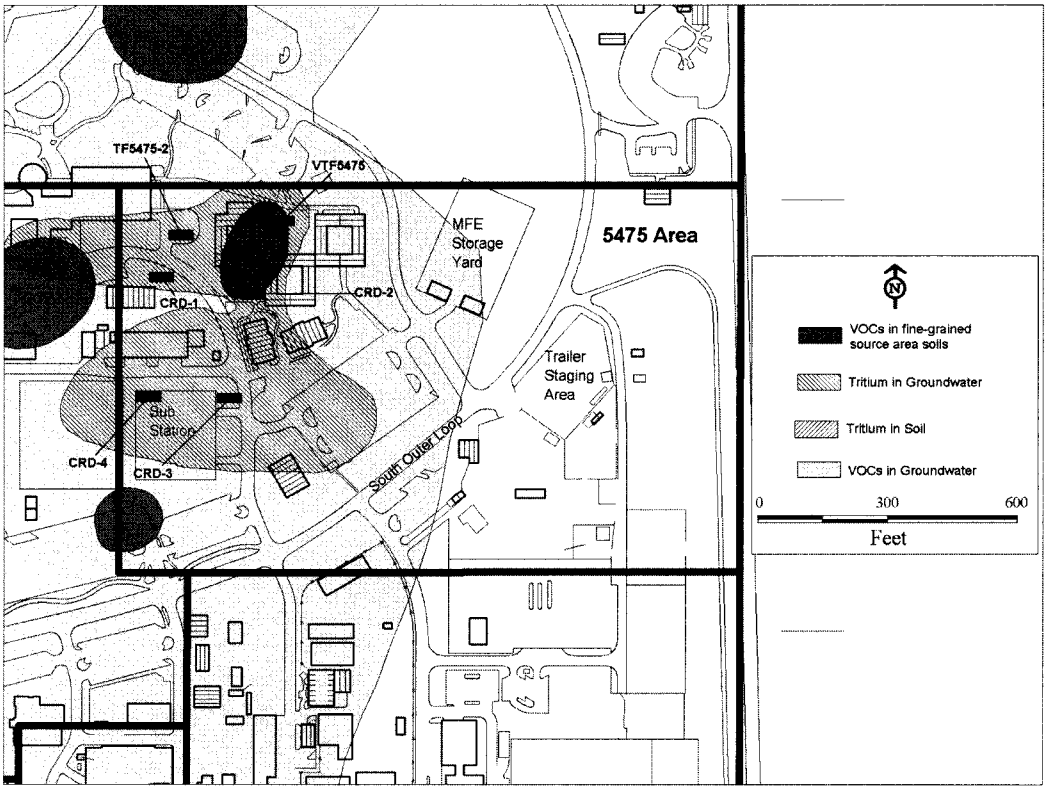
- Unlined Drainage Ditch 4B
- Unlined Drainage Ditch 4C
- East Taxi Strip Area Disposal Pits
- East Taxi Strip Area Disposal Pits
- East Taxi Strip Area Disposal Pits
- East Taxi Strip Area Liquid Waste Storage Area
- East Taxi Strip Area Radioactive Concrete Blocks
- East Taxi Strip Area TCE Spills
- East Taxi Area Trailer 5475

local co-contaminant poses an obstacle to the deployment of conventional groundwater treatment units in this area because the Record of Decision states that tritium must be kept in the subsurface as much as possible, where it will decay naturally. This precludes use of typical pump-and-treat methods.

3.9.1 Soil

Approximately 0.32 hectare (0.8 acre), overlying 99,000 cubic meters (130,000 cubic yards) of contaminated soil, containing both volatile organic compounds and tritium, encompasses this portion. Significant soil vapor concentrations of volatile organic compounds have been measured in the vadose zone soil vapor surrounding the former waste pits, with concentrations of total volatile organic compounds that exceed 700 parts per million by volume.

In 1982 and 1983, DOE excavated four disposal pits containing contaminated debris and approximately 2,300 cubic meters (3,000 cubic yards) of soil containing volatile organic compounds and radionuclides from the East Taxi Strip area for offsite disposal. This action removed a portion of the original source of contamination in the Treatment Facility 5475 area; however, contamination that remains in the vadose zone soil is a possible source of groundwater contamination. Therefore, to reduce the concentrations of volatile organic compounds in the vadose zone, a soil vapor extraction system has been deployed, along with an extraction well adjacent to the former waste pit location. A vapor extraction and treatment system is treating vapors containing both volatile organic compounds and tritium; this facility removes the volatile organic compounds and returns the tritium vapor to the subsurface to naturally self-remediate through radioactive decay. Through 1999, DOE has removed about 95 kilograms (210 pounds) of volatile organic compounds from the soil vapor.



Treatment Facility 5475

Soil Long-Term Stewardship Activities

Long-term stewardship activities include groundwater monitoring to determine if unsaturated soil contamination is adversely impacting groundwater quality by raising concentrations above MCLs. Operation of the soil vapor treatment system will continue until groundwater cleanup goals are achieved.

3.9.2 Groundwater

Approximately 4.5 hectares (11 acres), overlying 370,000 cubic meters (480,000 cubic yards) of contaminated groundwater, encompass this portion. The groundwater contaminants in the Treatment Facility 5475 area include chlorinated volatile organic compounds, specifically trichloroethylene, tetrachloroethylene, 1,1-dichloroethylene, chloroform, 1,2-dichloroethane, and carbon tetrachloride. In addition, tritium levels above the drinking water standards (i.e., levels greater than 20,000 picocuries per liter) have been detected in some groundwater wells in the Treatment Facility 5475 area.

The presence of tritium as a local co-contaminant poses an obstacle to the use of conventional portable treatment units in pump-and-treat groundwater remediation. Therefore, an in-situ technology is being used to destroy volatile organic compounds in the well bores via catalytic reductive dehalogenation. DOE will deploy four catalytic reductive dehalogenation units in the Treatment Facility 5475 area.

The volatile organic compound-contaminated groundwater plumes exist mainly in hydrostratigraphic units HSU-2, HSU-3A, and HSU-3B, but significant concentrations of tritium are limited to hydrostratigraphic units HSU-3A and HSU-3B. DOE also has recently discovered volatile organic compounds and tritium in HSU-5. Groundwater treatment in hydrostratigraphic unit HSU-2, where tritium contamination is not an issue, is being conducted using a modified solar-powered treatment unit. The presence of contaminants in the vadose zone soil is a possible source of groundwater contamination. Therefore, to reduce the concentrations of volatile organic compounds in the vadose zone soil, a soil vapor extraction system has been deployed, along with an extraction well adjacent to a former waste pit location. The groundwater remediation standards, described in the Record of Decision, are set to the lower of either the Federal or the State of California's MCLs allowed in drinking water and DOE expects to achieve these target levels by 2070 in this portion.

DOE will continue treating groundwater containing volatile organic compounds using granular activated carbon or catalytic reductive dehalogenation. DOE will operate these facilities until cleanup standards are reached. Through 1999, DOE has removed over two kilograms (4.4 pounds) of volatile organic compounds from groundwater in the Treatment Facility 5475 area.

Groundwater Long-Term Stewardship Activities

Long-term stewardship activities will include: (1) facility operation and maintenance of treatment systems; (2) continued regulatory interactions and compliance; (3) groundwater monitoring and wellfield operating and maintenance; (4) three-dimensional modeling as a cost-effective means to estimate future volatile organic compounds concentrations and risk to human health and the environment, optimize remediation, evaluate the effectiveness of cleanup, and to relay the progress of cleanup to the stakeholders; (5) maintaining the data information system that is required to support planning, collecting, tracking, verifying, validating, reporting, interpreting, and using the data; and (6) program management.

3.9.3 Estimated Long-Term Stewardship Costs for Treatment Facility 5475

Costs applicable during stewardship for the Treatment Facility 5475 area are those associated with treatment facility operation (including wellfield optimization and management) and maintenance, groundwater monitoring,

and regulatory and community interaction. See Section 2.2, Assumptions and Uncertainties, for a complete listing of assumptions used in developing the cost estimate for this portion.

Long-Term Stewardship Costs (Constant Year 2000 Dollars)							
FY 2000 - FY 2010	*FY 2011 - FY 2020*	*FY 2021 - FY 2030*	*FY 2031 - FY 2040*	*FY 2041 - FY 2050*	*FY 2051 - FY 2060*	*FY 2061 - FY 2070*	*Estimated Total*
$2,695,000	$5,211,000	$2,170,000	$903,000	$361,000	$145,000	$59,000	$9,669,000

3.10 Building 331 Area

Building 331 Area is located in the south central portion of the Livermore Site. This 1.6-hectare (four-acre) area includes environmental restoration activities, primarily groundwater monitoring and sampling around Building 331. Building 331, also referred to as the Tritium Facility, had once provided primary support to the laboratory's weapons program. The main effluent release from this building is the gaseous release of tritium through 30-meter-high (98-foot-high) stacks. A waste accumulation area at Building 331, which primarily stored radioactive waste and consists of about 12 to 10 meters (40 by 30 feet) of asphalt, started operation in 1959.

BUILDING 331 AREA HIGHLIGHTS

Major Long-Term Stewardship Activities - groundwater monitoring
Portion Size - 1.6 hectare (4 acres)
Estimated Volume of Residual Contaminants - soil 280,000 cubic meters (370,000 cubic yards); groundwater 76,000 cubic meters (99,000 cubic yards)
Long-Term Stewardship Start-End Years - 1998-2070
Average Annual Long-Term Stewardship Costs FY 2000-2006 - n/a (costs begin in FY 2008)

Building 331 Area Cleaned up Release Sites That Require Long-Term Stewardship Activities

- Building 331

3.10.1 Soil

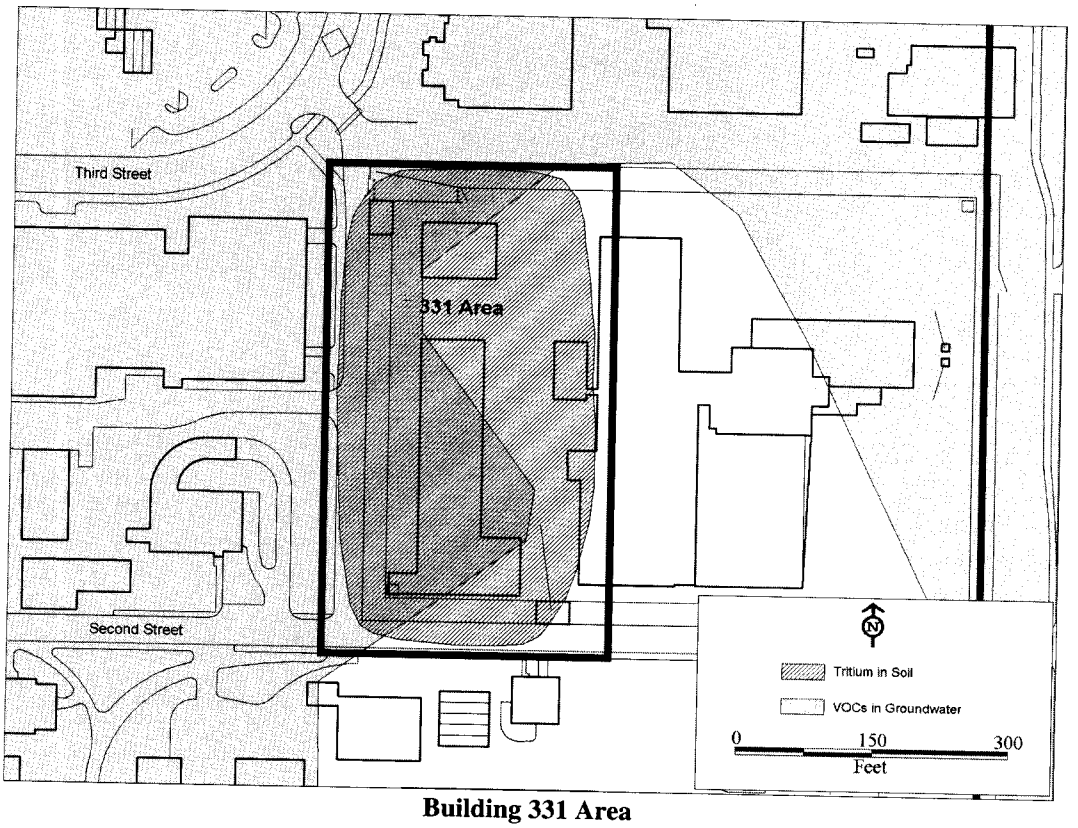
Approximately 1.2 hectares (three acres), overlying 280,000 cubic meters (370,000 cubic yards) of contaminated soil, encompass this portion. The soils consist of interbedded sand, silt, clay and gravel. The source of the existing contamination is not well understood because there are very few boreholes and soil samples in the area for adequate characterization of the onsite contamination.

DOE has collected soil samples up to a depth of 32 meters (105 feet) at three-meter (10-foot) intervals and analyzed the samples for the presence of volatile organic compounds. Soil samples taken at 27 meters (90 feet) and 32 meters (105 feet) below the soil surface were saturated. In soil samples taken between 15 meters (50 feet) and 24 meters (80 feet) below the soil surface, tetrachloroethylene concentrations ranged from 1.5 to 3.6 parts per billion. Trichloroethylene was detected at 10 meters (30 feet) below the surface at 0.54 part per billion and between 18-27 meters (60-90 feet) below the soil surface at concentrations ranging from 0.72 part per billion to 3.7 parts per billion. All soil samples had metal concentrations below hazardous material limits.

Radiological soil sample analysis showed tritium to be present at 1.5 meters (five feet) and 15 meters (50 feet) below the soil surface at concentrations ranging from 3,020 picocuries per liter to 148,000 picocuries per liter. Between 27 meters (90 feet) and 32 meters (105 feet) (i.e., the saturated soil area), radiological contaminants were measured at concentrations ranging from 380 to 870 picocuries per liter.

Soil Long-Term Stewardship Activities

Long-term stewardship activities include groundwater monitoring to determine if unsaturated soil contamination is adversely impacting groundwater quality to concentrations above MCLs. No active soil vapor treatment



Building 331 Area

system will be required in this area. Long-term stewardship activities also include: regulatory interactions and compliance, wellfield operation and maintenance, maintaining the data information system, and program management.

3.10.2 Groundwater

Approximately 0.8 hectares (two acres), overlying 76,000 cubic meters (99,000 cubic yards) of contaminated groundwater, encompass this portion. A source investigation borehole was drilled in 1995 and later converted to a hydrostratigraphic unit HSU-2 piezometer. Bailed water from this piezometer contained low concentrations of tetrachloroethylene, trichloroethlyene, and chloroform. Groundwater samples detected metals and radioactivity at concentration levels below State and Federal MCLs.

Hydrostratigraphic unit HSU-1B is contaminated primarily with trichloroethlyene at 19 micrograms per liter, tetrachloroethylene at 23 micrograms per liter, and chloroform at 74 micrograms per liter. Tritium concentrations have been detected below 1,000 picocuries per liter. Tritium concentrations of 3,000 picocuries per liter were detected in the groundwater in hydrostratigraphic unit HSU-3B.

Groundwater monitoring ensures that there are no substantive changes in contaminant concentrations and tracks any groundwater plume migration. Ongoing monitoring activities at the Building 331 Area include wellfield data evaluation to comply with permit monitoring program requirements and the monthly assessment of monitoring-well water levels from four monitoring wells. The monitoring data collected at the Building 331 Area are analyzed to determine if volatile organic compounds, tritium, and other contaminant concentrations in the groundwater are increasing and if the contaminants are migrating toward the western boundary of the Lawrence

Livermore National Laboratory site.

Groundwater Long-Term Stewardship Activities

Groundwater containing volatile organic compounds and tritium will continue to be monitored until cleanup standards are reached. DOE assumes no active groundwater treatment system will be required in this area. Long-term stewardship activities will include: (1) continued regulatory interactions and compliance; (2) groundwater monitoring and wellfield operating and maintenance; (3) maintaining the data information system that is required to support planning, collecting, tracking, verifying, validating, reporting, interpreting, and using the data; and (4) program management.

3.10.3 Estimated Long-Term Stewardship Costs for Building 331 Area

Costs applicable during stewardship for Building 331 are those associated with groundwater monitoring and regulatory and community interaction. Furthermore, the costs for groundwater monitoring are the same as those that were estimated for the FY 2000 Revised (February 29, 2000) Work Plan. The estimates of the costs of long-term stewardship were also based on the assumption that environmental regulations will not become more stringent and that no additional contamination sources will be found in the future. The end state for this portion is based upon the following assumptions: (1) cleanup funding is adequate and stable to support life cycle work scope and schedule for remediation activities, (2) costs to seal and abandon wells and piezometers have not been included, (3) the only costs applicable during long-term stewardship are those associated with groundwater monitoring, and regulatory and community interactions, and (4) no additional contamination sources or other contaminated areas that are difficult to remediate are found.

Long-Term Stewardship Costs (Constant Year 2000 Dollars)							
FY 2000 - FY 2010	*FY 2011 - FY 2020*	*FY 2021 - FY 2030*	*FY 2031 - FY 2040*	*FY 2041 - FY 2050*	*FY 2051 - FY 2060*	*FY 2061 - FY 2070*	*Estimated. Total*
$3,000	$6,000	$4,000	$0	$0	$0	$0	$13,000

3.11 Building 419/511

This 1.2-hectare (three-acre) area includes environmental restoration activities, primarily groundwater monitoring and sampling around Building 419, which is located in the southeastern quadrant of the Livermore Site, east of the Treatment Facility 518 area. Work in this area also includes source area remediation activities being conducted in the Building 511 area.

BUILDING 419/511 HIGHLIGHTS

Major Long-Term Stewardship Activities - groundwater monitoring
Portion Size - 1.2 hectares (3 acres)
Estimated Volume of Residual Contaminants - soil 34,000 cubic meters (44,000 cubic yards); groundwater 87,000 cubic meters (114,000 cubic yards)
Long-Term StewardshipStart-End Years - 2006-2063
Average Annual Long-Term Stewardship Costs FY 2000-2006 - n/a (costs begin in FY 2008)

During the years that the U.S. Navy operated at this location, the area around Building 419 was used for aircraft assembly, overhaul, and maintenance. During this time, solvents, including trichloroethylene and carbon t etrachloride, were probably poured out onto the ground to be washed off into the storm drains during rainstorms. Later, the 730-square meter (7,860-square foot) building was used as a paint and varnish shop by

the Navy. Through 1975, Building 419 was used as an assay lab and then as a decontamination and reduction facility by the Lawrence Livermore National Laboratory Hazardous Waste Management Division.

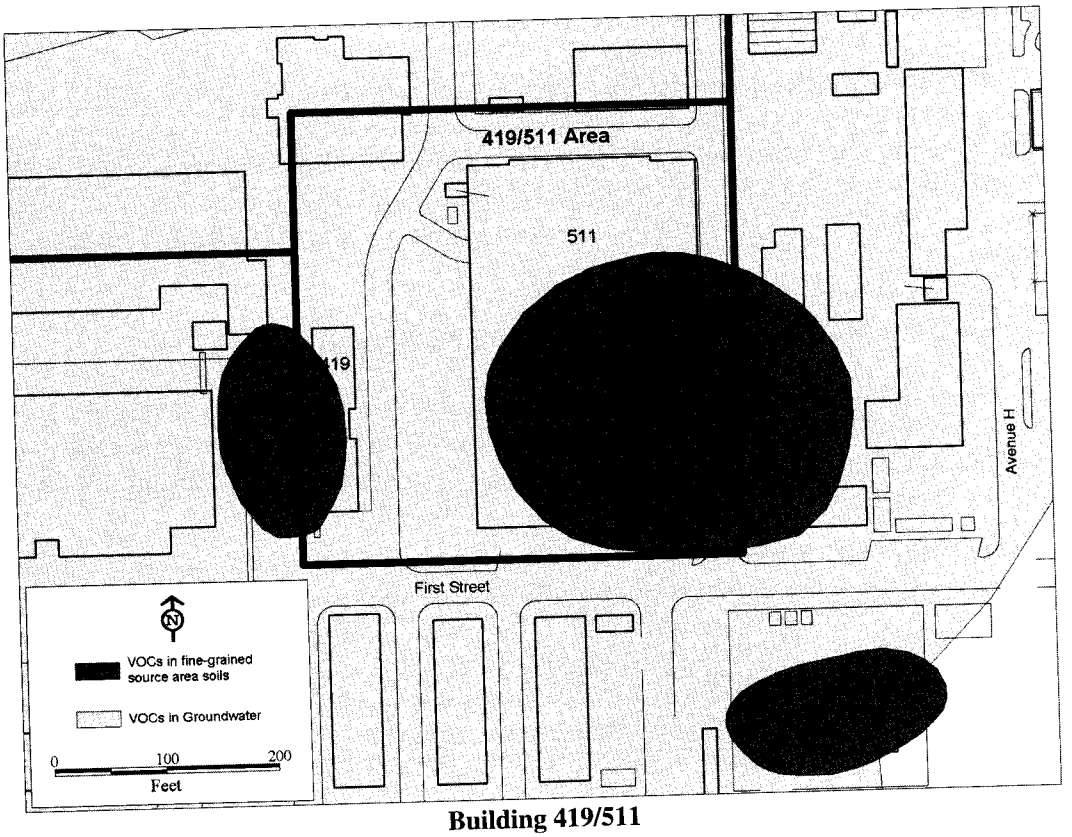
DOE has completed partial closure of Building 419 pursuant to the requirements of the Resource Conservation and Recovery Act and California Hazardous Waste Control Law. DOE has held discussions with the California Department of Toxic Substances Control about the future of this building, which has been added to the Laboratory's list of excess facilities. DOE will complete any additional characterization and cleanup of soil and groundwater pursuant to CERCLA.

Release Sites Expected to Be Cleaned Up By 2006 and Expected to Require Long-Term Stewardship Activities

- Building 419
- Building 511

3.11.1 Soil

Approximately 0.08 hectare (0.2 acre), overlying 34,000 cubic meters (44,000 cubic yards) of contaminated soil, encompasses this portion. Sediment samples in the upper 10 meters (30 feet) of the soil indicated the presence of tritium and volatile organic compounds, primarily trichloroethylene, tetrachloroethylene, carbon tetrachloride and 1,2-dichloroethane. Soil samples collected in 1996 revealed mercury concentrations beyond the California Hazardous Waste Total Threshold Limit Concentration. No other metals exceeded these limits, although tritium radioactivity in one soil sample exceeded the criteria limit of 45,000 picocuries per gram. As an additional remediation measure, DOE removed two underground mixed waste storage tanks in 1986 and two additional ones in 1995.



Building 419/511

Soil Long-Term Stewardship Activities

There are very few boreholes and soil samples from this area for adequate characterization. DOE installed 40 passive soil vapor detectors to help identify areas of high volatile organic compounds. DOE will remediate the Building 419/511 hotspots by deploying electro-osmosis to remove volatile organic compounds from the fine-grained sediments.

3.11.2 Groundwater

Approximately 1.2 hectares (three acres), overlying 87,000 cubic meters (114,000 cubic yards) of contaminated groundwater, encompass this portion. The contaminants of concern are found in hydrostratigraphic units HSU-3A, HSU-3B and HSU-5. Hydrostratigraphic unit HSU-3A is the first saturated unit underlying Building 419. Wells adjacent to Building 419 contain volatile organic compound concentrations up to 3 parts per million in HSU-3A. These wells do not contain levels of tritium or metals above MCLs in this area. Building 419 area is considered an important source of the trichloroethylene contamination that is being remediated by the Treatment Facility 518 and 406 areas, northwest and southwest of the building, respectively. The groundwater remediation standards, described in the CERCLA Record of Decision, are set to the lesser of either the Federal or the State of California's MCLs allowed in drinking water and DOE expects to reach these target levels by 2061 in this portion.

DOE is conducting groundwater monitoring to ensure that there are no substantive changes in the environmental concentrations of volatile organic compounds, tritium, and mercury and to track any groundwater plume migration.

Groundwater Long-Term Stewardship Activities

DOE will continue to monitor groundwater containing volatile organic compounds and tritium until cleanup standards are reached. An electro-osmosis facility will continue operation until cleanup goals are met. This will require that a groundwater treatment system operate in this area. Long-term stewardship activities include: (1) facility operation and maintenance, (2) regulatory interactions and compliance, (3) wellfield operation and maintenance, (4) remediation optimization, (5) maintaining the data information system, and (6) program management.

3.11.3 Estimated Long-Term Stewardship Costs for Building 419/511

Costs applicable during stewardship for Treatment Facility 419/511 are those associated with treatment facility operation (including wellfield optimization and management) and maintenance, groundwater monitoring, and regulatory and community interaction. See Section 2.2, Assumptions and Uncertainties, for a complete listing of assumptions used in developing the cost estimate for this portion.

Long-Term Stewardship Costs (Constant Year 2000 Dollars)							
FY 2000 - FY 2010	***FY 2011 - FY 2020***	***FY 2021 - FY 2030***	***FY 2031 - FY 2040***	***FY 2041 - FY 2050***	***FY 2051 - FY 2060***	***FY 2061 - FY 2070***	***Estimated Total***
$2,087,000	$4,960,000	$2,065,000	$859,000	$358,000	$149,000	$4,000	$10,482,000

3.12 Building 292 Area

This 1.2-hectare (three-acre) area includes environmental restoration activities in the vicinity of Building 292, which is located in the northwest side of the Livermore Site near the West Traffic Circle. The area is surrounded by the Treatment Facility C area. During 1977-1987, Building 292 housed a rotating target neutron source that was used for energy research. The waste water from these experiments was collected in a 3.8-cubic meter (five cubic-yard) underground waste water storage tank. In 1990, a leak from the underground storage tank released tritium into the environment. Tritium and volatile organic compounds are the only contaminants present in this portion.

BUILDING 292 AREA HIGHLIGHTS

Major Long-Term Stewardship Activities - groundwater monitoring
Portion Size - 1.2 hectares (3 acres)
Estimated Volume of Residual Contaminants - soil 7,000 cubic meters (9,000 cubic yards); groundwater 110,000 cubic meters (140,000 cubic yards)
Long-Term Stewardship Start-End Years - 1998-2070
Average Annual Long-Term Stewardship Costs FY 2000-2006 - n/a (costs begin FY 2008)

Nineteen boreholes for sampling of the Building 292 area had been drilled by October 1992. The data from these boreholes indicated that the tritium was concentrated beneath the suspected leak site of the tank. Tritiated water migrated in diminishing concentrations from the tank to the groundwater, and laterally in the vadose zone soil. Currently, the concentration of tritium in the groundwater is below the MCLs allowed in drinking water. The tritium concentrations in the vadose zone soil range from as high as 220 million picocuries per liter in the soil moisture directly beneath the tank to non-detectable levels within 10 meters (30 feet) horizontally of the tank.

Building 292 Area Cleaned Up Release Sites That Require Long-Term Stewardship Activities

- Building 292
- Tank 292-R1U1

3.12.1 Soil

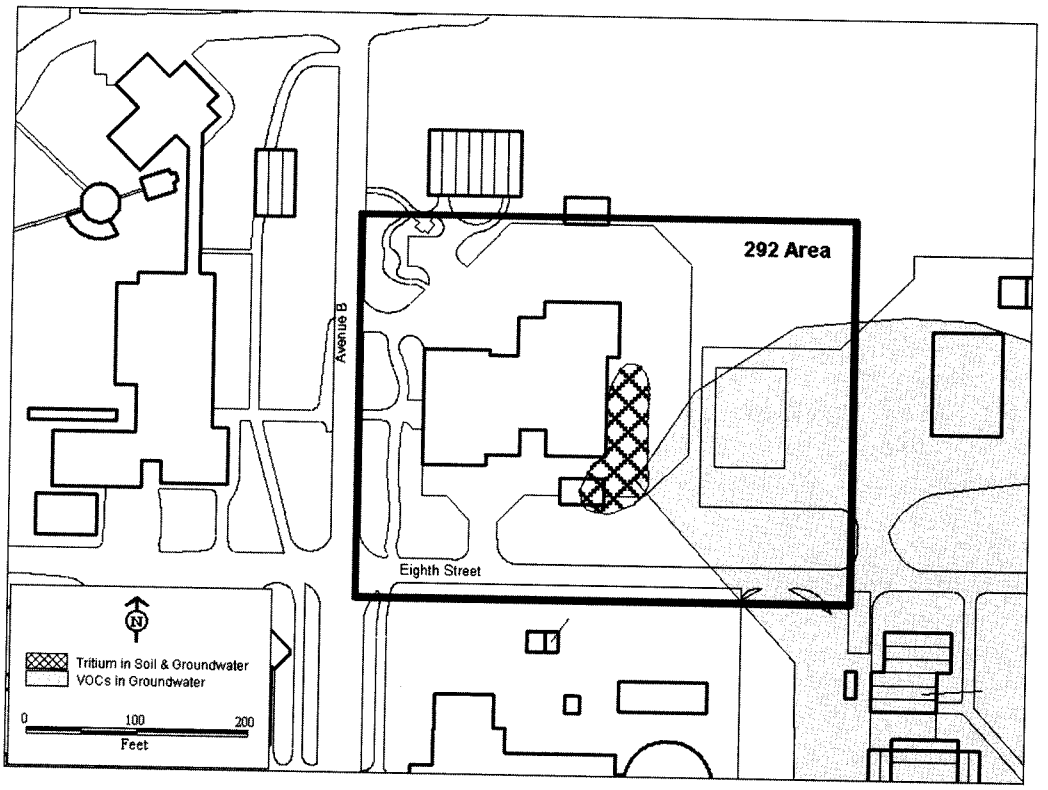
Approximately 0.04 hectare (0.1 acre), overlying 7,000 cubic meters (9,000 cubic yards) of contaminated soil, encompasses this portion. DOE sealed and grouted in place the tank causing the tritium contamination. The CERCLA Record of Decision for cleanup of the Lawrence Livermore National Laboratory Site indicates that the tritium is effectively self-remediating via natural decay, and the potential dose from the measured tritium in soil would not exceed 0.01 percent of the 10-millirem per year Federal dose standard.

Soil Long-Term Stewardship Activities

Long-term stewardship activities include groundwater monitoring to determine if unsaturated soil contamination continues to further degrade groundwater quality to concentrations above MCLs. The tritium is anticipated to self-remediate via natural decay. Long-term stewardship activities for Building 292 soil also includes: regulatory interactions and compliance, wellfield operation and maintenance, maintaining the data information system, and program management.

3.12.2 Groundwater

Approximately 1.2 hectares (three acres), overlying 110,000 cubic meters (140,000 cubic yards) of contaminated groundwater, encompass this portion. The primary contaminant of concern in the Building 292 area is tritium in hydrostratigraphic unit HSU-1B. DOE has not detected significant tritium contamination down-gradient of the Building 292 area. Low levels of trichloroethylene, chloroform, Freon-11, and Freon-113 also have been detected in the Building 292 area.



Building 292 Area

The CERCLA Record of Decision for cleanup of the Lawrence Livermore National Laboratory Site indicates that the tritium is effectively self-remediating via natural decay, and the potential dose from the measured tritium in soil would not exceed 0.01 percent of the 10-millirem per year Federal dose standard. No pathway to humans exists for the observed tritium in the groundwater. Since the underground tank was closed, groundwater tritium concentrations have decreased and, at times, fluctuate below MCLs. As determined in the Record of Decision, no groundwater treatment is required in this location. The groundwater in the surrounding area will continue to be monitored for tritium to track its distribution and concentration over the duration of the site cleanup.

Groundwater Long-Term Stewardship Activities

Long-term stewardship activities include groundwater monitoring to determine if unsaturated soil contamination continues to further degrade groundwater quality to concentrations above MCLs. DOE anticipates that the tritium will self-remediate via natural decay. Long-term stewardship activities also include: regulatory interactions and compliance, wellfield maintenance, maintaining the data information system, and program management.

3.12.3 Estimated Long-Term Stewardship Costs for Building 292 Area

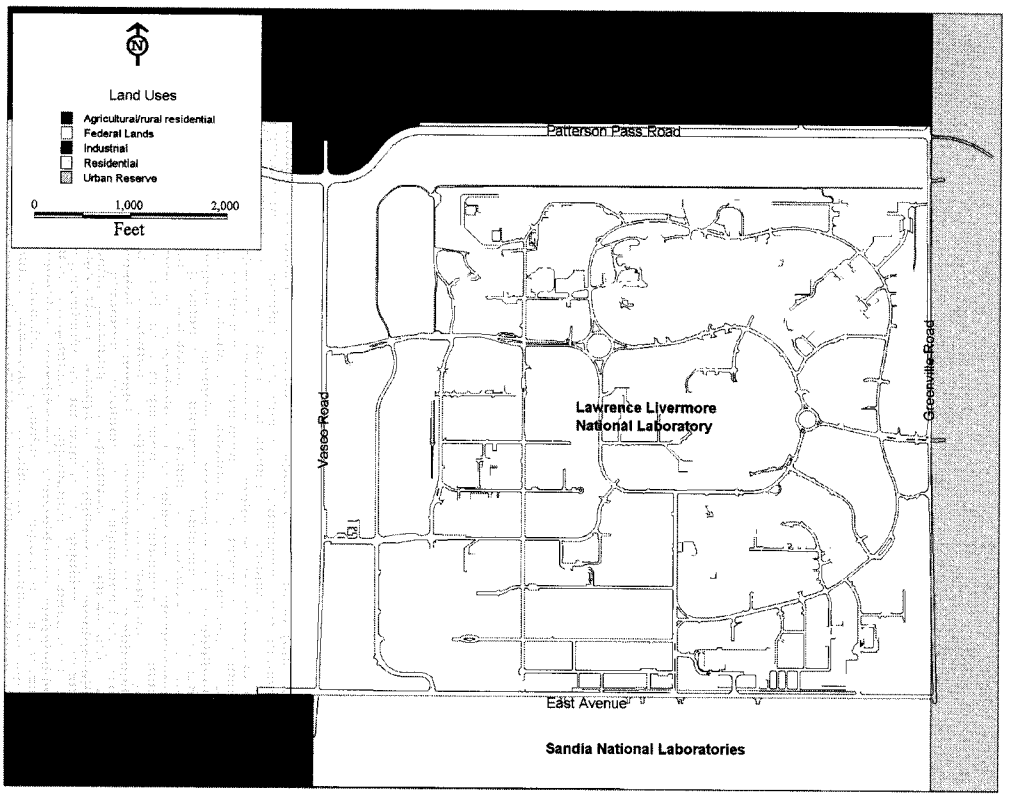
Costs applicable during stewardship for Building 292 are those associated with continued monitoring. This assumption excludes the drilling of monitoring and extraction wells, the construction of new treatment facilities, and the decontamination and decommissioning of treatment facilities and wells. Furthermore, the costs for groundwater monitoring are the same as those that were estimated for the FY 2000 Revised (February 29, 2000) Work Plan submittal. Long-term stewardship cost estimates were also based on the assumption that

environmental regulations will not become more stringent and that no additional contamination sources will be found in the future. The end state for this portion is based upon the following assumptions: (1) cleanup funding is adequate and stable to support life cycle work scope and schedule for remediation activities; (2) costs to seal and abandon wells and piezometers have not been included; (3) the only costs applicable during long-term stewardship are those associated with groundwater monitoring and regulatory and community interactions; and (4) no additional contamination sources or other recalcitrant areas are found.

Long-Term Stewardship Costs (Constant Year 2000 Dollars)							
FY 2000 - FY 2010	***FY 2011 - FY 2020***	***FY 2021 - FY 2030***	***FY 2031 - FY 2040***	***FY 2041 - FY 2050***	***FY 2051 - FY 2060***	***FY 2061 - FY 2070***	***Estimated Total***
$3,000	$6,000	$4,000	$0	$0	$0	$0	$13,000

4.0 FUTURE USES

DOE expects that the Lawrence Livermore National Laboratory- Livermore Site will continue to be operational in support of nuclear weapons stockpile stewardship and scientific research projects. In addition, DOE will perform CERCLA compliance and cleanup implementation specified in the Federal Facility Agreement and Record of Decision. DOE is also committed to its responsibility for environmental cleanup independent of any possible future decisions regarding the continued use of the Livermore Site. For the foreseeable future, Lawrence Livermore National Laboratory will remain, in some capacity, a controlled access research and development facility.



Land Use

For additional information about the Lawrence Livermore National Laboratory - Livermore Site, please contact:

Hannibal Joma, Deputy Division Director
Livermore Environmental Programs Division
U.S. Department of Energy, Oakland Operations Office
1301 Clay Street 700N
Oakland, CA 94612-5208
Phone: 925-422-0830
or visit the Internet website at http://www.doe.gov

LAWRENCE LIVERMORE NATIONAL LABORATORY - SITE 300

1.0 SITE SUMMARY

1.1 Site Description and Mission

The Lawrence Livermore National Laboratory–Site 300 is an experimental testing facility that has supported the U.S. Department of Energy (DOE) and its predecessor agencies in various defense and non-defense missions. The Lawrence Livermore National Laboratory is composed of two non-contiguous sites, the Lawrence Livermore National Laboratory–Main Site and the Lawrence Livermore National Laboratory–Site 300. The Main Site is located approximately 80 kilometers (50 miles) east of San Francisco, and Site 300 is approximately 27 kilometers (17 miles) southeast of the Main Site. (Site 300 is the subject of this site summary -- the Main Site is covered in a separate site summary.)

LONG-TERM STEWARDSHIP HIGHLIGHTS

Major Long-Term Stewardship Activities - treatment facility operation and maintenance; groundwater monitoring; exposure control through risk and hazard management; long-term surveillance and maintenance of landfills; remediation optimization
Total Site Area - 2,860 hectares (7,067 acres)
**Estimated Volume of Residual Contaminants* - groundwater 4.66 million cubic meters (6.07 million cubic yards); soil 568,318 cubic meters (743,332 cubic yards); engineered units 1,453 cubic meters (1,900 cubic yards); surface water/sediment 1.4 cubic meters (1.85 cubic yards)
Portions in Long-Term Stewardship as of 2006 - 8[1]
Average Annual Long-Term Stewardship Cost FY 2000-2006 - n/a (costs begin in FY 2009)[2]
Landlord - U.S. Department of Energy, Office of Defense Programs
*The estimated volume indicates only the known amounts of residual contaminants. For certain portions discussed for this site, exact volume is not known at this point. For specific discussions, please see Section 3.0.

Site 300 is a remote, experimental testing facility with several areas for high explosives components research, instrumental firing tables for explosives testing, an advanced test particle accelerator, and various support and service facilities, such as a motor-pool and machine shops. The site occupies approximately 2,860 hectares (7,067 acres) of rugged foothills that straddle Alameda and San Joaquin Counties, and is surrounded by agricultural land that has an average population density of fewer than one person per 259 hectares of land (i.e., fewer than one person per square mile). The site is owned by DOE. It was originally purchased by the U.S. Atomic Energy Commission (a predecessor agency to DOE) from local ranchers in the 1950s.

The University of California operates both the Lawrence Livermore National Laboratory–Main Site and Site 300 for DOE. The Site 300 landlord, DOE's Office of Defense Programs, has an ongoing mission to test, research, and develop high explosives materials. Over the years, the Laboratory's mission has broadened to meet other national needs, such as enhancing economic competitiveness and science education. As currently envisioned, DOE's Office of Defense Programs will continue to operate the site as a controlled access research facility and as a high explosives materials testing site.

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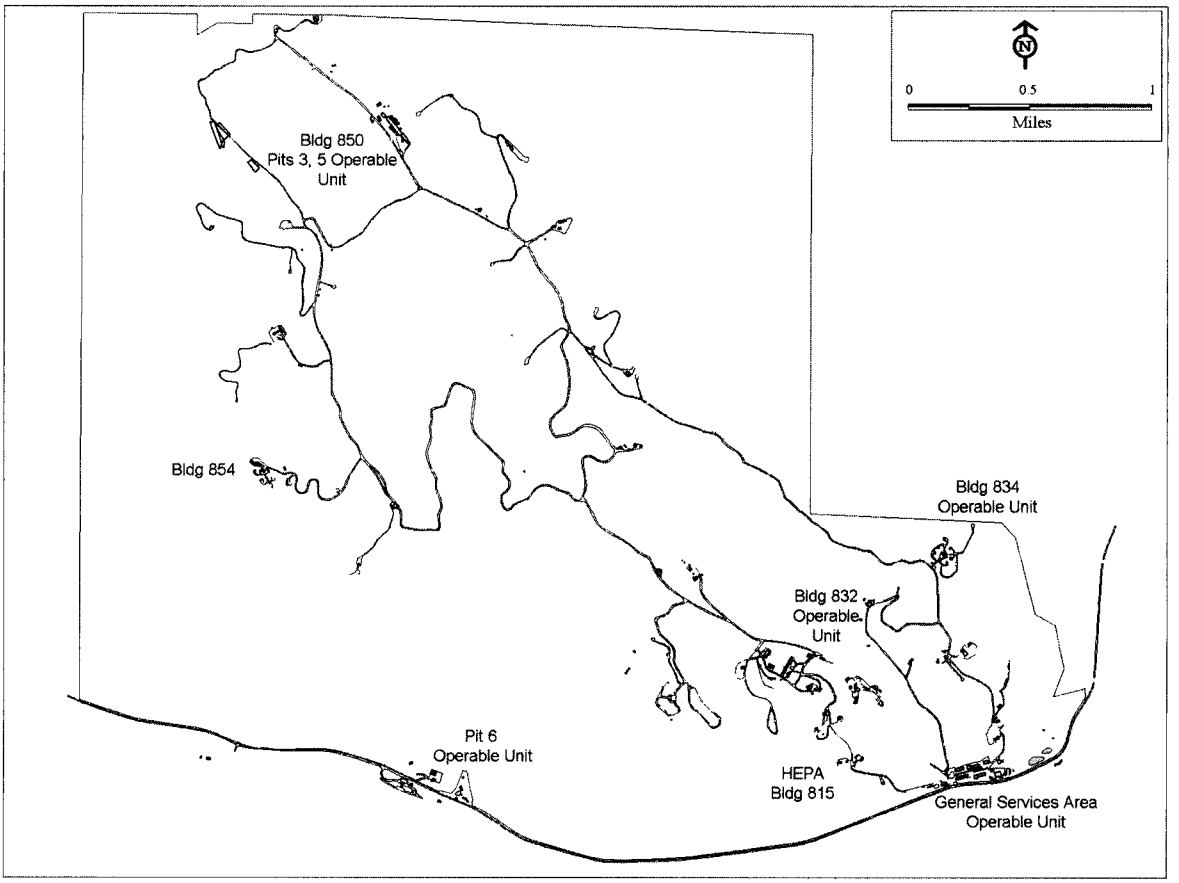
[1] Represents completion of assessment and remedial action for at least one release site within a portion even though the entire portion may not have initiated long-term stewardship activities. A release site is defined as a unique location where a contaminant release has occurred or is suspected to have occurred. A portion may have several release sites.

[2] For FY2000 -2008 long-term stewardship costs can not be separately identified because the environmental restoration activities at Site 300 are managed on a subproject area, i.e., portion, basis to accommodate the regulatory cleanup process and ensure consistency with local DOE project management and accounting systems. Long-term stewardship costs are not reported from FY 2000 through FY 2008 since costs are not available at the release site level. It should also be noted that the costs associated with the long-term stewardship and maintenance of release sites are a minor part of the operable unit, and or portion.



Lawrence Livermore National Laboratory - Site 300

There are numerous facilities operating at Site 300 to support the experimental test work. These facilities include: five test facilities; six high explosives assembly, machining, and/or treatment facilities; 31 explosives storage magazines; two outdoor firing tables; three chemistry processing facilities; the "Press and Oven Complex" used to prepare and press bulk explosives; eight craft and engineering shops; 16 general storage facilities; three waste management storage and treatment units; and 19 buildings that are used for offices or by security and health/emergency response services. DOE assumes that the Office of Defense Programs will continue to be responsible for all landlord activities and their associated costs.

1.2 Site Cleanup and Accomplishments

Past operations at Site 300 resulted in the release of hazardous and radioactive materials, primarily from surface spills, leaching from unlined landfills and pits, high explosive test detonations, and past disposal of waste fluids in lagoons and dry wells, to the environment at 73 identified locations (release sites). In 1990, Site 300 was placed on the U.S. Environmental Protection Agency's (EPA) National Priorities List because trichloroethylene (TCE) was detected in a groundwater sample from an onsite well in the regional aquifer at concentrations above drinking water standards. In 1992, a Federal Facility Agreement under the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) was signed by DOE, EPA, the California Department of Toxic Substances Control and the California Central Valley Regional Water Quality Control Board. The Federal Facility Agreement formalizes the cleanup process and delineates each organization's roles and responsibilities under CERCLA for Site 300 remedial actions. DOE is the responsible party and lead agency

for environmental investigations and cleanup at Site 300.

Consistent with this Federal Facility Agreement, the final selected remedies and cleanup standards will not be determined until the issuance of the Site-Wide Final Record of Decision (ROD), scheduled for April 2007. However, to facilitate continued progress towards remediation, an Interim ROD will be completed by December 2000. An Interim ROD is needed because: (1) additional testing and evaluation of technologies is still taking place, (2) final cleanup standards are being negotiated, and (3) some areas of Site 300 still need further investigation. This Interim ROD will propose remedies to restore groundwater that contains contaminant concentrations above the Federal Maximum Contaminant Levels (MCLs). All groundwater treatment systems and other remedial actions will be in place and operational by fiscal year (FY) 2009. To the degree that these cleanup objectives are achieved by interim measures, the interim measures may be selected as the final remedies for the site, pending review of their effectiveness and any needed contingency plans. The ultimate determination, however, will be in the Final ROD.

To effectively manage the site cleanup, and based on the site's hydrogeologic characteristics and the nature and extent of contamination, all releases have been assigned to one of eight operable units (OUs). These operable units are as follows:

- General Services Area (GSA) (OU#1);
- Building 834 (OU#2);
- Pit 6 Landfill (OU#3);
- High Explosives Process Area (OU#4);
- Building 850/Pits 3 and 5 (OU#5);
- Building 854 (OU#6);
- Building 832 Canyon (OU#7); and
- Site-Wide (OU#8).

SITE ACCOMPLISHMENTS

- Signed Federal Facility Agreement in 1992
- Installed guard wells to detect offsite migration of contaminated groundwater
- Installed nine groundwater and three soil vapor extraction and treatment systems to begin contaminant remediation
- Closed numerous dry wells that were used to dispose of contaminated rinsewater (1989)
- Capped and closed nine High Explosives (HE) rinsewater lagoons, three HE Burn Pits, and four landfills that were used to dispose of contaminated debris
- Signed Final Record of Decision for the General Services Area (GSA) Operable Unit (1997)
- Remediated the contaminant plume in eastern GSA nearer to site boundary (the plume formerly extended nearly a mile offsite)
- Excavated contaminated soil and waste at several locations throughout the site
- Removed contaminated table gravel and experiment debris from five firing tables
- Completed assessment and remedial action at 53 release sites (see the table on the following page)
- Completed Interim Record of Decision in 2000

BY 2009, SITE 300 WILL HAVE ACCOMPLISHED

- Implementation and operation of the selected remedies for cleanup of contamination in all operable units Site 300
- Completion of remedial action at 21 release sites
- Completion of the Final Record of Decision by 2007

Portion	*Release Sites Where Cleanup Has Been Completed and Require Long-Term Stewardship (51)*	*Portion*	*Release Sites Where Cleanup Has Been Completed and Require Long-Term Stewardship (51)*
General Services Area (GSA) (OU#1)	- Dry Well 873-N - Building 879 Steam Cleaning/Sink Facility - Debris Burial Trench #1 - Debris Burial Trench #3 - Decommissioned Solvent Drum Rack and Tank - Dry Well 872-S - Dry Well 873-S - Dry Well 875-S1 - Dry Well 875-S2 - Ground Water Project - Dry Well 874-N - Building 874 Acid Dip Dry Well	*Site-Wide (OU#8)*	- Building 829 Burn Pit 1 (SWMU 131) - Building 829 Burn Pit 2 (SWMU 133) - Building 829 Burn Pit 3 (SWMU 136) - Building 829 Drying Area (AOC 5) - Building 827 Complex - Building 823 Wastewater Outfall (LLNL) - Building 827B Dry Well - Building 809 Disposal Slope - Building 801 Firing Table - Building 802 Firing Table - Building 851 Firing Table - Building 845 Firing Table - Pit 2 - Area North of Building 833 - Pit 1 (SWMU 150) - Pit 7 (SWMU 155) - Building 833 Disposal Lagoon - Building 833 Test Cell and Settling Basin Area - Building 836B Disposal Lagoon - Building 840 - Building 841 - Leach Field Southeast of Building 833 - Pit 9 - Building 801 Dry Well - Pit 8 - Building 833 Brine System Drainage Outfall - Building 833 Exterior Drainage System Outfall - Building 836 Dry Well Drainage - Three Earthen Pits South of Building 833
Building 834 (OU#2)	- Building 834 Diesel Tank - Building 834 Septic Tank - TCE Pump Station 834B - Test Cell 834G - Test Cell 834H - Test Cell 834J		
Pit 6 Landfill (OU#3)	- Pit 6 Landfill		
High Explosives Area (OU#4)			
Building 850/Pits 3 and 5 (OU#5)	- Building 850 Diesel Tank - Pit 4 - Building 850 Drainage Ditch		
Building 854 (OU#6)			
Building 832 Canyon (OU#7)			

The overall environmental remediation strategy for these operable units is expected to integrate: (1) risk and hazard mitigation and management; (2) source control, isolation, or removal; (3) hydraulic plume control; (4) monitored natural attenuation of contaminants; and (5) compliance monitoring (assuming that the preferred remedies described in DOE's *Proposed Plan for Environmental Cleanup at Lawrence Livermore National Laboratory (LLNL) Site 300* are selected and implemented). The *Proposed Plan* was developed jointly with the regulatory agencies and presented to the public at a meeting on May 4, 2000. The *Proposed Plan* was finalized on April 20, 2000.

Onsite remediation efforts are directed at the contaminated soil and groundwater. There are 12 onsite groundwater plumes that are contaminated with volatile organic compounds. Two of these groundwater plumes have migrated to offsite locations and threaten two water-supply wells. These wells are monitored regularly, and DOE has a formal agreement with the well users to provide clean water wells or local surface water supplies if the offsite wells should become contaminated. Upon securing the alternative water supplies, DOE would deactivate the original wells and convert them into monitoring wells. Furthermore, guard wells have been installed between the plume and the water-supply wells to detect any plume movement toward these offsite wells. There are seven active and six inactive water-supply wells located within 0.8 kilometer (0.5 mile) of the site, although only two of the wells are used to supply drinking water. Twenty-four springs and one active water-supply well are located onsite. Assessment activities continue to focus on determining the extent of onsite and offsite soil and groundwater contamination.

Several groundwater plumes contaminated with volatile organic compounds are also mixed with other contaminants, such as nitrate and perchlorate. DOE has installed several groundwater remediation systems that extract contaminated groundwater and remove the volatile organic compounds. Tritium contamination in two areas of the site (i.e., Pit 6 Landfill and Building 850 area) may be left in place to naturally attenuate. DOE will use containment technologies to ensure that additional contaminated groundwater does not migrate offsite and will continue to operate groundwater treatment systems until final cleanup levels, currently being negotiated, are achieved.

Trichloroethylene (TCE), used primarily as a heat transfer fluid, was released into the ground through pipe leaks and spills. The contamination is still present in the soil and groundwater. At the Building 834 (OU#2) site, two clay-soil systems physically separate the site from the regional aquifer, and the perched groundwater has no viable pathway out of the site. In light of this unique situation, DOE proposed to test innovative removal/cleanup technologies for volatile organic compounds and dense nonaqueous phase liquids (DNAPLs), and the regulatory agencies granted approval for such an approach. DOE expects that soil vapor extraction undertaken at Building 834 will remediate approximately 34,000 cubic meters (44,540 cubic yards) of soil.

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

By 2009, all release sites at Site 300 will have been assessed and completed and all groundwater treatment systems and other remedial actions will be in place and operational. Currently, activities are being conducted at several completed release site(s) that are consistent and commensurate with the overall planned long-term stewardship goals for the site. These activities will serve as the basis for key components of long-term stewardship. Portions of the site that require long-term stewardship include areas with soil and groundwater contamination resulting from past operations and releases from spills, as well as closed waste treatment and land disposal facilities. Contaminants of concern include volatile organic compounds, tritium, high explosive compounds, perchlorate, nitrate, silicone-based lubricants (i.e., tetrakis (2-ethylbutoxy) silane and tetrabutyl ortho silicate), and uranium-238. Closed land disposal facilities may require maintenance and monitoring indefinitely to meet post-closure permit requirements. Treatment systems will be operated until groundwater contaminant concentrations meet the cleanup standards.

Cleanup will be considered complete when contaminant concentrations remain below the cleanup standards for a period of time to be agreed upon with the regulatory agencies. Following achievement of cleanup standards, contaminant concentrations will be monitored to ensure concentrations do not rebound. All treatment system hardware will be decontaminated, dismantled, and salvaged if rebound does not occur. DOE expects that groundwater monitoring and the long-term surveillance and monitoring of closed areas will be required for a minimum of 23 years. Additionally, cap inspection and repair following closure will be needed.

SITE LONG-TERM STEWARDSHIP GOALS

As part of long-term stewardship, DOE has implemented institutional controls to ensure land use restrictions are employed and that selected remedies remain protective of human health and the environment and restore beneficial uses of natural resources. The primary long-term stewardship goals for the Lawrence Livermore National Laboratory – Site 300are as follows: monitor groundwater plumes, prevent contaminants from migrating, restrict access to the site, prevent exposure to contaminants that pose a risk to human or ecological receptors, monitor closed areas, ensure the proper maintenance of landfill caps and other engineering units, and optimize remediation to provide for faster and more cost-effective cleanup.

The Site-Wide Final ROD, scheduled to be completed in 2007, will establish cleanup standards and may include additional specific post-remediation monitoring requirements based on the results of additional testing and investigation. Additionally, engineered treatment systems may need to be modified or shut down and/or new

STAKEHOLDER INVOLVEMENT

Department of Energy/Lawrence Livermore National Laboratory has prepared a Community Relations Plan to meet the following objectives:

- Provide accurate and timely information to interested members of the community
- Provide for an open dialogue on Site 300 cleanup issues between DOE/LLNL and the public, and factor community concerns into the ongoing environmental investigation
- Continue to work closely with the neighbors of Site 300
- Be responsive to the special information needs of elected officials, agency representatives, and interested members of the public, including the environmental and peace activists
- Seek to increase the level of understanding in the community with regard to Site 300 cleanup plans
- Inform Site 300 employees about all cleanup activities being planned and conducted at the site before information is released to the press and public
- Respond to changes in community concerns and interest levels

Reviews of the objectives and the methods described in the Community Relations Plan are conducted regularly to ensure that the objectives are being met. The public is invited to attend various CERCLA-required and voluntary public meetings and workshops to learn about and comment on planned environmental restoration activities at Site 300. Tri-Valley Communities Against a Radioactive Environment has held a Technical Assistance Grant from the U.S. Environmental Protection Agency (EPA) since 1994, and representatives meet quarterly with DOE, regulatory agencies, and Lawrence Livermore National Laboratory staff to discuss on-going and planned cleanup actions. The local community is currently provided, and will continue to be provided, information by way of local repositories and newsletters.

ones may need to be built to accommodate the final agreements reached in the Site-Wide ROD. Details of long-term stewardship activities will be detailed in the Final ROD and other documents required under CERCLA and the *Resource Conservation and Recovery Act* (RCRA). Facility structures and contamination controls will be maintained to prevent onsite worker exposures and offsite public exposures.

While DOE is not expected to complete cleanup of the entire site until 2008, many of long-term stewardship key operational components have already been initiated concurrent with the active, compliant cleanup program described above. Similarly, several administrative and institutional controls and surveillance/maintenance programs that currently exist will be maintained to support the overarching long-term stewardship foals of maintain and operating required remediation systems and ensuring that selected remedies will remain protective of human health and the environment, and restore beneficial uses of natural resources. Long-term stewardship activities include or will include, but are not limited to, the following:

- Facility operation and maintenance of treatment systems;
- Inspection and maintenance of landfill caps and any other passive engineered environmental remediation systems;
- Continued regulatory interactions and compliance;
- Soil vapor and groundwater monitoring and wellfield operations and maintenance;
- Use of three-dimensional modeling as a cost-effective means to estimate future contaminant concentrations and risk to human health and the environment, to optimize remediation, to evaluate the effectiveness of cleanup, and to relay progress of cleanup to the stakeholders;
- Maintaining the data information system that is required to support planning, collecting, tracking, verifying, validating, reporting, interpreting and using the data; and
- Program management.

Several administrative and institutional controls that already exist at Site 300 are also expected to be maintained

in the long-term and are the same for each portion in long-term stewardship, i.e., Site 300 access is restricted and controlled by fencing and a full-time security force; the building occupancy and land use is controlled by Site 300 management; additional access controls are in place in areas outside of regular work areas; all personnel at Site 300 are required to attend a safety briefing which addresses requirements and areas of contamination; no drinking water wells are located in onsite contaminated areas; any new water supply wells are subject to review; Operational Safety Plans are required for all construction activities, which include checks for hazardous materials and sensitive species; and no additional portion-specific institutional controls, above the site-level, are required.

In addition, several record-keeping activities are required for Site 300. These include maintaining an administrative record for the selection of response actions to be conducted at the site (in accordance with Title 40 Code of Federal Regulations, Subchapter J (Superfund Program), Part 300 (National Oil and Hazardous Substances Pollution Contingency Plan)), treatment facility permit and monitoring program reporting and documentation, compliance monitoring plans, and post-closure monitoring reporting and documentation. The Administrative Record must be maintained throughout the life of the CERCLA process, is updated as new project information is available, and is made available to the public. In addition, reports are submitted to regulatory agencies and are maintained at the site, documenting groundwater monitoring program activities.

2.2 Long-Term Stewardship Technology Development and Deployment

DOE has used Site 300 as a "test bed" for the development and deployment of innovative remediation technologies over the years. This testing has included the use of surfactant injection to help mobilize contaminants, ultraviolet radiation and an electron accelerator to treat contaminated soil vapor, an electrical soil-heating pilot test, and the testing of ultraviolet radiation coupled with peroxidation to treat contaminated groundwater. Enhanced in situ bioremediation, containerized wetlands, and ion exchange resins are currently being tested for long-term application at Site 300.

Innovative technologies that shorten cleanup time, improve cleanup efficiency, and reduce costs will continue to be considered for application at Site 300 throughout the remediation process. These technologies may be employed if site conditions change or technology development and testing indicate a potential cost-effective and expedited remediation. Innovative technologies would be employed with regulatory concurrence. An Explanation of Significant Differences or Amendment to the Record of Decision may be necessary to employ an innovative technology if it replaces or represents a significant deviation from the remedy selected in the Record of Decision.

2.3 Assumptions and Uncertainties

DOE assumes that, at a minimum, long-term stewardship activities at Site 300 will be maintained by the DOE Office of Environmental Management through FY 2030, at which time DOE will prepare a petition to delist the site from the National Priorities List in accordance with the provisions of CERCLA. DOE will continue to ensure maintenance and operation of required remediation systems to meet cleanup goals and ensure protection of human health, the environment, and beneficial uses of natural resources.

The accuracy of the estimated extent of onsite contamination (i.e., area, volume, and mass) varies throughout the site. The target contaminant used to project cleanup schedules was TCE for all operable units except the Building 850/Pits 3 and 5 and Pit 6 Landfill operable units, where tritium was used to project the cleanup schedule. Cleanup schedules were also estimated based on average concentrations and flow rates, chosen to be representative of the true three-dimensional distribution of contaminants in the subsurface. It was assumed, for purposes of this report, that tritium and uranium contamination in groundwater will be addressed through monitored natural attenuation; therefore, costs do not reflect "active" remediation of these contaminants in groundwater. In areas where nitrate, perchlorate, and high explosive compounds are present as contaminants of

concern in groundwater, TCE is also present at much higher concentrations. Therefore, DOE assumed that the time to achieve cleanup would be driven by TCE, and by the time TCE concentrations were reduced to cleanup standards, the other contaminants with much lower concentrations would have also reached cleanup standards. The cleanup end date was determined based on when an individual plume is projected to reach the target cleanup standard, predicted by fitting an exponential model of concentration versus time. In some cases, rates of concentration decline in individual wells were used instead of the exponential model. Only dissolved mass estimates and concentrations were used in the calculations, and dense non-aqueous phase liquids were not included as part of these cleanup estimates. Soil acreage by medium includes both unsaturated and saturated soil.

The cost estimate for long-term stewardship was also based on the assumption that environmental regulations will not become more stringent and that no additional contamination sources or other recalcitrant areas will be found in the future. In addition, DOE estimated the duration and cost of long-term stewardship using the assumption that the final groundwater cleanup standards for Site 300 would be to drinking water standard MCLs.

2.4 Estimated Site-Wide Long-Term Stewardship Costs

Estimated costs for long-term stewardship activities for Site 300 are identified in the table below. The average annual site-wide cost estimate for long-term surveillance and monitoring activities for Site 300 is approximately $680,000 per year from 2009 through 2070. The costs shown below are mainly attributable to operation and maintenance of treatment systems, long-term soil vapor and groundwater monitoring, wellfield operation and maintenance, and remediation optimization. DOE also considered data management, regulatory compliance, and program activities in the cost estimate.

DOE based the cost estimates on the following assumptions: the only costs applicable during stewardship are those associated with treatment facility operation (including wellfield optimization and management) and maintenance, groundwater monitoring, and regulatory and community interaction. These assumptions most notably exclude the drilling of monitoring and extraction wells, the construction of new treatment facilities, and the decontamination and decommissioning of treatment facilities and wells.

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	***Amount***	***Year(s)***	***Amount***	***Year(s)***	***Amount***
FY 2000	$n/a	**FY 2008**	$n/a	**FY 2036-2040**	$686,000
FY 2001	$n/a	**FY 2009**	$4,483,000	**FY 2041-2045**	$264,000
FY 2002	$n/a	**FY 2010**	$4,010,000	**FY 2046-2050**	$70,000
FY 2003	$n/a	**FY 2011-2015**	$15,326,000	**FY 2051-2055**	$37,000
FY 2004	$n/a	**FY 2016-2020**	$8,872,000	**FY 2056-2060**	$24,000
FY 2005	$n/a	**FY 2021-2025**	$4,815,000	**FY 2061-2065**	$16,000
FY 2006	$n/a	**FY 2026-2030**	$2,448,000	**FY 2066-2070**	$11,000
FY 2007	$n/a	**FY 2031-2035**	$1,297,000		

Environmental restoration activities at Site 300 are managed on a subproject area, i.e., portion, basis to accommodate the regulatory cleanup process and ensure consistency with local DOE project management and accounting systems. Therefore, costs in this report are identified and based on the time frame in which an entire portion, and not its individual release site(s), will transition from the active, ongoing cleanup phase to a long-term

stewardship mode according to remedies and cleanup standards promulgated in the Final ROD. To that end, long-term stewardship costs are not reported from FY 2000 through FY 2008 since costs are not available at the release site level, the costs associated with the long-term stewardship and maintenance of release sites are a minor part of the operable unit, and or portion. Not all release sites will have been completed according to site-specific final CERCLA agreements and schedules. It is anticipated that all release sites in each portion will be assessed and completed by FY 2009.

3.0 PORTION OVERVIEW

Based on hydrogeologic characteristics and the nature and extent of contamination, all release sites are assigned to one of eight operable units (OUs), or portions, to effectively address site cleanup, thereby dividing a large complicated site into manageable projects. For the purposes of this report, a "portion" is a geographically contiguous and distinct area (which may involve residually contaminated facilities, engineered units, soil, groundwater, and/or surface water/sediment) for which cleanup, disposal, and or stabilization will have been completed and long-term stewardship will be required. The site portions include the following operable units: General Services Area (OU#1), Building 834 (OU#2), Pit 6 Landfill (OU#3), High Explosives Process Area (OU#4), Building 850/Pits 3 and 5 (OU#5), Building 854 (OU#6), Building 832 Canyon (OU#7), and Site-Wide (OU#8). Each operable unit (or portion) includes one or more contaminant release sites and any contamination in soil, rock, groundwater, or surface water associated with those release sites. These eight operable units are identified in the table below, with accompanying discussion of cleanup and long-term stewardship activities in Sections 3.1 through 3.8. The rationale for defining these portions is based upon the proximity and types of similar residual contaminants present which allows for an area-specific cleanup strategy.

Portion	*Long-Term Stewardship Start Year**	*Entire Portion Cleanup Completion Year***	*Long-Term Stewardship End Year*
General Services Area (GSA) (OU#1)	1995	2009	2030
Building 834 (OU#2)	1996	2009	2047
Pit 6 Landfill (OU#3)	1998	2009	2070
High Explosives Process Area (OU#4)	1999	2009	2042
Building 850/Pits 3 and 5 (OU#5)	1994	2009	2070
Building 854 (OU#6)	1999	2009	2032
Building 832 Canyon (OU#7)	1999	2009	2045
Site-Wide (OU#8)	1994	2009	2070

*Represents date when completion of assessment and remedial action for at least one release site within a portion that could require long-term stewardship activities is done and/or operation of treatment systems on a portion-specific basis that will remediate release site(s) to allow eventual long-term stewardship activities to commence is initiated.

**Represents date when all release sites for an entire portion will have been assessed and completed and all groundwater treatment systems and other remedial actions will be in place and operational according to remedies and cleanup standards promulgated in the Final ROD.

3.1 General Services Area (OU#1)

GENERAL SERVICES AREA (OU#1) HIGHLIGHTS

Major Long-Term Stewardship Activities - treatment facility operation and maintenance; groundwater monitoring; exposure control through risk and hazard management; remediation optimization
Portion Size - 12.5 hectares (31 acres)
Estimated Volume of Residual Contaminants - groundwater 85,000 cubic meters (110,000 cubic yards); soil 25,000 cubic meters (33,000 cubic yards)
Long-Term Stewardship Start-End Years - 1995-2030
Average Annual Long-Term Stewardship Cost FY 2000-2006 - n/a (costs begin FY 2009)

The General Services Area is a 12.5-hectare (31-acre) operable unit (OU#1) located along the southeastern border of Site 300 and includes equipment stores, machine shops, and other support facilities. The majority of the General Services Area operable unit is within the boundaries of the Site 300 property. Past disposal of degreasing solvents from craft shops and equipment fabrication and repair facilities have resulted in volatile organic compound contamination in the subsurface soils. During 1950 through 1960, solvents were discharged into dry wells or the ground at several locations in this area, resulting in soil and groundwater contamination. TCE plumes have reached the shallow alluvial aquifer in the Corral Hollow Basin and into the regional aquifer of the General Services Area. At present, the contamination levels in the groundwater and soil do not pose immediate health risks to site workers or the general public.

General Services Area (OU#1) Release Sites Cleaned up That Require Long-Term Stewardship Activities

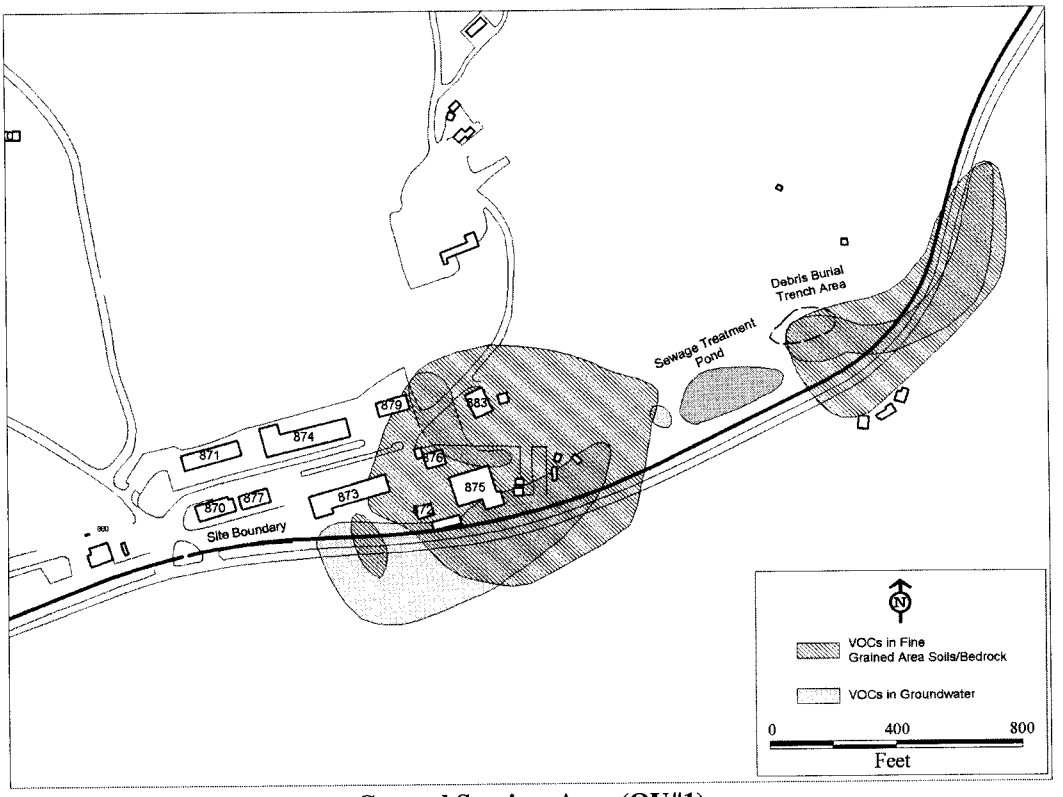
- Dry Well 873-N
- Building 879 Steam Cleaning/Sink Facility
- Debris Burial Trench #1
- Debris Burial Trench #3
- Decommissioned Solvent Drum Rack and Tank
- Dry Well 872-S
- Dry Well 873-S
- Dry Well 875-S1
- Dry Well 875-S2
- GSA Ground Water Project
- Dry Well 874-N
- Building 874 Acid Dip Dry Well

Prior to initiating remediation in this area, the groundwater contamination plume extended offsite and down the Corral Hollow alluvial channel for approximately 1.6 kilometers (one mile). Remediation of solvent-contaminated soils and groundwater began in 1991, as part of the selected removal action under CERCLA. In 1997, a ROD for this operable unit was signed. Currently, the groundwater and soil cleanup is underway. Groundwater contamination still extends offsite. Ongoing cleanup activities have resulted in the completion of twelve release sites.

3.1.1 Soil

The General Services Area lies on unconsolidated alluvial sand and gravel deposited by Corral Hollow Creek. Sandstones and siltstone/claystone bedrock lie beneath these deposits. The soil and bedrock are unsaturated to a depth of up to 4.6 meters (15 feet) in the eastern region of the General Services Area and up to six meters (20 feet) in the central region of the General Services Area. The soil and bedrock became contaminated from past discharges of rinse waters containing solvents into dry wells; solvent spills from a now decommissioned drum storage rack; wastewater discharges from a steam-cleaning/sink facility operated in the 1960s and 1970s; and burial of craft shop debris contaminated with solvents. The highest concentrations of volatile organic compounds in soil and bedrock have been detected in saturated sandstone bedrock in the central region of the General Services Area.

Approximately 6.5 hectares (16 acres) and 25,000 cubic meters (33,000 cubic yards) of soil at the General Services Area are contaminated with volatile organic compounds. In the eastern General Services Area, very low concentrations of volatile organic compounds [0.19 part volatile organic compound per million parts of soil (hereafter referred to as parts per million)] have been detected in soil at the debris burial trenches area. In the central General Services Area, the highest pre-remediation trichloroethylene concentrations in soil and bedrock (up to 360 parts per million) were detected below the Building 875 dry wells. Concentrations of



General Services Area (OU#1)

trichloroethylene up to 1,000 parts per million also have been reported in soil vapor samples from the vadose zone.

Soil vapor extraction has been underway in the vicinity of the Building 875 dry wells to reduce volatile organic compound concentrations in the bedrock, to reduce the exposure risk to onsite workers, and to prevent further releases of volatile organic compounds to the groundwater. DOE expects to remediate 25,000 cubic meters (33,000 cubic yards) of the contaminated soil.

Soil Long-Term Stewardship Activities

In 1995, DOE began the extraction and treatment of volatile organic compounds in subsurface soil and bedrock to reduce risk to onsite workers posed by these contaminants and to prevent contamination of the groundwater above the drinking water standards. Ongoing cleanup activities have resulted in the completion of twelve release sites. The Final ROD for the General Services Area operable unit requires that soil vapor remediation continue until: (1) the excess cancer risk to onsite workers is reduced to levels considered to be protective by EPA (below one in one million) and (2) contamination in subsurface soil and rock will cause groundwater contamination above the drinking water standards.

3.1.2 Groundwater

In the eastern region of the General Services Area, the water table is approximately 3-4.6 meters (10-15 feet) below the surface, and the groundwater flow is eastward in the alluvial valley fill and shallow bedrock, turning north to follow the trend of the valley. Groundwater flow velocity is estimated to be about 0.006 meters per hour

(0.02 feet per hour) to 0.04 meters per hour (0.13 feet per hour). Groundwater in the shallow aquifer, as well as any contamination in that groundwater, can move into the deeper regional aquifer unimpeded. The regional aquifer is a source of drinking water for both Site 300 and nearby neighbors.

In the central region of the General Services Area, the groundwater is approximately 3 to 6 meters (10 to 20 feet) below the surface, and the groundwater flow is south-southeast, with an estimated flow velocity of 0.06 centimeter per hour (0.002 foot per hour) to 0.1 centimeter per hour (0.004 foot per hour). Groundwater occurs in the shallow alluvial sands and gravel and the underlying fractured sandstone bedrock. The aquifer groundwater is hydraulically isolated from the regional aquifer by a 18-to-24-meter (60-to-80-foot) thick impermeable claystone layer that prevents the downward migration of groundwater and any associated contamination. Groundwater flow in the regional aquifer is south-southeast at a velocity of 0.4 centimeter per hour (0.013 foot per hour).

Approximately 3.6 hectares (nine acres) and 85,000 cubic meters (110,000 cubic yards) of groundwater in the General Services Area are contaminated with volatile organic compounds. Volatile organic compounds were released into the groundwater as a result of past disposal of degreasing solvents from craft shops and equipment fabrication and repair facilities; leaks/spills from solvent storage tanks and drums; and leaching from buried debris. Volatile organic compounds, primarily trichloroethylene, were identified as contaminants of concern in groundwater in both the eastern and central regions of the General Services Area. The highest trichloroethylene concentrations [up to 74 parts of trichloroethylene per billion parts of groundwater (hereafter referred to as parts per billion)] were detected in the groundwater in the alluvium near the debris burial trench at the eastern General Services Area. DOE also has detected trichloroethylene in the underlying bedrock regional aquifer at maximum concentrations of 62 parts per billion. A groundwater plume extends eastward from the debris burial trench area and also has migrated northward in the alluvial sand and gravel underlying the Corral Hollow Creek floodplain. In the central region of the General Services Area, a groundwater plume, consisting primarily of trichloroethylene, extends into the Corral Hollow Creek alluvium. DOE detected trichloroethylene in groundwater at a maximum concentration of 240,000 parts per billion in the vicinity of a former dry well. The bulk of the contamination is currently present in the sandstone bedrock, approximately 10.7 meters (35 feet) below the surface. There is a smaller groundwater plume, with significantly lower trichloroethylene concentrations, in the drum storage rack and steam cleaning release sites to the north of this area.

Groundwater Long-Term Stewardship Activities

In 1991, DOE began treating groundwater contaminated with trichloroethylene in the eastern region of the General Services Area, using an aqueous-phase granulated activated carbon groundwater extraction and treatment system. The central region of the General Services Area has been using both groundwater and soil vapor extraction systems to remediate trichloroethylene-contaminated groundwater in a shallow aquifer since 1993. DOE treats groundwater in the central General Services Area by air stripping and filtration in a Portable Treatment Unit. By the end of 1999, a total of 14.7 kilograms of volatile organic compounds had been removed from these eastern and central General Services Area groundwater treatment systems.

Groundwater remediation activities will reduce volatile organic compounds concentrations to meet the Federal MCLs allowed in drinking water. DOE expects that such target cleanup levels will be achieved by 2025.

3.1.3 Estimated Long-Term Stewardship Costs for the GSA (OU#1)

In developing these cost estimates for the General Services Area, DOE assumed that long-term stewardship activities included treatment facility operation and maintenance, groundwater monitoring, exposure control through risk and hazard management, and remediation optimization. DOE used trichloroethylene as the target contaminant for projecting cleanup schedules. See Section 2.3, Assumptions and Uncertainties, and Section 2.4,

Estimated Site-Wide Long-Term Stewardship Costs, for a complete listing of the assumptions used for developing these costs. The same assumptions were used for the cost estimates for this portion.

Long-Term Stewardship Costs (Constant Year 2000 Dollars)							
FY 2000 - FY 2010	*FY 2011 - FY 2020*	*FY 2021 - FY 2030*	*FY 2031 - FY 2040*	*FY 2041 - FY 2050*	*FY 2051 - FY 2060*	*FY 2061 - FY 2070*	*Estimated Total*
$799,000	$2,425,000	$677,000	$0	$0	$0	$0	$3,901,000

3.2 Building 834 Complex (OU#2)

BUILDING 834 COMPLEX (OU#2) HIGHLIGHTS

Major Long-Term Stewardship Activities - treatment facility operation and maintenance; groundwater monitoring; exposure control through risk and hazard management; remediation optimization
Portion Size - 9.3 hectares (23 acres)
Estimated Volume of Residual Contaminants - groundwater 15,000 cubic meters (20,000 cubic yards); soil 17,000 cubic meters (22,000 cubic yards)
Long-Term Stewardship Start-End Years - 1996-2047
Average Annual Long-Term Stewardship Cost FY 2000-2006 - n/a (costs begin FY 2009)

The Building 834 Complex is a 9.3-hectare (23-acre) operable unit (OU#2) located on the north-south trending ridge in the hydrogeologically complex, southeastern portion of Site 300. The Building 834 Complex is comprised of facilities that were originally used for materials testing and involved the use of trichloroethylene as a primary heat transfer fluid. Past spills of trichloroethylene and other volatile organic compounds from release sites at the core of the Building 834 Complex have resulted in soil and groundwater contamination. Additional groundwater contaminants of concern include nitrate and silicone-based lubricants, such as tetrakis (2-ethylbutoxy) silane and tetrabutyl ortho silicate.

In 1983, some trichloroethylene-contaminated soils were removed. An Interim ROD was signed in 1995, and groundwater and soil cleanup is currently underway. Ongoing cleanup activities have resulted in the completion of six release sites (as noted in the box at right). Innovative cleanup technologies, such as enhanced *in situ* bioremediation, are also being tested at the Building 834 Complex.

Building 834 Complex (OU#2) Release Sites Cleaned up That Require Long-Term Stewardship Activities

- Building 834 Diesel Tank
- Building 834 Septic Tank
- TCE Pump Station 834B
- Test Cell 834E
- Test Cell 834F
- Test Cell 834G
- Test Cell 834H
- Test Cell 834J

Release Sites Expected to Be Cleaned Up By 2006 and Expected to Require Long-Term Stewardship Activities

- Building 834 Groundwater Project
- TCE Pump Station 834C
- TCE Pump Station 834D

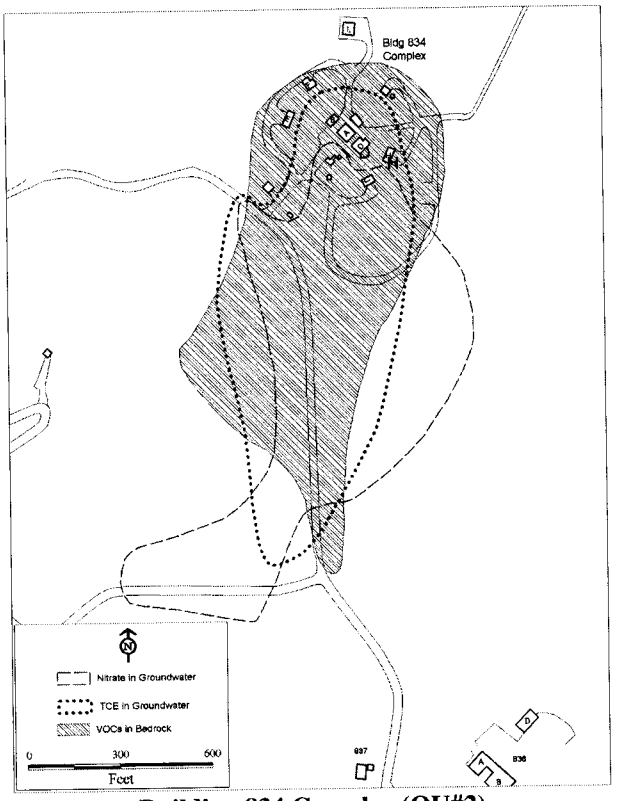
3.2.1 Soil

The Building 834 Complex area is underlain primarily by deposits of clay with sand and gravel. These clay, sand and gravel deposits are underlain by sandstone and siltstone/claystone bedrock. The deposits and underlying bedrock are unsaturated to depths of 6-21 meters (20-70 feet).

About 6.7 hectares (16.5 acres) and 17,000 cubic meters (22,000 cubic yards) of the soil in the Building 834 Complex are contaminated with volatile organic compounds, primarily trichloroethylene, perchloroethylene, and toluene. A portion of this volume of contaminated soil resulted from the migration of contaminated groundwater through saturated soil and bedrock. The highest concentrations of volatile organic compounds have been detected in the saturated sandstone bedrock

in the core of the Building 834 Complex, near Buildings 834B, C, and D, where past spills and discharges of volatile organic compounds occurred.

Trichloroethylene concentrations in subsurface soil and bedrock vary throughout the core area of the Building 834 Complex spatially and with depth. This variability in trichloroethylene concentrations is the result of multiple releases and amounts of trichloroethylene released, as well as the variability of the type and distribution of subsurface rock types and the amount of time that has passed since the releases occurred. The maximum concentrations of trichloroethylene in soil and rock occur mostly within 1.5 meters (five feet) above or below a relatively impermeable clay layer that prevents the migration of significant amounts of groundwater and associated contaminants into the underlying rock.



Building 834 Complex (OU#2)

In 1983, some trichloroethylene-contaminated soils were removed from the Building 834 Complex. The maximum trichloroethylene concentration in soil, 12,000 parts per million, was detected in a soil sample collected in 1982 from a depth of one meter (3.2 feet) below the soil surface in the vicinity of a former trichloroethylene overflow drain behind Building 834C. At that time, trichloroethylene-contaminated soil behind the building was excavated, aerated, and replaced with clean soil. The next highest trichloroethylene concentration, 970 parts per million, was found in the vicinity of Building 834D at a depth of 8.9 meters (29.2 feet) below the soil surface. Perchloroethylene and toluene have been detected at concentrations of less than 0.001 part per million. Soil vapor extraction has been underway in the vicinity of the Building 834 Complex core area to reduce volatile organic compounds concentrations in bedrock. An Interim ROD was signed in 1995, and groundwater and soil cleanup is currently underway.

Soil Long-Term Stewardship Activities

Assuming that the preferred remedial alternative contained in the *Proposed Plan* is selected as part of the Site-Wide Interim ROD, the ongoing and future long-term stewardship activities will include: (1) monitoring soil vapor and groundwater to evaluate the effectiveness of the remedial action in reaching remediation goals, plus post-remediation monitoring; (2) risk and hazard management to prevent contaminant exposure to humans and impacts to ecological receptors; and (3) soil vapor extraction and treatment by carbon adsorption at the volatile organic compounds source area. Soil vapor extraction would be conducted to reduce volatile organic compounds concentrations in soil vapor to levels protective of groundwater drinking water standards, and to mitigate volatile organic compounds inhalation risk in and around the Building 834 Complex.

3.2.2 Groundwater

Approximately 8.7 hectares (21.5 acres) and 15,000 cubic meters (20,000 cubic yards) of groundwater are contaminated as a result of releases from the Building 834 Complex core area. The contaminants of concern in groundwater are primarily volatile organic compounds, specifically trichloroethylene and, to a lesser degree, cis-1,2-dichloroethylene and perchloroethylene. Other contaminants of concern include silicone-based oils tetrakis (2-ethylbutoxy) silane and tetrabutyl ortho silicate, and nitrate.

Two water-bearing zones have been identified beneath the Building 834 Complex, the regional aquifer and a perched water-bearing zone. A shallow perched water-bearing zone occurs directly beneath the Building 834 Complex. The perched water-bearing zone is soil or rock containing groundwater that is above the regional water table. Groundwater collects (or is "perched") above a layer (such as clay) that does not allow water to pass through to the underlying regional aquifer. Depending on topographical variations of the land, the groundwater in this perched water-bearing zone is typically found 3 to 21 meters (10 to 70 feet) beneath the ground surface. This perched water is contaminated with trichloroethylene and other volatile organic compounds, and tetrabutyl ortho silicate from past onsite releases. The regional aquifer underlies the perched water-bearing zone at about 99 meters (325 feet) below the ground surface. No contamination from releases at the Building 834 Complex has been detected in the regional aquifer.

The primary contamination source area (or core area) is located on an isolated hilltop that is underlain by shallow [i.e., less than 15 meters (50 feet)] perched groundwater. A secondary contamination source area, a septic system leach field, is located about 46 meters (150 feet) to the southwest of the Building 834 Complex. The hydraulic connection between the perched water-bearing zones of these two contamination source areas is unknown. Contaminated perched groundwater exists at these two source areas in semi-consolidated sands and gravel that are underlain by a bedrock sequence containing several low permeability layers of siltstones and claystones. Soil vapor and groundwater monitoring data indicate that these layers act as an effective barrier against downward migration of contaminants through unsaturated sandstone layers and, thus, prevent access to the regional aquifer. Furthermore, the spread of dissolved contaminants is restricted by the limited extent of saturation and the topography of the land.

Dissolved volatile organic compounds concentrations in the primary contamination source area or core area have been measured at levels as high as 800 parts per million. The physical dimensions of the groundwater plume have not changed significantly over time. In 1982, the plume dimensions were measured at approximately 457 meters by 183 meters (1,500 feet by 600 feet) in length and width, respectively.

Groundwater Long-Term Stewardship Activities

Since 1995, dual-phase (i.e., groundwater and soil vapor) extraction has been underway at the Building 834 Complex source area to reduce contaminant concentrations in the subsurface groundwater and soil. Pump-and-treat cleanup at the site is hampered by the complex hydrogeology and the limited groundwater yields [many wells produce less than 190 liters (50 gallons) per day]. Due to these difficulties, the identification of an alternative innovative treatment technology is highly desirable and is actively being pursued. An evaluation of the potential for Enhanced In Situ Bioremediation to expedite cleanup at the Building 834 Complex source area is underway. Enhanced In Situ Bioremediation is an innovative technique for the remediation of dissolved, adsorbed, and/or separate phase contaminants through the injection of nutrients that stimulate microbial growth. For example, use of surfactants have been used to mobilize contaminants with limited success.

Assuming the preferred remedial alternative contained in the *Proposed Plan* is selected as part of the Site-Wide Interim ROD, onsite controls will include groundwater extraction and treatment by air sparging, with granular activated carbon for the air stream, and phytoremediation at the source area and in down gradient portions of the

plume. Groundwater extraction will be conducted to reduce contaminant concentrations to the drinking water standards, thereby restoring beneficial uses of the groundwater. The preliminary cleanup levels for the contaminated groundwater are set to Federal MCLs allowed in drinking water. These levels could change once the Final ROD (scheduled for release in 2007) is completed. DOE expects to achieve such target cleanup levels by 2042.

3.2.3 Estimated Long-Term Stewardship Costs for the Building 834 Complex (OU#2)

In developing these cost estimates for the Building 834 Complex operable unit/portion, DOE assumed that long-term stewardship activities included treatment facility operation and maintenance, groundwater monitoring, exposure control through risk and hazard management, and remediation optimization. DOE used trichloroethylene as the target contaminant for projecting cleanup schedules. See Section 2.3, Assumptions and Uncertainties, and Section 2.4, Estimated Site-Wide Long-Term Stewardship Costs, for a complete listing of the assumptions used for developing these costs. The same assumptions were used for the cost estimates for this portion.

Long-Term Stewardship Costs (Constant Year 2000 Dollars)							
FY 2000 - FY 2010	***FY 2011 - FY 2020***	***FY 2021 - FY 2030***	***FY 2031 - FY 2040***	***FY 2041 - FY 2050***	***FY 2051 - FY 2060***	***FY 2061 - FY 2070***	***Estimated Total***
$1,003,000	$3,044,000	$1,267,000	$498,000	$65,000	$0	$0	$5,877,000

3.3 Pit 6 Landfill (OU#3)

The Pit 6 Landfill operable unit (OU#3) is a 5.6-hectare (14-acre) area, near the southern boundary of Site 300 along Corral Hollow Road, that was used from 1964 to 1973 to bury waste in nine unlined debris trenches and animal pits. The buried waste includes laboratory equipment, craft shop debris, and biomedical waste. In addition, waste disposal records for the animal pits indicate that the buried waste (including cows used in biomedical experiments) may be contaminated with beryllium, mercury, polychlorinated biphenyls, and several radiological constituents.

The Pit 6 Landfill is located on alluvial sand and gravel deposits that are up to 17 meters (55 feet) thick and is situated along the northern limit of the Corral Hollow-Carnegie Fault Zone. Evidence of Holocene activity (or movement) within the last 10,000 years has been observed along a fault strand located about 46 meters (150 feet) south of the landfill.

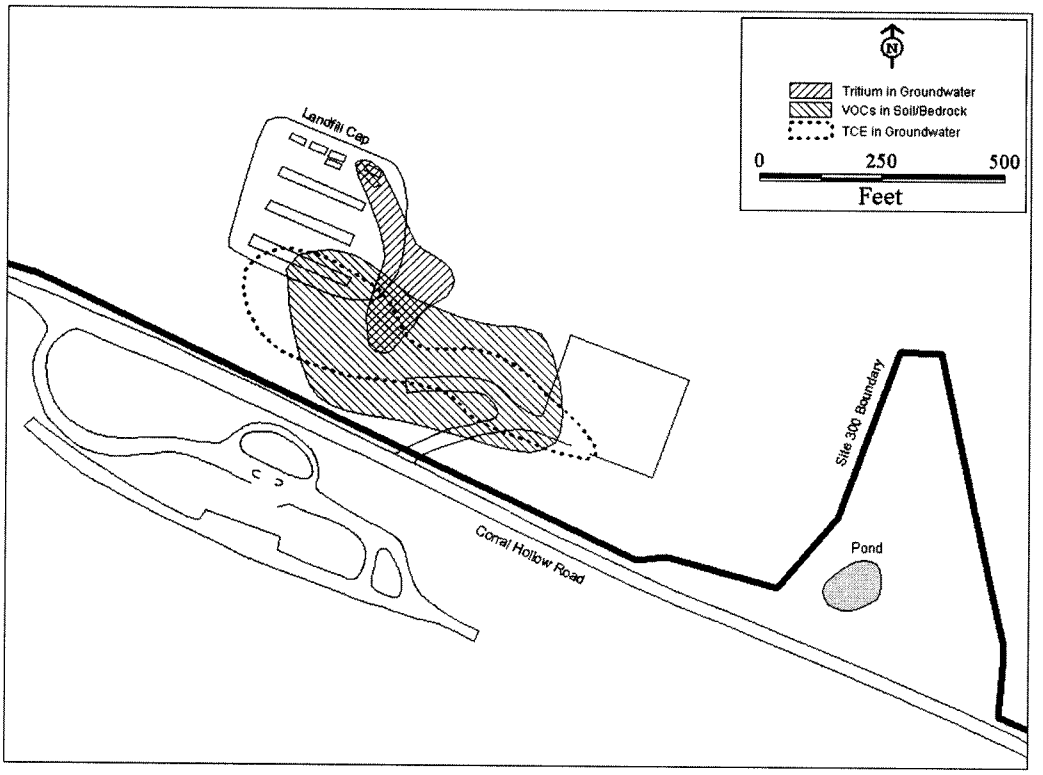
PIT 6 LANDFILL (OU#3) HIGHLIGHTS

Major Long-Term Stewardship Activities - groundwater monitoring; exposure control through risk and hazard management; long-term surveillance and maintenance of the landfill; remediation optimization
Portion Size - 5.6 hectares (14 acres)
Estimated Volume of Residual Contaminants - groundwater 15,000 cubic meters (20,000 cubic yards); engineered units 1,500 cubic meters (1,900 cubic yards)
Long-Term Stewardship Start-End Years - 1998-2070
Average Annual Long-Term Stewardship Cost FY 2000-2006 - n/a (costs begin in FY2009)

Pit 6 Landfill (OU#3) Release Site Cleaned Up That Requires Long-Term Stewardship Activities

- Pit 6 Landfill

This portion is within the boundaries of the Site 300 property. The landfill is covered by an engineered landfill cap. Volatile organic compounds, tritium, perchlorate, and nitrate are present in groundwater beneath the landfill.



Pit 6 Landfill (OU#3)

3.3.1 Groundwater

The groundwater begins approximately 7.6 to 23 meters (25 to 75 feet) below the surface of the Pit 6 Landfill in the alluvial sand and gravel deposits, and extends to the lower blue sandstone bedrock. While the depth to groundwater below the ground surface can vary seasonally by several meters, the water table has consistently remained at least 4.6 meters (15 feet) below the bottom of the buried waste. Shallow, unconfined groundwater flows to the southeast at an estimated average rate of 9 to 21 meters (30 to 70 feet) per year. During some winter rainy seasons, groundwater has been observed to flow intermittently from springs along the edge of the alluvial terrace. Data also indicate that the northern limit of the Carnegie Fault Zone acts as a hydraulic barrier to the flow of groundwater in the lower blue sandstone.

Monitoring activities have determined that the groundwater is contaminated from leaching contaminants in the buried waste. Approximately 1.4 hectares (3.5 acres) and 15,000 cubic meters (20,000 cubic yards) of groundwater at the Pit 6 Landfill is contaminated with trichloroethylene, tritium, perchlorate, and nitrate. These contaminants are present in the groundwater in the uppermost aquifer beneath the landfill area. The groundwater from this aquifer reaches the surface at a location approximately 152 meters (500 feet) west of the landfill within the site boundary. The contaminants slowly evaporate from the surface in this area. The concentrations of volatile organic compounds in the groundwater have dropped significantly since 1987 due to natural attenuation and are close to or below the enforceable drinking water standards (i.e. the MCLs allowed in drinking water.) Tritium levels in the groundwater are above the background levels in four groundwater monitoring wells; however, these tritium concentrations are still below the enforceable drinking water standards (i.e., 20,000 picocuries per liter). Perchlorate has been detected in the groundwater at concentrations of up to 47 parts per billion, which is above the State Action Level of 18 parts per billion. Nitrate has also been detected in the

groundwater at concentrations exceeding the MCLs.

In 1971, DOE excavated the portion of the waste containing uranium-238, and in 1997, the landfill was capped to prevent further leaching of contaminants via infiltration of rainwater into the buried waste. The release site for Pit 6 was verified to be complete in 1998.

Groundwater Long-Term Stewardship Activities

The Pit 6 Landfill was capped and closed in accordance with CERCLA to prevent further releases of contaminants from the landfill. Assuming the preferred remedial alternative contained in the *Proposed Plan* is selected as part of the Site-Wide Interim ROD, remedial components will include risk and hazard management to prevent exposure to contaminants and the monitoring and modeling of contaminants of concern in the groundwater to: (1) determine if plumes are migrating and ensure that there is no impact to people living down-gradient of the plume; (2) evaluate the effectiveness of natural attenuation of contaminants in the groundwater to meet cleanup standards; (3) identify any toxic by-products resulting from biodegradation; (4) verify attainment of cleanup standards; and (5) assess if risk and hazard management goals are achieved for the contaminants found in the groundwater.

The preliminary cleanup levels are set to Federal MCLs allowed in drinking water. These levels could change once the Final ROD (scheduled to be released in 2007) is completed. DOE expects to achieve these target cleanup standards by 2065.

3.3.2 Engineered Units

The Pit 6 Landfill engineered cap is about one hectare (2.4 acres) in size and extends more than 7.6 meters (25 feet) beyond the perimeter of the buried waste trenches and animal pits. In some areas, the cap extends farther due to uncertainties in the exact location of the buried waste and to cover areas where volatile organic compounds in the subsurface had potential to cause worker inhalation exposure. Approximately 1,453 cubic meters (1,900 cubic yards) of mixed low-level radioactive waste are buried in three unlined trenches and six animal pits that have since been covered by the engineered landfill cap.

The cap consists of several layers, i.e, from the surface down: (1) a 0.6-meter (two-foot) topsoil and vegetative layer, (2) a geocomposite drainage layer and biotic barrier, (3) a high-density polyethylene liner over a bonded bentonite clay layer, (4) a 0.6-meter (2-foot) compacted native soil layer, and (5) geogrid reinforcement material overlaying the waste.

Engineered Units Long-Term Stewardship Activities

Past monitoring activities had determined that the groundwater was being contaminated from leaching contaminants in the buried waste. Therefore, in 1971, DOE excavated the portion of the waste containing uranium-238. In addition, the Pit 6 Landfill was capped and closed in 1997, in accordance with CERCLA, to prevent further leaching of contaminants via infiltration of rainwater into buried waste. The engineered cap is intended to prevent rainwater infiltration into the buried waste, mitigate potential damage by burrowing animals and vegetation, prevent potential hazards from the collapse of void spaces in the buried waste, and prevent the potential flux of volatile organic compound vapors through the soil. The cap is designed to sustain minimal damage to its liner integrity in case of an earthquake at the nearby fault and to accommodate ongoing activities (i.e., support the installation and use of a rifle range on top of the cap).

As required by the California Code of Regulations Titles 22 and 23, a Post-Closure Monitoring Plan was prepared that requires the continued monitoring of groundwater to assess the effectiveness of the landfill cap in

preventing future releases of contaminants. The Post-Closure Plan for the Pit 6 Landfill also requires ongoing surveillance and monitoring of the cap and diversion or drainage structures to ensure they remain in good operating condition.

3.3.3 Estimated Long-Term Stewardship Costs for the Pit 6 Landfill (OU#3)

In developing these cost estimates for the Pit 6 Landfill operable unit/portion, DOE assumed that long-term stewardship activities included surveillance and maintenance of the landfill cap, groundwater monitoring, and exposure control through risk and hazard management. DOE used tritium as the target contaminant for projecting cleanup schedules. See Section 2.3, Assumptions and Uncertainties, and Section 2.4, Estimated Site-Wide Long-Term Stewardship Costs, for a complete listing of the assumptions used for developing these costs. The same assumptions were used for the cost estimates for this portion.

Long-Term Stewardship Costs (Constant Year 2000 Dollars)							
FY 2000 - FY 2010	***FY 2011 - FY 2020***	***FY 2021 - FY 2030***	***FY 2031 - FY 2040***	***FY 2041 - FY 2050***	***FY 2051 - FY 2060***	***FY 2061 - FY 2070***	***Estimated Total***
$112,000	$338,000	$141,000	$59,000	$25,000	$10,000	$5,000	$690,000

3.4 High Explosives Process Area (OU#4)

The High Explosives Process Area operable unit (OU#4) is a 50-hectare (125-acre) area that has several release sites, located mainly at Buildings 815 and 810, the former High Explosives Process Area wastewater lagoons, the former High Explosives Process Area burn pits, and their associated groundwater plumes. From 1958 to 1986, Building 815 served as a central steam plant for the High Explosives Process Area. Spills and releases from operations in this area, where trichloroethylene was routinely used to clean pipelines, have resulted in soil and groundwater contamination. In addition, from 1959 to 1985, waste fluids were discharged to dry well 810A, resulting in volatile organic compound releases to the subsurface soil.

HIGH EXPLOSIVES PROCESS AREA (OU#4) HIGHLIGHTS

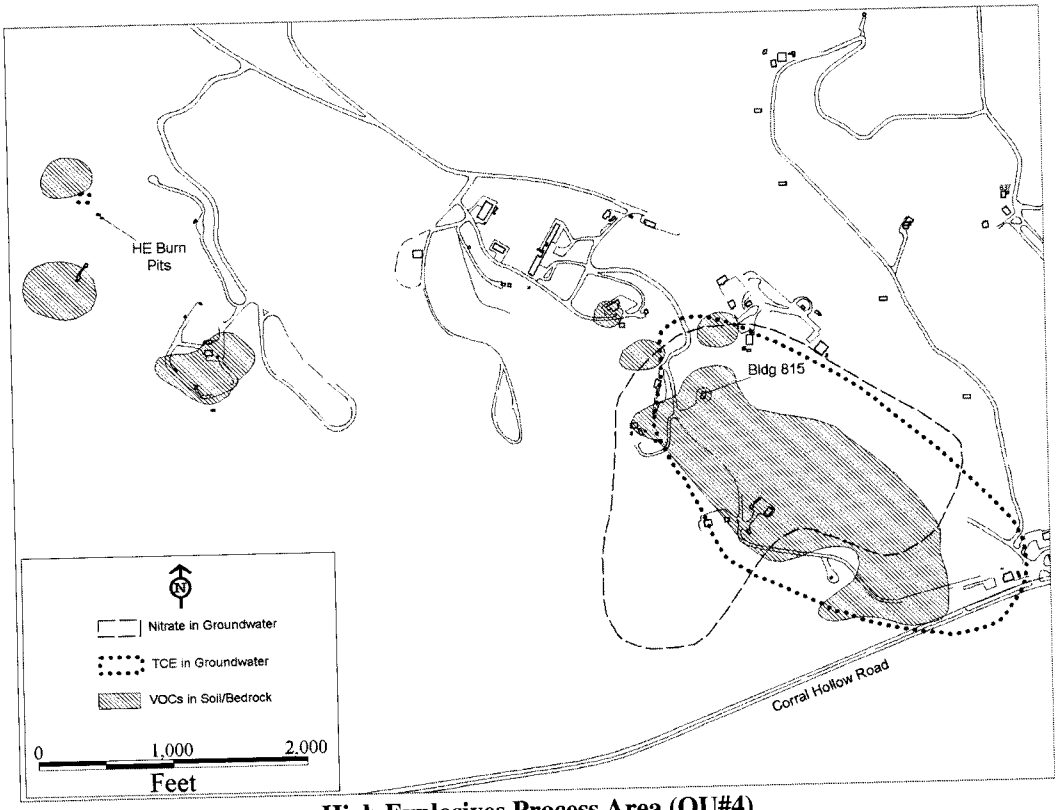
Major Long-Term Stewardship Activities -treatment facility operation and maintenance; groundwater monitoring; exposure control through risk and hazard management; remediation optimization
Portion Size - 50 hectares (125 acres)
Estimated Volume of Residual Contaminants - groundwater 42.5 million cubic meters (55.5 million cubic yards); soil 16,000 cubic meters (20,000 cubic yards)
Long-Term Stewardship Start-End Years - 1999-2042
Average Annual Long-Term Stewardship Cost FY 2000-2006 - n/a (costs begin FY 2009)

High Explosives Process Area (OU#4) Release Sites Expected to Be Cleaned Up By 2006 and Expected to Require Long-Term Stewardship Activities

- Building Groundwater Project

From the mid- to late-1950s to 1985, wastewater from high explosives formulation and machining operations was discharged to the former High Explosives Process Area unlined rinse water lagoons (HE rinse water lagoons). This wastewater subsequently leached to the subsurface soil, leading to high explosive compounds [high melting explosive (HMX), research department explosive (RDX)], nitrate, and perchlorate migrating to the surrounding soil and groundwater. DOE closed these unlined rinse water lagoons in 1989.

There were three High Explosives Process Area burn pits (HE burn pits) located in the vicinity of Building 829 and regulated under the Resource Conversation and Recovery Act. They were operated from the late 1950s until their closure in 1998. The HE burn pits were used to burn high explosive particulates and cuttings, explosive



High Explosives Process Area (OU#4)

chemicals, and explosives-contaminated debris. As a result, high explosive compounds, volatile organic compounds, nitrate, and perchlorate were released into the surrounding environment and groundwater. Two extraction and treatment systems have been in operation at the High Explosives Process Area to remediate groundwater at the operable unit site boundary and at the Building 815 source area. These systems initiated operations in 1999 and 2000, respectively.

3.4.1 Soil

The High Explosives Process Area is underlain primarily by clay with sand and gravel. These clay, sand and gravel deposits are underlain by sandstone and siltstone/claystone bedrock. Shallow soil and bedrock are unsaturated to depths of 7.6 to 15 meters (25 to 50 feet). Approximately 26.7 hectares (66 acres) and 16,000 cubic meters (20,000 cubic yards) of soil are contaminated with trichloroethylene at the High Explosives Process Area. A large portion of this area of contaminated soil is the result of the migration of contaminants in groundwater through saturated soil. The contaminants of concern in the subsurface soil and rock are the high explosive compounds (high melting explosive, research department explosive), and volatile organic compounds. High melting explosives and research department explosives also have been detected in surface soil, and volatile organic compounds have been found in shallow soil and bedrock in the vicinity of Building 815. High explosive compounds and trichloroethylene have been detected in shallow soil and bedrock in the vicinity of the HE rinse water lagoons. Low levels of high explosive compounds and volatile organic compounds are also present in shallow subsurface soils in the vicinity of the HE burn pits.

Soil Long-Term Stewardship Activities

Assuming that the preferred remedial alternative contained in the *Proposed Plan* is selected in the Site-Wide Interim ROD, groundwater will be monitored to determine if contaminants in surface and subsurface soil and bedrock impact groundwater in the future. No further action is proposed for contaminants in subsurface soil and bedrock at the HE rinse water lagoons and the HE burn pits because: (1) source control measures have already been implemented to prevent further impact to groundwater; (2) there is no risk or hazard to human health or ecological receptors currently posed by these contaminants; (3) the existing groundwater contamination is addressed through groundwater extraction and treatment; and (4) there is no practical treatment for non-volatile substances in bedrock except excavation, which would be costly at the depths where some of the high explosive compounds occur.

3.4.2 Groundwater

DOE identified six hydrogeologic units (water-bearing rocks) in the High Explosives Process Area. The four principle water-bearing strata are alluvial deposits, the nonmarine sediments, the upper blue sandstone, and the lower blue sandstone units. Groundwater has been encountered locally in the alluvial sand and gravel and the siltstone and claystone hydrogeologic units. The siltstone and claystone hydrogeologic units function as confining layers preventing the downward flow of groundwater into the deeper water-bearing units. Groundwater in the nonmarine sediments collects (is perched) above these impermeable confining layers in the northern part of the High Explosives Process Area. The upper blue sandstone aquifer is saturated in the High Explosives Process Area in southeastern Site 300. Depth to groundwater ranges from 3 meters (10 feet) below the ground surface in the shallow alluvial sand and gravel deposits to up to 114 meters (375 feet) in the lower blue sandstone. This lower blue sandstone water-bearing bedrock (which underlies the High Explosives Process Area) serves as local, offsite water-supply aquifer.

Approximately 50 hectares (125 acres) and 42.5 million cubic meters (55.5 million cubic yards) of groundwater at the High Explosives Process Area are contaminated with trichloroethylene, nitrate, perchlorate, and high explosive compounds. Volatile organic compounds have been detected in the groundwater in the vicinity of Building 815. Trichloroethylene concentrations in the Building 815 area groundwater have decreased from a maximum of 450 parts per billion in 1992 to 330 parts per billion in 1998. Concentrations of other volatile organic compounds have also decreased, with most concentrations occurring below levels detectable by commonly-used laboratory measurement instruments. Concentrations of all volatile organic compounds, except for trichloroethylene, are currently below the MCLs allowed in drinking water. High explosive compounds, nitrate, and perchlorate have also been detected in groundwater in the vicinity of the HE rinse water lagoons, but these contaminant concentrations are decreasing or remain at stable concentrations. Contaminants originating from the HE rinse water lagoons have, to an extent, mixed with volatile organic compounds in the groundwater originating from the Buildings 815 and 810 area.

Volatile organic compounds, nitrate, and perchlorate have been detected in groundwater in shallow bedrock in the vicinity of the HE burn pits. The HE burn pits are geologically isolated from other contaminated areas in the High Explosives Process Area. Trichloroethylene has been detected in a monitoring well adjacent to a spring (Spring 5), located approximately 240 meters (800 feet) south of Building 815. Groundwater from this monitoring well feeds Spring 5, which supports wetland-type vegetation, but there is no actual measurable water flowing into Spring 5; therefore, there is no means for humans or animals to be exposed to contaminants in the spring. DOE believes that the trichloroethylene concentrations detected in Spring 5 originate from contamination at Building 815.

Groundwater Long-Term Stewardship Activities

In 1999, DOE initiated groundwater extraction and treatment at the site boundary of the High Explosives Process Area to prevent the offsite migration of a groundwater plume (originating at Building 815) of volatile organic compounds. In 2000, DOE installed an additional groundwater extraction and treatment system to reduce contaminant concentrations at the Building 815 release site and prevent trichloroethylene-contaminated groundwater from moving offsite. The preliminary cleanup levels are set to MCLs allowed in drinking water. These levels could change once the Final ROD (scheduled for release in 2007) is completed. DOE expects to achieve these target cleanup levels by 2037.

Assuming the preferred remedial alternative contained in the *Proposed Plan* is selected as part of the Site-Wide Interim ROD, onsite controls will include: (1) groundwater monitoring to track changes in plume concentration and size as remediation progresses, evaluate the effectiveness of the remedial action, and determine when cleanup standards are met; (2) risk and hazard management to prevent contaminant exposure to humans and impacts to ecological receptors until cleanup standards are achieved through active remediation; (3) control of contaminant migration by extracting and treating groundwater using carbon adsorption at the leading edge of the Building 815 trichloroethylene-contaminated groundwater plume; (4) control of the contaminant source area and groundwater plume migration by extracting and treating groundwater using carbon adsorption and biodegradation to remove volatile organic compounds, high explosives compounds, nitrate, and perchlorate released from Building 815 and the HE rinse water lagoons; and (5) control of contaminant migration by extracting and treating groundwater using carbon adsorption and biodegradation in a bioreactor to remove volatile organic compounds, nitrate, and perchlorate released from the HE burn pits.

3.4.3 Estimated Long-Term Stewardship Costs for the High Explosives Process Area (OU#4)

In developing these cost estimates for the High Explosives Process Area operable unit/portion, DOE assumed that long-term stewardship activities included treatment facility operation and maintenance, groundwater monitoring, exposure control through risk and hazard management, and remediation optimization. DOE used trichloroethylene as the target contaminant for projecting cleanup schedules. See Section 2.3, Assumptions and Uncertainties, and Section 2.4, Estimated Site-Wide Long-Term Stewardship Costs, for a complete listing of the assumptions used for developing these costs. The same assumptions were used for the cost estimates for this portion.

Long-Term Stewardship Costs (Constant Year 2000 dollars)							
FY 2000 - FY 2010	***FY 2011 - FY 2020***	***FY 2021 - FY 2030***	***FY 2031 - FY 2040***	***FY 2041 - FY 2050***	***FY 2051 - FY 2060***	***FY 2061 - FY 2070***	***Estimated Total***
$1,588,000	$4,496,000	$1,367,000	$225,000	$7,000	$0	$0	$7,683,000

3.5 Building 850/Pits 3 and 5 (OU#5)

The Building 850/Pits 3 and 5 operable unit (OU#5) is a 165-hectare (409-acre) site located in the East Firing Area and West Firing Area of Site 300. DOE has divided the unit into three sections for cleanup evaluation purposes: the Building 850 Firing Table area, the Pit 7 Complex (i.e., Pits 3, 4, 5, and 7 Landfills, which are co-located in the West Firing Area), and the Pit 2 Landfill area, which is located in the East Firing Area. Pit 1 also is located in the East Firing Area near Pit 2; however, there is no evidence of contaminants being released from this landfill and, therefore, DOE is not remediating Pit 1. DOE conducted high explosives experiments at the Building 850 firing table, and then the firing table gravels were periodically disposed of in several disposal pits in the Pit 7 Complex.

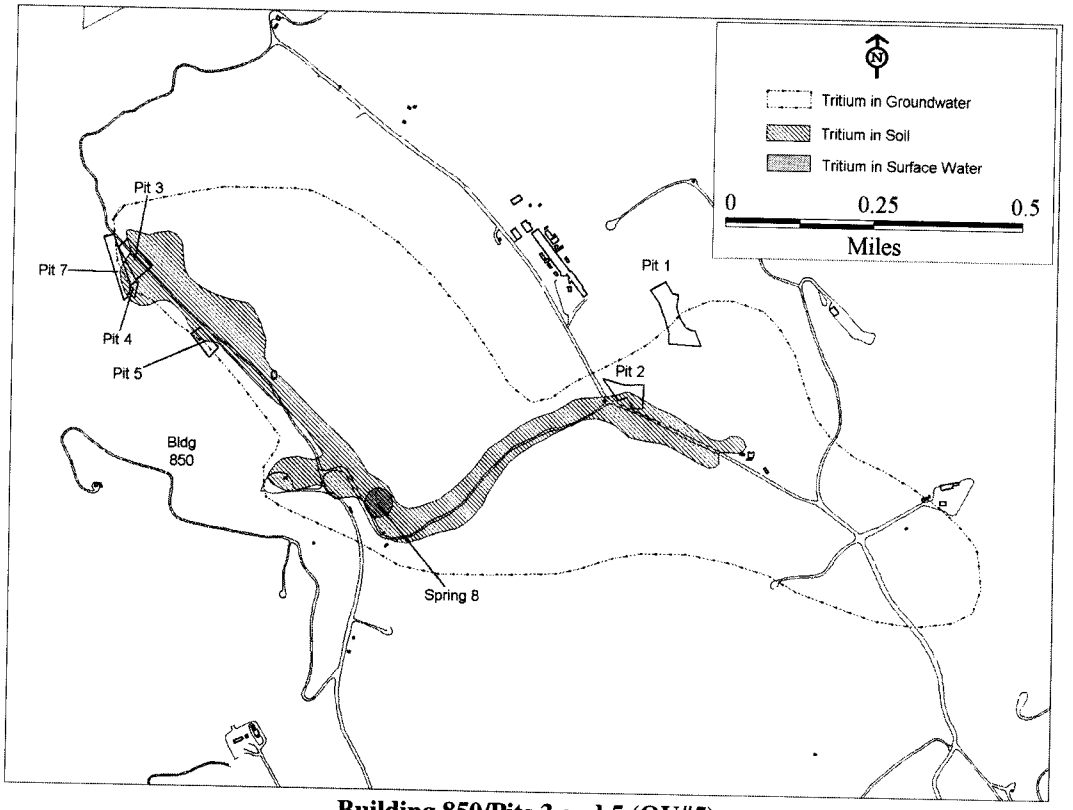
Releases from contaminated gravel and debris at the firing table, as well as in the Pit 7 Complex, have resulted in tritium and uranium-238 contamination in the soil and bedrock. High explosive compounds, metals, and polychlorinated biphenyls also were found in surface soil near the Building 850 firing table. Tritium is the primary contaminant in groundwater in this operable unit, but uranium-238, trichloroethylene, nitrate, and perchlorate also have been found in the area surrounding the Building 850 firing table and the Pit 7 Complex. In 1992, DOE completed capping the Pits 1, 4 and 7 Landfills. Ongoing remediation activities have resulted in the completion of three release sites. The nearby Pit 2 Landfill, operated from 1956 to 1960, contains firing table waste from Buildings 801 and 802. There is no evidence of contaminant releases from the Pit 2 Landfill.

BUILDING 850/PITS 3 and 5 (OU#5) HIGHLIGHTS

Major Long-Term Stewardship Activities - groundwater monitoring; exposure control through risk and hazard management; long-term surveillance and maintenance of the landfills; remediation optimization
Portion Size - 165 hectares (409 acres)
Estimated Volume of Residual Contaminants - groundwater - 3.7 million cubic meters (4.8 million cubic yards); soil 120,000 cubic meters (160,000 cubic yards); engineered units 39,500 square meters (47,300 square yards)
Long-Term Stewardship Start-End Years - 1994-2070
Average Annual Long-Term Stewardship Cost FY 2000-2006 - n/a (costs begin FY 2009)

3.5.1 Soil

The Building 850 and Pit 7 Complex area is underlain by unconsolidated alluvial silts, sands, and gravels that were deposited in the valley bottom of the Elk Ravine drainage. These alluvial deposits are variably saturated depending on the rainfall. These deposits are underlain by the lower blue sandstone bedrock. Data collected in



Building 850/Pits 3 and 5 (OU#5)

the vicinity of the Pit 7 Complex indicate that unsaturated soil/bedrock, and at times the pit contents, become saturated from heavy rainfall and leach/release contaminants from the soil/rock and waste to groundwater.

Approximately 21 hectares (53 acres) and 120,000 cubic meters (160,000 cubic yards) of contaminated soil exist at the Building 850/Pits 3 and 5 site portion. Much of this contaminated soil resulted from the migration of contaminated groundwater through saturated soil and bedrock. Soil and bedrock contamination at this portion is largely attributable to the leaching of tritium and uranium-238 from firing table debris, at the Building 850 firing table area and buried in Pits 3, 5, and 7. In 1988, tritium was detected at the Building 850 firing table at a maximum level of 11,000,000 picocuries per liter of soil moisture in the subsurface soil at a 1.5-meter (five-foot) depth beneath the Building 850 firing table gravel. Tritium activities up to 2,790,000 picocuries per liter of soil moisture were detected in subsurface bedrock in boreholes directly adjacent to the firing table at depths up to 6 meters (20 feet) below ground surface. Uranium-238 was also detected in subsurface soil at a maximum activity of 28.2 picocuries per gram. Tritium and uranium-238 have leached from the subsurface soil and rock to groundwater; however, the data indicate that the source of these radionuclides in the soil and rock is diminishing.

Because of the dispersion of contaminated shrapnel during explosives testing, the surface soil in the vicinity of the Building 850 firing table also was contaminated with various metals, polychlorinated biphenyls, high melting explosive compounds, and uranium. Dioxins and furans have also been identified as contaminants of concern in the surface soils at Building 850. Polychlorinated biphenyls have been detected in surface soil at concentrations of up to 180 parts per million in the vicinity of the firing table. Dioxins and furans also have been detected in surface soil but at much lower concentrations – 0.0096 parts per million and 0.057 parts per million, respectively. The metals beryllium, cadmium, and copper have been detected in surface soil at maximum concentrations of 15 parts per million, nine parts per million, and 1,000 parts per million, respectively. Modeling indicated that these concentrations of polychlorinated biphenyls, dioxins and furans in surface soil posed an excess cancer risk above levels considered by EPA to be protective of human health.

At the Pit 7 Complex, tritium and uranium-238 have been identified as contaminants of concern in the surface soil, subsurface soil, and bedrock, i.e., up to 24 picocuries of uranium-238 per gram were detected in surface soil, and 2.4 picocuries per gram were detected in subsurface soil and bedrock. In 1984, up to 18,100 picocuries of tritium per liter of soil moisture were detected in surface soil, and up to 8,090,000 picocuries per liter of soil moisture were detected in subsurface soil and bedrock.

Soil Long-Term Stewardship Activities

Assuming the preferred remedial alternative contained in the *Proposed Plan* is selected as part of the Site-Wide Interim ROD, onsite soil and bedrock controls for the completed release sites and those remaining in this portion will include: (1) risk and hazard management to prevent contaminant exposure to humans and impacts to ecological receptors until cleanup standards are achieved through active remediation; (2) monitoring contaminants in groundwater to track changes in plume concentrations/activities to evaluate the effectiveness of source control measures and natural attenuation of contaminants in groundwater and surface water to health- and environmentally- protective levels, as well as to ensure there is no impact to downgradient receptors; (3) the removal of PCB-, dioxin-, and furan-contaminated surface soil in the Building 850 firing table area; and (4) removal of a sand pile contaminated with tritium adjacent to the Building 850 firing table.

The ROD schedule is currently being negotiated with the regulatory agencies. The Pit 7 Complex was not included in the Site-Wide *Proposed Plan* because DOE and regulatory agencies agreed that further evaluation of this area was necessary before a remedial action could be selected. In the future, DOE will prepare an area-specific Remedial Investigation/Feasibility Study and an Amendment to the ROD for the Pit 7 Complex. The final engineering controls to be implemented at the Pit 7 Complex will be selected as part of the Final Record

of Decision.

3.5.2 Groundwater

The Building 850/Pits 3 and 5 area is underlain by one hydrogeologic unit made up of three stratigraphic units: alluvial sand and gravel, lower blue sandstone bedrock, and sandstone/siltstone bedrock. DOE has identified two water-bearing shallow zones in this hydrogeologic unit. The two water-bearing zones are separated by a thick claystone layer that acts as an impermeable confining layer that prevents the flow of groundwater between the two water-bearing zones. Groundwater can occur at 4.6 meters (15 feet) below the soil surface (e.g., at the Pits 3 and 5 valley region) to 23 meters (75 feet) below the ground surface (e.g., in the hills above Pit 1).

Approximately 165 hectares (409 acres) and 3.7 million cubic meters (4.8 million cubic yards) of groundwater are contaminated at the Building 850/Pits 3 and 5 portion. Contamination in this area originates mainly from the Building 850 firing table and from Pits 3, 5, and 7 Landfills. Tritium is the primary contaminant in groundwater, but trichloroethylene and 1,1-dichloroethene have also been detected downgradient of Pit 5. Uranium isotope signatures characteristic of depleted uranium (i.e., uranium with the uranium-235 isotope extracted, leaving almost entirely uranium-238) have also been identified downgradient of Pits 5 and 7 and Building 850. Although tritium was found in the groundwater in the vicinity of Pit 2, it appears to originate upgradient at the Building 850 area. Other groundwater contaminants are nitrate and perchlorate.

Contaminants of concern identified in the groundwater in the vicinity of Pit 3 and 5 Landfills were released to the subsurface soil from the pits. In 1998, a maximum tritium level of 2,660,000 picocuries per liter in the groundwater near the Pit 3 and 5 Landfills was detected, indicating continued releases of tritium from these pits. These levels exceed the drinking water standard for tritium (20,000 picocuries per liter). Periodic spikes of tritium in groundwater occur in conjunction with elevated rainfall periods. During such periods, groundwater levels rise to the bottom of the Pit 3 and 5 Landfills, thus releasing tritium into the groundwater. Previous releases of tritium from the Pit 7 Landfill to groundwater occurred prior to the installation of the engineered cap. Although elevated tritium levels were detected in the shallow soil between the Pit 3 Landfill and the Pit 4 Landfill, elevated tritium concentrations have not been detected in groundwater from wells immediately downgradient of the Pit 4 Landfill.

Also in 1998, uranium-238 was detected in the groundwater in the vicinity of the Pit 3 and 5 Landfills at a maximum level of 187 picocuries per liter, exceeding the drinking water standard for total uranium (20 picocuries per liter). The extent of uranium-238 in groundwater is limited to the area immediately adjacent to the pits. Trichloroethylene and 1,1-dichloroethene have been detected in groundwater downgradient of the Pit 5 Landfill. From 1995 to 1998, the concentration of volatile organic compounds declined in the vicinity of the Pit 5 Landfill with trichloroethylene concentrations decreasing from a maximum of 15 parts per billion (in 1995) to 3.5 parts per billion (in 1998). Recent measurements of 1,1-dichloroethene are below one part per billion, which is below drinking water standards.

Pits 1 and 7 operated until November 1988, when DOE discontinued their use. By 1992, DOE completed closure of Pits 1 and 7 pursuant to the requirements of the Resource Conservation and Recovery Act. Guard wells (monitoring wells) within 610 meters (2,000 feet) of the site boundary indicate that elevated tritium levels do not occur along any viable flow path to human receptors. DOE is adding new monitoring wells further to the east to better define the eastern extent of the groundwater plumes from the Building 850/Pit 7 complex.

Tritium activities in groundwater in the vicinity of Building 850 have decreased from 471,000 picocuries per liter in 1984 to 96,500 picocuries per liter in 1998. Data indicate that the source of tritium in the Building 850 area, as well as the plume originating from this area, is diminishing. Uranium-238 activities in groundwater have decreased from a maximum of 18.4 picocuries per liter to less than 4 picocuries per liter in the Building 850 area,

below both the drinking waste standard (20 picocuries per liter) and background levels for total uranium. Nitrate concentrations in groundwater have also decreased from 140 milligrams per liter (in 1995) to 97 milligrams per liter (in 1998). Nitrate and perchlorate have also been detected in groundwater downgradient of the Pit 7 Complex. Nitrate has decreased from a maximum of 195 parts per million (ppm) in 1993 to 120 ppm in 1998. Perchlorate was first detected in 1998 at a maximum concentration of 6.4 parts per billion. Recent measurements of 1,1-dichloroethene concentrations have been recorded at below 1 part per billion. These declines are likely attributable to natural attenuation.

Groundwater Long-Term Stewardship Activities

Assuming the preferred remedial alternative contained in the *Proposed Plan* is selected as part of the Site-Wide Interim Record of Decision, onsite groundwater controls will include: (1) risk and hazard management to prevent contaminant exposure to humans and impacts to ecological receptors until cleanup standards are achieved through active remediation; (2) monitoring contaminants in groundwater to track changes in plume concentrations/activities, and evaluate the effectiveness of source control measures and natural attenuation of contaminants in groundwater and surface water; and (3) monitored natural attenuation of tritium in groundwater.

The ROD schedule is currently being negotiated with the regulatory agencies. The Pit 7 Complex was not included in the Site-Wide *Proposed Plan* because DOE and regulatory agencies agreed that further evaluation of this area was necessary before a remedial action could be selected. In the future, DOE will prepare an area-specific Remedial Investigation/Feasibility Study and Amendment to the Record of Decision for the Pit 7 Complex. The final engineering controls to be implemented at the Pit 7 Complex will be selected as part of the Final ROD.

The preliminary cleanup levels are set at MCLs allowed in drinking water and DOE expects to achieve these target cleanup levels by 2065. However, these levels could change once the Record of Decision is completed.

3.5.3 Surface Water/Sediment

Approximately 0.4 hectare (1 acre) of the surface water/sediment in the Building 850/Pits 3 and 5 area is contaminated. A plume of tritium in groundwater, extending downgradient from Building 850, previously discharged at a rate of 190 liters (50 gallons) per minute or less to the ground's surface via a pipe inserted into the ground. The pipe discharge created a moist area on the ground that was called Well 8 Spring. DOE had detected tritium at the Well 8 Spring with an activity as high as 770,000 picocuries per liter in the early 1970s, but levels had declined through natural attenuation to less than 40,000 picocuries per liter in 1998.

Surface Water/Sediment Long-Term Stewardship Activities

As the water discharged at Well 8 Spring is fed by groundwater, the preferred alternative for groundwater remediation in the *Proposed Plan* also will address contamination in Well 8 Spring.

3.5.4 Engineered Units

Prior to 1990, tritium was used during explosives testing in the East Firing Area and West Firing Area of Site 300. Tritium became entrained in gravel used to cover the firing tables and was periodically disposed of in several disposal pits (Pits 1, 2, 3, 4, 5, and 7) in the northern portion of the site. Pits 3, 4, 5, and 7 are located in the West Firing Area and are frequently referred to as the Pit 7 Complex. Pits 1 and 2 are located in the East Firing Area and, although neither has been determined to be a source of groundwater contamination, ongoing monitoring is required to determine whether there could be future problems. DOE estimates that 39,500 square meters (47,300 square yards) of engineered units exist at the Building 850/Pits 3 and 5 area.

All six disposal pits are unlined trenches into which firing table gravel and debris were disposed. However in 1989, Pits 1,4 and 7 underwent a Resource Conservation and Recovery Act closure, and at that time, Pits 1, 4, and 7 were covered with engineered caps. The pit caps consist of several layers: (1) a topsoil and vegetative layer, (2) a geocomposite drainage layer and biotic barrier, (3) a low permeability clay layer, (4) a 0.6-meter (2-foot) compacted native soil layer, and (5) geogrid reinforcement material overlaying the waste. The caps are intended to prevent rainwater infiltration into the buried waste, mitigate potential damage by burrowing animals and vegetation, prevent potential hazards due to collapse of void spaces in the buried waste, and prevent the potential flux of volatile organic compound vapors through the soil. Furthermore, surface water flow onto the area is prevented by drainage channels constructed at the pit edges.

The volume of residual contamination varies depending on the particular unlined trench/disposal pit, i.e., Pit 1 (330 cubic meters or 390 cubic yards); Pit 2 (21,250 cubic meters or 25,412 cubic yards); Pit 3 (22,000 cubic meters or 26,000 cubic yards); Pit 4 (2,300 cubic meters or 2,800 cubic yards); Pit 5 (25,000 cubic meters or 29,910 cubic yards); and Pit 7 (26,000 cubic meters or 31,100 cubic yards). Firing table gravel and debris, primarily from the Building 850 firing table, were disposed of in Pits 3, 4, 5, and 7. VOCs, tritium, uranium-238, nitrate, and perchlorate have been detected in groundwater directly downgradient of the pits, indicating the buried waste is the source of these releases. A maximum tritium activity of 2,660,000 picocuries per liter in groundwater near the Pit 3 and 5 Landfills was detected in 1998, indicating that tritium is still present in and being released from the waste in these pits.

Engineered Units Long-Term Stewardship Activities

In 1989, DOE began closing Pits 1 and 7 pursuant to the requirements of the Resource Conservation and Recovery Act. DOE covered the pits with engineered caps. DOE also covered Pit 4 due to its proximity to Pit 7 and the cap design. The caps are intended to prevent rainwater infiltration into the buried waste; mitigate potential damage by burrowing animals and vegetation; prevent potential hazards due to collapse of void spaces in the buried waste; and prevent potential flux of volatile organic compound vapors through the soil. Furthermore, surface water flow onto the area is prevented by drainage channels constructed at the pit edges.

As required by the California Code of Regulations, Titles 22 and 23, a Post-Closure Monitoring Plan was prepared that prescribes the continued monitoring of groundwater to assess the effectiveness of the landfill cap in preventing future releases of contaminants. The Post-Closure Plan for the Pit 1 and 7 Landfills also requires ongoing surveillance and monitoring of the caps and diversion or drainage structures to ensure they remain in good operating condition. The Pit 7 Complex was not included in the Site-Wide *Proposed Plan* because DOE and regulatory agencies agreed that further evaluation of this area was necessary before a remedial action could be selected. In the future, DOE will prepare an area-specific Remedial Investigation/Feasibility Study and Amendment to the ROD for the Pit 7 Complex. The final engineering controls to be implemented at the Pit 7 Complex will be selected as part of the Final ROD.

3.5.5 Estimated Long-Term Stewardship Costs for Building 850/Pits 3 and 5 (OU#5)

In developing these cost estimates for the Building 850/Pits 3 and 5 operable unit/portion, DOE assumed that long-term stewardship activities included long-term surveillance and maintenance of the landfill caps, groundwater monitoring, exposure control through risk and hazard management, and remediation optimization. DOE used tritium as the target contaminant for projecting cleanup schedules. See Section 2.3, Assumptions and Uncertainties, and Section 2.4, Estimated Site-Wide Long-Term Stewardship Costs, for a complete listing of the assumptions used for developing these costs. The same assumptions were used for the cost estimates for this portion.

Long-Term Stewardship Costs (Constant Year 2000 Dollars)							
FY 2000 - FY 2010	*FY 2011 - FY 2020*	*FY 2021 - FY 2030*	*FY 2031 - FY 2040*	*FY 2041 - FY 2050*	*FY 2051 - FY 2060*	*FY 2061 - FY 2070*	*Estimated Total*
$451,000	$1,367,000	$569,000	$237,000	$99,000	$41,000	$17,000	$2,781,000

3.6 Building 854 (OU#6)

BUILDING 854 (OU#6) HIGHLIGHTS

Major Long-Term Stewardship Activities - treatment facility operation and maintenance; groundwater monitoring; exposure control through risk and hazard management; remediation optimization
Portion Size - 35 hectares (86 acres)
Estimated Volume of Residual Contaminants - groundwater 170,000 cubic meters (220,000 cubic yards); soil 250,000 cubic meters (330,000 cubic yards)
Long-Term Stewardship Start-End Years - 1999-2032
Average Annual Long-Term Stewardship Cost FY 2000-2006 - n/a (costs begin FY 2009)

The Building 854 area is a 35-hectare (86-acre) operable unit (OU#6) composed mainly of facilities that were involved in materials testing. These facilities used trichloroethylene as the primary heat transfer fluid in a brine cooling system. The brine system leaked, releasing trichloroethylene to the subsurface soil in the vicinity of Building 854. Tritium, high melting explosive compounds, metals, and polychlorinated biphenyls were also released to the surface soil in the vicinity of Building 854. DOE removed the brine system in 1989 and excavated and removed some of the trichloroethylene-contaminated soil in 1983. In 1999, an extraction and treatment system was installed to remediate contaminated groundwater at the Building 854 source area.

3.6.1 Soil

Building 854 (OU#6) Release Sites Expected to Be Cleaned Up By 2006 and Expected to Require Long-Term Stewardship Activities

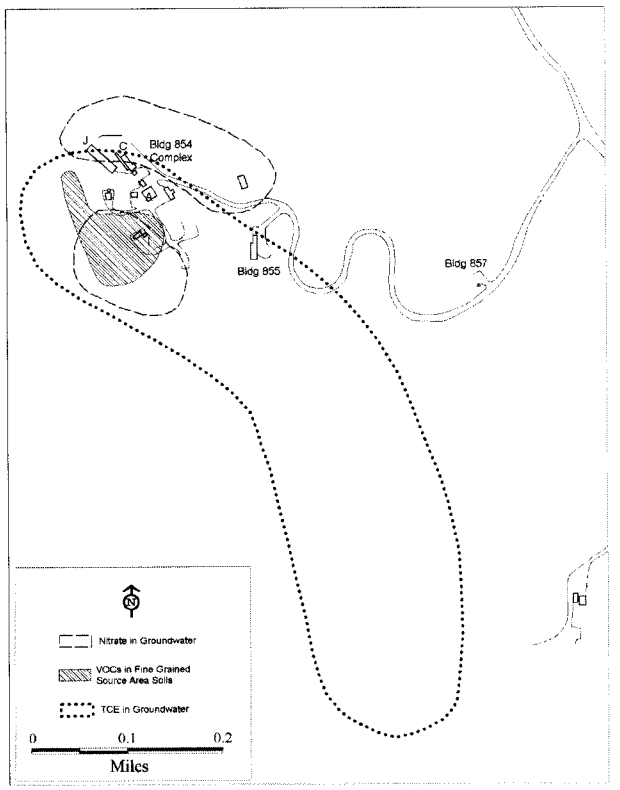
- Building 854 Groundwater Project
- Building 854H Drain Outfall
- Building 855 Lagoon

Much of the Building 854 area is underlain by a landslide deposit which appears to be unsaturated throughout the site. These deposits are underlain by lower blue sandstone bedrock. The sandstone is unsaturated to depths of up to 55 meters (180 feet) below the surface soil.

Approximately 1.2 hectares (3 acres) and 250,000 cubic meters (330,000 cubic yards) of soil at the Building 854 area are contaminated with volatile organic compounds. Soil and bedrock in the Building 854 area were contaminated by releases of trichloroethylene, tritium, high melting explosive compounds, metals, and polychlorinated biphenyls. Trichloroethylene concentrations in the unsaturated soil zone, that was excavated in the vicinity of the Building 854H drain outfall in 1983, measured at concentrations up to 1,000 parts per million. In the subsurface soil region, the maximum trichloroethylene concentration was measured at 30.7 parts per million in 1983. However, almost 200 soil samples from the Building 854 area that have been analyzed since 1983 have shown that current trichloroethylene concentrations are below 0.06 part per million.

Lead, zinc, and high melting explosive compounds have been detected at maximum concentrations of 98 parts per million, 1,400 parts per million, and 150 parts per million, respectively. DOE detected tritium in surface soil at a maximum concentration of 317 picocuries per liter of soil moisture, slightly above background levels for tritium. Polychlorinated biphenyls have been detected in surface soil at a maximum concentration of 52 parts per million. Modeling indicated that the high explosive compounds, metals, polychlorinated biphenyls, and

tritium detected in soil and bedrock would not impact groundwater. In addition, the baseline risk assessment indicated that these compounds do not pose a threat to human health or the environment.



Building 854 (OU#6)

Soil Long-Term Stewardship Activities

Some of the trichloroethylene-contaminated soil in the vicinity of the Building 854H drain outfall was excavated and removed in 1983. Assuming the preferred remedial alternative contained in the *Proposed Plan* is selected as part of the Site-Wide Interim ROD, controls for soil contamination will include: (1) no further action for metals, high melting explosive compounds, polychlorinated biphenyls, and tritium in surface soil, as these compounds do not pose a risk or hazard to human or ecological receptors and no significant impact to groundwater is indicated by modeling; (2) monitoring groundwater to track plume concentration and size as remediation progresses, evaluate the effectiveness of the remedial action, and determine when cleanup standards are met; (3) risk and hazard management to prevent contaminant exposure to humans until cleanup standards are achieved through active remediation; and (4) soil vapor extraction and treatment by carbon adsorption at the volatile organic compound source area. Soil vapor extraction would be conducted to reduce volatile organic compound concentrations in soil to levels protective of ground water.

3.6.2 Groundwater

Approximately 25 hectares (61 acres) and 170,000 cubic meters (220,000 cubic yards) of groundwater are contaminated at this portion. Groundwater contamination occurs in a 3- to-6 meter (10- to-20 foot) thick, shallow water-bearing zone that appears to be perched because of the presence of unsaturated permeable material below the low permeability siltstone/claystone confining layer. No contamination has been detected in the deeper water-bearing zone, which is located at least 15 meters (50 feet) below the first water-bearing zone.

Trichloroethylene concentrations in the groundwater decreased from a recorded maximum of 2,900 parts per billion in 1997 to 410 parts per billion in 1998. Other contaminants in groundwater include tritium, uranium-238, nitrate, and perchlorate. The maximum level of tritium in groundwater (410 picocuries per liter) slightly exceeds the 300 picocuries per liter regional background activity and is below the drinking water standard of 20,000 picocuries per liter for tritium. Uranium-238 has been detected in one monitoring well in the Building 854 area at a maximum of 2.6 picocuries per liter in 1996, which is below the drinking water standard (20 picocuries per liter) and regional background activity. Nitrate was reported at a maximum of 180 parts per million in 1996. Perchlorate (State Action Limit of 18 parts per billion) was detected for the first time in July 1998 at 6.5 parts per billion.

Groundwater Long-Term Stewardship Activities

DOE installed a groundwater extraction treatment system at the Building 854 source area and began treatability studies for the removal of contaminants. Assuming the preferred remedial alternative contained in the *Proposed Plan* is selected as part of the Site-Wide Interim ROD, controls for groundwater contamination will include: (1) monitoring groundwater to track plume concentration and size as remediation progresses, evaluate the effectiveness of the remedial action, and determine when cleanup standards are met; (2) risk and hazard management to prevent contaminant exposure to humans until cleanup standards are achieved through active remediation; and (3) controlling plume migration by extracting and treating volatile organic compounds, perchlorate, and nitrate in groundwater and soil vapor by carbon absorption and ion exchange.

The preliminary cleanup levels are set to the MCLs allowed in drinking water. These cleanup levels could change once the Final ROD (scheduled for release in 2007) is completed. DOE expects to achieve these the target cleanup levels by 2027.

3.6.3 Estimated Long-Term Stewardship Costs for Building 854 (OU#6)

In developing these cost estimates for the Building 854 operable unit/portion, DOE assumed that long-term stewardship activities included treatment facility operation and maintenance, groundwater monitoring, exposure control through risk and hazard management, and remediation optimization. DOE used trichloroethylene as the target contaminant for projecting cleanup schedules. See Section 2.3, Assumptions and Uncertainties, and Section 2.4, Estimated Site-Wide Long-Term Stewardship Costs, for a complete listing of the assumptions used for developing these costs. The same assumptions were used for the cost estimates for this portion.

Long-Term Stewardship Costs (Constant Year 2000 Dollars)							
FY 2000 - FY 2010	***FY 2011 - FY 2020***	***FY 2021 - FY 2030***	***FY 2031 - FY 2040***	***FY 2041 - FY 2050***	***FY 2051 - FY 2060***	***FY 2061 - FY 2070***	***Estimated Total***
$765,000	$2,038,000	$261,000	$7,000	$0	$0	$0	$3,071,000

3.7 Building 832 Canyon (OU#7)

The Building 832 Canyon is a 21.8-hectare (54-acre) operable unit (OU#7), located in the southeast part of Site 300 between the General Services Area to the east and the High Explosives Process Area to the west. Building 832 Canyon facilities were used to test the stability of weapons and associated components under various environmental conditions. Contaminants were released from Buildings 830 and 832 through piping leaks and surface spills during testing activities at these buildings. Contaminants released to the subsurface are primarily volatile organic compounds, although nitrate and perchlorate also have been detected in groundwater. Vadose zone soil and groundwater contamination originated from the Building 830 and Building 832 release sites. Nitrate and high melting explosive compounds have been detected in the subsurface soil. High melting explosive compounds also have been detected in surface soil.

The local environment is strongly influenced by seasonal rainfall infiltration and multi-year droughts. Rainfall can cause flushing and dilution of contaminants in the shallow hydrogeologic units. The canyon's topography is also a major factor in channeling water down the canyon to the south toward the General Services Area and the Site 300 boundary. Both the Building 832 and the Building 830 contaminant release sites are located in areas

that were created by filling natural drainage ways, thus placing the release locations above the channel fill. Two groundwater treatment systems and a soil vapor extraction system are in operation at the operable unit. At the Building 832 Canyon source area, a dual-phase (i.e., groundwater and soil vapor) extraction and treatment system began operations in 1999. In 2000, an additional groundwater treatment system began operations to remediate contaminants in groundwater downgradient of the Building 830 source area.

BUILDING 832 CANYON (OU#7) HIGHLIGHTS

Major Long-Term Stewardship Activities - treatment facility operation and maintenance; groundwater monitoring; exposure control through risk and hazard management; remediation optimization
Portion Size - 21.8 hectares (54 acres)
Estimated Volume of Residual Contaminants - groundwater 132,000 cubic meters (173,000 cubic yards); soil 106,000 cubic meters (138,000 cubic yards); surface water/sediment 1.4 cubic meters (50 cubic feet)
Long-Term Stewardship Start-End Years - 1999-2045
Average Annual Long-Term Stewardship Cost FY 2000-2006 - n/a (costs begin FY 2009)

3.7.1 Soil

Alluvial deposits of silt, clay, sand, and gravel occur in thicknesses up to 12 meters (40 feet) in the entrenched stream channels on the canyon floor. The extent of saturation and depth to water is variable, depending on location and recharge. Siltstone/claystone and sandstone bedrock form the canyon walls. The siltstone/claystone unit underlies the alluvium at the Buildings 830 and 832 release sites. This unit is unsaturated beneath the release sites but becomes saturated further to the south. The alluvial deposits and underlying siltstone/claystone have been affected by contaminant releases from Buildings 830 and 832.

Building 832 Canyon (OU#7) Release Sites Expected to Be Cleaned Up By 2006 and Expected to Require Long-Term Stewardship Activities

- Building 830
- Building 832

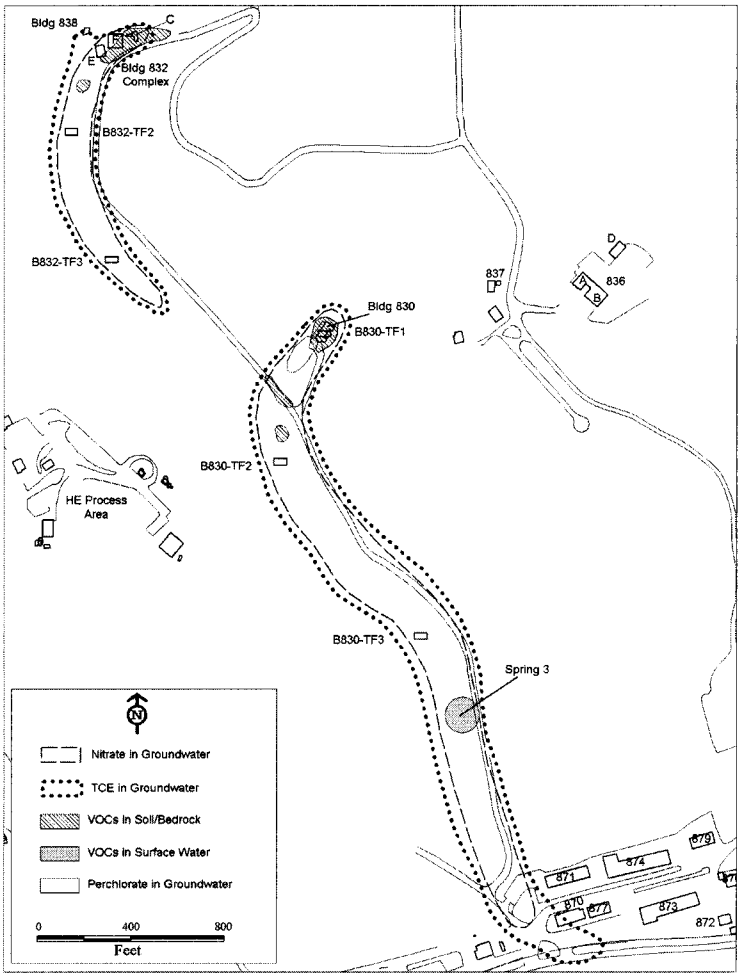
Approximately 0.4 hectares (1 acre) and 106,000 cubic meters (138,000 cubic yards) of soil at the Building 832 Canyon portion are contaminated with trichloroethylene and high melting explosive compounds. Trichloroethylene and other contaminants were released from Buildings 830 and 832 through piping leaks and surface spills during testing activities at these buildings.

Trichloroethylene has been detected in subsurface soil and bedrock in the vicinity of Buildings 830 and 832 at six parts per million and 0.16 part per million, respectively. Freon-113 and methylene chloride also have been detected in subsurface soil and rock in the vicinity of Building 830 at very low concentrations. Nitrate has been detected at a maximum of 13.5 parts per million in subsurface soil/bedrock at Building 830. High melting explosive compounds have been detected at extremely low concentrations in surface soil and subsurface soil and bedrock at Building 830. This contamination was caused by rinse water containing high explosive compounds was discarded via floor drains in Building 830 that discharged to the ground surface outside the building. The maximum high melting explosive compounds concentration was 0.2 part per million in 1994 in Building 830 surface soil, and 0.07 part per million in a duplicate sample. The maximum high melting explosive compounds concentration in subsurface soil/bedrock at Building 832 was 0.2 part per million in 1994. Modeling of high melting explosive compounds at Buildings 830 and 832 and nitrate in subsurface soil/bedrock at Building 830 indicates that the contamination will not significantly impact groundwater.

Soil Long-Term Stewardship Activities

Extraction and treatment of volatile organic compounds in subsurface soil and bedrock is proposed as part of the preferred remedy for Buildings 830 and 832 in the *Proposed Plan*. The preliminary cleanup levels for volatile organic compounds in soil/bedrock are to reduce contamination concentrations to levels that are protective of groundwater (i.e.. will not impact groundwater at concentrations above the drinking water standards).

No further action is proposed for high melting explosive compounds in surface soil at Building 830 and subsurface soil/rock at Building 832 because there is: 1) no risk or hazard to human health or ecological receptors posed by this contaminant, and 2) no impact to groundwater (as indicated by modeling). No further action is proposed for nitrate in subsurface soil/rock at Building 830 because: 1) there is no risk or hazard to human health or ecological receptors posed by this contaminant; 2) nitrate in groundwater is believed to be, in part, from other than anthropogenic sources; and 3) nitrate in groundwater will be addressed through extraction and treatment. In addition, DOE will implement a risk and hazard management program to prevent human exposure to contaminants and impacts to ecological receptors until cleanup standards are achieved through active remediation.



Building 832 Canyon (OU#7)

3.7.2 Groundwater

DOE has identified four hydrogeologic units in the Building 832 Canyon area: alluvial sands and gravel, the upper blue sandstone layer, siltstone/claystone bedrock layer, and the lower blue sandstone bedrock. Most contaminants of concern in this area are found in hydrogeologic units that are 4.6-18 meters (15-60 feet) below the ground surface. Approximately 10 hectares (24.5 acres) and 132,000 cubic meters (173,000 cubic yards) of groundwater are contaminated with volatile organic compounds, nitrate, and perchlorate. These contaminants were released from Buildings 830 and 832 through piping leaks and surface spills during testing activities and septic system releases.

Trichloroethylene in groundwater in the Building 830 area has decreased over time from a maximum of 30,000 parts per billion in 1997 to 7,900 parts per billion in 1998. Trichloroethylene has also been detected in groundwater at Building 832, at a maximum of 1,800 parts per billion in 1998. Nitrate in groundwater at Buildings 830 and 832 may be the result of explosives-related testing, septic system releases, and naturally occurring nitrate from local geologic units. Although the source of perchlorate is not known, it may have been a component of explosive test assemblies. Contaminants in groundwater near Buildings 830 and 832 are present in the shallow alluvium and underlying sandstone and siltstone/claystone bedrock. However, no water-supply wells are currently contaminated with volatile organic compounds, nitrate, or perchlorate originating from the Building 830 or 832 areas.

Groundwater Long-Term Stewardship Activities

Groundwater extraction and treatment systems are currently removing volatile organic compounds, nitrate, and perchlorate from the groundwater at the Building 832 source area and in the Building 830 area. Assuming the preferred remedial alternative contained in the *Proposed Plan* is selected as part of the ROD will include: (1) monitoring groundwater and surface water to track plume concentration and size as remediation progresses, evaluate the effectiveness of the remedial action, and determine when cleanup standards are met; (2) risk and hazard management to prevent contaminant exposure to humans and impacts to ecological receptors until cleanup standards are achieved through active remediation; (3) controlling plume migration by extracting and treating groundwater and soil vapor by carbon adsorption (a presumptive remedy), both in the source area and at the leading edge of the Building 832 volatile organic compounds, perchlorate, and nitrate plumes; (4) controlling plume migration by extracting and treating groundwater and soil vapor by carbon adsorption (a presumptive remedy) to remove volatile organic compounds, nitrate, and perchlorate at Building 830; and (5) downgradient plume control by groundwater extraction using a siphon and ex situ treatment by iron filings for the Building 830 area.

The preliminary cleanup levels are set at MCLs allowed in drinking water. These cleanup levels could change once the Final ROD (scheduled to be released in 2007) is completed. DOE expect to achieve these target by 2040.

3.7.3 Surface Water/Sediment

Approximately 0.2 hectare (0.5 acre) and 1.4 cubic meters (50 cubic feet) of surface water is contaminated with volatile organic compounds. Groundwater, migrating downgradient from Building 830 in alluvial deposits and the underlying sandstone, discharges intermittently onto the ground surface at Spring 3. Trichloroethylene concentrations in the water in Spring 3 have decreased from a maximum of 200 parts per billion in 1985 to 27 parts per billion in 1998. Because groundwater is the source of the water in Spring 3, the extraction and treatment of contaminants in groundwater should reduce contaminant concentrations in Spring 3 as well.

Surface Water/Sediment Long-Term Stewardship Activities

Because the water discharged at Spring 3 is fed by groundwater, the preferred alternative for groundwater remediation in the *Proposed Plan* will also address contamination in Spring 3.

3.7.4 Estimated Long-Term Stewardship Costs for the Building 832 Canyon (OU#7)

In developing these cost estimates for the Building 832 Canyon operable unit/portion, DOE assumed that long-term stewardship activities included treatment facility operation and maintenance, groundwater monitoring, exposure control through risk and hazard management, and remediation optimization. DOE used trichloroethylene as the target contaminant for projecting cleanup schedules. See Section 2.3, Assumptions and Uncertainties, and Section 2.4, Estimated Site-Wide Long-Term Stewardship Costs, for a complete listing of the assumptions used for developing these costs. The same assumptions were used for the cost estimates for this portion.

Long-Term Stewardship Costs (Constant Year 2000 Dollars)							
FY 2000 - FY 2010	***FY 2011 - FY 2020***	***FY 2021 - FY 2030***	***FY 2031 - FY 2040***	***FY 2041 - FY 2050***	***FY 2051 - FY 2060***	***FY 2061 - FY 2070***	***Estimated Total***
$2,169,000	$5,616,000	$952,000	$219,000	$18,000	$0	$0	$9,926,000

3.8 Site-Wide (OU#8)

This 4.8-hectare (12-acre) operable unit (OU#8) is divided into four areas for cleanup evaluation purposes: the Building 801 Dry Well and Pit 8 Landfill area, the Building 833 area, the Building 845 and the Pit 9 Landfill area, and the Building 851 Firing Table area. This site-wide portion or operable unit covers the release sites/sources that are not covered in the seven other individual operable units.

SITE-WIDE (OU#8) HIGHLIGHTS

Major Long-Term Stewardship Activities - groundwater monitoring; exposure control through risk and hazard management; long-term surveillance and maintenance of the landfills; remediation optimization
Portion Size - 4.8 hectares (12 acres)
Estimated Volume of Residual Contaminants - groundwater 1,000 cubic meters (1,300 cubic yards); soil 33,500 cubic meters (43,800 cubic yards)
Long-Term Stewardship Start-End Years - 1994-2070
Average Annual Long-Term Stewardship Cost FY 2000-2006 - n/a (costs begun FY 2009)

The Building 801 firing table was used for explosives testing, which resulted in contamination of adjacent soil with metals and uranium-238. However, no contaminants have been found in the groundwater in this area. Use of this firing table was discontinued in 1998, and the firing table gravel and some underlying soil were removed under the oversight of the Regional Water Quality Control Board. Debris from the firing table was buried in the nearby Pit 8 Landfill until 1974. No contamination of the vadose zone soil or the groundwater has occurred as a result of releases from the Pit 8 Landfill. Waste fluid discharges to the Building 801 dry well resulted in low concentrations of volatile organic compounds in the surrounding soil and groundwater. The dry well was investigated in 1981 and decommissioned and filled with concrete in 1984.

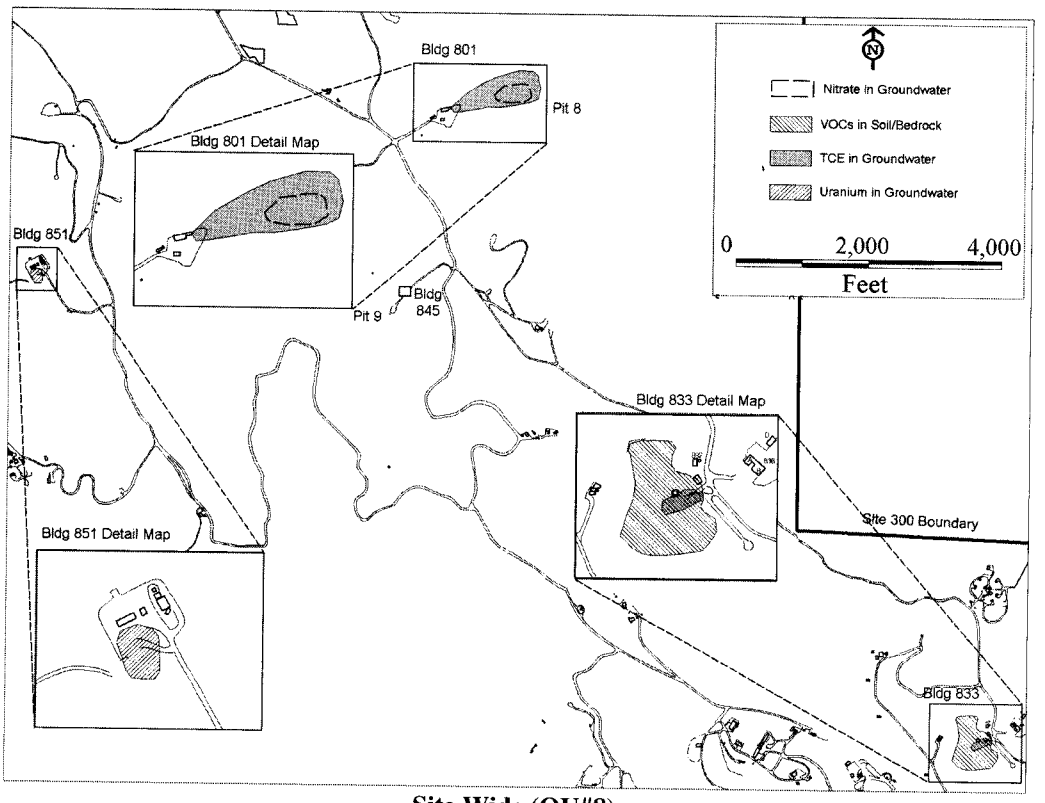
Trichloroethylene was used as a heat-exchange fluid at Building 833. Surface discharges (i.e., from spills, building washdown, rinse water from the test cell and settling basin, and rinse water disposal in a disposal lagoon) of waste fluids from this facility caused contamination of soil and groundwater. Waste fluids were disposed of in several areas surrounding Building 833, e.g., the disposal lagoon, the test cell and settling basin,

Site-Wide (OU#8) Release Sites Cleaned Up That Require Long-Term Stewardship Activities

- Building 829 Burn Pit 1 (SWMU 131)
- Building 829 Burn Pit 2 (SWMU 133)
- Building 829 Burn Pit 3 (SWMU 136)
- Building 829 Drying Area (AOC 5)
- Building 827 Complex
- Building 823 Wastewater Outfall (LLNL)
- Building 827B Dry Well
- Building 809 Disposal Slope
- Building 801 Firing Table
- Building 802 Firing Table
- Building 851 Firing Table
- Building 845 Firing Table
- Pit 2
- Area North of Building 833
- Pit 1 (SWMU 150)
- Pit 7 (SWMU 155)
- Building 833 Disposal Lagoon
- Building 833 Test Cell and Settling Basin Area
- Building 836B Disposal Lagoon
- Building 840
- Building 841
- Leach Field Southeast of Building 833
- Pit 9
- Building 801 Dry Well
- Pit 8
- Building 833 Brine System Drainage Outfall
- Building 833 Exterior Drainage System Outfall
- Building 836 Dry Well Drainage
- Three Earthen Pits South of Building 833

Release Sites Expected to Be Cleaned Up By 2006 and Expected to Require Long-Term Stewardship Activities

- Paper Canyon
- ATA (Building 865)
- Building 812 Firing Table
- Building 812 Waste-Water Outflow
- Building 835 Dry Well
- Sandia Test Facility



Site Wide (OU#8)

and the area north of Building 833.

The Building 845 firing table was used until 1963 to conduct experiments with explosives that may have occasionally contained tritium and uranium. As a result, the soil is contaminated with uranium-238 and high explosive compounds. DOE has not detected contaminants in groundwater under the Building 845 firing table. Debris generated at the Building 845 firing table was buried in the Pit 9 Landfill and monitoring indicates that contaminants have not been released to the environment from the Pit 9 Landfill. In 1988, the firing table gravel and soil from the firing table berm were removed and disposed of in Pit 1.

The Building 851 firing table has been used since 1962 and is still used to conduct experimental high explosives research. Former explosives experiments have contaminated the surrounding soil with uranium-238, high explosives, and metals and the groundwater with volatile organic compounds and uranium-238. Uranium-238 with anthropogenic isotope ratios have been detected in the groundwater in four monitoring wells in the vicinity of the firing table. Although the firing table is still used for explosives testing, DOE removed the table gravels in 1988 and continues to periodically replace them to prevent the accumulation of contaminants in gravels that could be released to the environment. Ongoing cleanup activities have resulted in the completion of 30 release sites.

3.8.1 Soil

The Building 801 and Pit 8 Landfill area is underlain by unconsolidated sand, gravel and clay landslide deposits and the lower blue sandstone bedrock. Building 833 is underlain by silty clays, silt, sand, and gravel and semilithified clays and silts. These deposits are underlain by a low permeability claystone/siltstone which

prevent groundwater in the shallow sediments from migrating into the underlying sandstone bedrock. The underlying sandstone bedrock is unsaturated for approximately 76 meters (250 feet) under these shallow units. The Building 845 firing table area is underlain by unconsolidated sand, gravel and clay landslide deposits and the lower blue sandstone bedrock. The units are unsaturated to a depth of at least 30 meters (100 feet). The Building 851 firing table area is underlain by unconsolidated sand, gravel and clay landslide deposits and the lower blue sandstone bedrock. The units are unsaturated to a depth of at least 30 meters (100 feet).

Approximately 4 hectares (10 acres) and 33,500 cubic meters (43,800 cubic yards) of soil and bedrock in this operable unit are contaminated with volatile organic compounds. Much of the contamination resulted from migration of contaminated groundwater through the saturated soil and bedrock. Trichloroethylene has been detected in the subsurface soils below the Building 801 dry well at extremely low concentrations. The highest trichloroethylene concentrations in the subsurface soil was recorded in 1989 at 0.057 part per million. Soil, rock, and groundwater chemical data indicate that contaminants have not been released from the Pit 8 Landfill. Trichloroethylene has also been identified in shallow subsurface sand and gravel at a maximum concentration of 1.5 parts per billion in the surrounding area of Building 833.

Leaching of contaminants from the Building 845 firing table resulted in the contamination of subsurface soil and bedrock with uranium-238 and high melting explosive compounds, e.g., up to 1.2 picocuries per gram of uranium-238 and 0.054 part per million high melting explosive compounds have been detected in the shallow subsurface clay, silt, gravel, and bedrock underlying the firing table. However, no contaminants have been detected in the groundwater under the Building 845 firing table. Furthermore, soil, rock, and groundwater monitoring data indicate that contaminants have not been released from the Pit 9 Landfill. Experiments using explosives at the Building 851 firing table have resulted in the release of volatile organic compounds and uranium-238 to subsurface soil. In addition, cadmium, copper, zinc, research department explosive compounds, and uranium-238 were released to surface soil surrounding the Building 851 firing table. Modeling indicates, however, that research department explosive compounds, cadmium, copper, and zinc in surface soil would not reach groundwater at concentrations above the drinking water standards.

Soil Long-Term Stewardship Activities

Assuming the preferred remedial alternative contained in the *Proposed Plan* is selected as part of the Site-Wide Interim Record of Decision, controls for soil and bedrock will include: (1) monitoring groundwater for contaminants of concern or potential contaminant releases, and (2) risk and hazard management to prevent exposure of onsite workers to trichloroethylene volatilization from subsurface soils.

No further action is proposed for some contaminants in surface soil and subsurface soil and bedrock at release sites in this operable unit. No further action for volatile organic compounds in subsurface soil and rock at Building 801 is considered to be protective because: (1) there is no risk or hazard to human health or ecological receptors posed by trichloroethylene in subsurface soil/rock; (2) the dry well source area has been removed and closed; and (3) trichloroethylene concentrations in groundwater are below drinking water standards and are declining, indicating a diminishing source of trichloroethylene in subsurface soil and bedrock.

No further action for contaminants of concern in subsurface soil and bedrock at the Building 845 and 851 firing tables and in surface soil at Building 851 is considered protective because: (1) there is no risk or hazard associated with these contaminants in soil or bedrock at the Building 845 and 851 firing tables; (2) there is no threat to groundwater posed by these contaminants; and (3) groundwater monitoring would detect any future release to groundwater that could affect human health and the environment.

3.8.2 Groundwater

The Building 801 and Pit 8 Landfill area is underlain by one hydrogeologic unit, which consists of three stratigraphic units: quaternary landslide deposits, the lower blue sandstone bedrock, and the underlying sandstone/siltstone bedrock. The lower blue sandstone bedrock and sandstone/siltstone bedrock are saturated throughout the area. Groundwater in the vicinity of Building 801 flows to the east.

Beneath Building 833 is a shallow perched aquifer that appears to be saturated mainly after periods of rainfall and groundwater rarely occurs in these sediments. Groundwater has been encountered periodically in only two monitoring wells in this area, primarily after periods of rainfall. Underlying the sand and gravel is a low-permeability claystone that prevents groundwater and any contamination from migrating further downward. When groundwater is present, the thickness of the shallow, perched water-bearing zone is approximately 0.3-1.2 meters (1-4 feet) deep. Approximately 76 meters (250 feet) of unsaturated rock separates this shallow, perched water-bearing zone from the underlying regional aquifer. No contamination has been detected in the underlying regional aquifer.

The Building 851 and Pit 9 Landfill area is underlain by one hydrogeologic unit which consists of three stratigraphic units: quaternary landslide deposits, the lower blue sandstone bedrock and the underlying sandstone/siltstone bedrock. Groundwater can be found at depths varying from 30 meters (100 feet) to 46 meters (150 feet) below the ground surface.

Approximately 4.6 hectares (11.5 acres) and 1,000 cubic meters (1,300 cubic yards) of the onsite groundwater in this operable unit are contaminated with trichloroethylene. Low-concentrations of volatile organic compounds in the groundwater and the vadose zone soil resulted from waste fluid discharges to a dry well beneath Building 801D. Concentrations of volatile organic compounds in groundwater beneath Building 801 are currently near or within levels considered to be safe for drinking water. Trichloroethylene, which was used at Building 833 as a heat-transfer fluid, was discharged to the subsurface soil. Therefore, the shallow soil/bedrock and perched groundwater in this area are contaminated. However, groundwater is present in small quantities, and only occasionally beneath Building 833. Furthermore, this groundwater is not used for drinking water. DOE has not detected any contaminants in groundwater in the Building 845/Pit 9 Landfill area. The Building 851 firing table is currently used to conduct experimental high explosives research. Although volatile organic compounds were identified in the groundwater in the past, no volatile organic or high explosive compounds are currently detected in the Building 851 firing table area. Uranium-238 with anthropogenic isotope ratios has also been detected in the groundwater in four monitoring wells in the vicinity of the firing table. Concentrations of uranium-238 in groundwater in this area are less than drinking water standards and within background levels for total uranium.

Groundwater Long-Term Stewardship Activities

Assuming the preferred remedial alternative contained in the *Proposed Plan* is selected as part of the Site-Wide Interim ROD, controls for groundwater will include: (1) monitoring groundwater for contaminants of concern or potential contaminant releases, and (2) risk and hazard management to prevent exposure of onsite workers to contaminants.

The preliminary cleanup levels are set to the MCLs allowed in drinking water. These cleanup levels could change once the Final ROD, scheduled to be released in 2007, is completed. It is expected that these cleanup levels will be achieved by 2065.

3.8.3 Estimated Long-Term Stewardship Costs for the Site-Wide (OU#8)

In developing these cost estimates for the Site-Wide operable unit (OU#8), DOE assumed that long-term stewardship activities included long-term surveillance and maintenance of the landfills, groundwater monitoring, exposure control through risk and hazard management, and remediation optimization. DOE used trichloroethylene as the target contaminant for projecting cleanup schedules. See Section 2.3, Assumptions and Uncertainties, and Section 2.4, Estimated Site-Wide Long-Term Stewardship Costs, for a complete listing of the assumptions used for developing these costs. The same assumptions were used for the cost estimates for this portion.

Long-Term Stewardship Costs (Constant Year 2000 Dollars)							
FY 2000 - FY 2010	***FY 2011 - FY 2020***	***FY 2021 - FY 2030***	***FY 2031 - FY 2040***	***FY 2041 - FY 2050***	***FY 2051 - FY 2060***	***FY 2061 - FY 2070***	***Estimated Total***
$1,606,000	$4,874,000	$2,029,0000	$738,000	$120,000	$10,000	$5,000	$27,643,000

4.0 FUTURE USES

All cleanup remedies at Site 300 will be implemented by FY 2009, and groundwater treatment systems will be in place and operational by FY 2009. The future use of Site 300 is expected to remain a controlled access research and development facility that will be used for both industrial purposes and for open space/wildlife management. Assuming that the preferred remedies described in the *Proposed Plan for Environmental Cleanup at LLNL Site 300* are selected in the Site-Wide Interim ROD, scheduled to be complete in December 2000, Lawrence Livermore National Laboratory will install and operate the selected remedies and subsequently implement the long-term stewardship requirements.

For additional information about the Lawrence Livermore National Laboratory-Site 300, please contact:

Hannibal Joma, Deputy Division Director
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U.S. Department of Energy, Oakland Operations Office
1301 Clay Street 700N
Oakland, CA 94612-5208
Phone: 925-422-0830
or visit the Internet website at http://www.doe.gov

SANDIA NATIONAL LABORATORIES - CALIFORNIA

1.0 SITE SUMMARY

1.1 Site Description and Mission

The Sandia National Laboratories-California is located in Alameda County, California, approximately 64 kilometers (40 miles) east of San Francisco. It occupies approximately 165 hectares (413 acres) of land in the Livermore Valley, and its boundaries start approximately five kilometers (three miles) east of the Livermore City Center.

As part of the U.S. Department of Energy's (DOE) national laboratory complex, Sandia National Laboratories-California was established in 1956 to conduct research and development in the interest of national security, with principal emphasis on nuclear weapons development and engineering, excluding the nuclear materials. For 44 years, Sandia was managed by AT&T, but today it is managed by the Lockheed Martin Corporation for DOE.

LONG-TERM STEWARDSHIP HIGHLIGHTS

Major Long-Term Stewardship Activities - groundwater monitoring; cell cover maintenance and monitoring; institutional and engineered controls
Total Site Area - 165 hectares (413 acres)
Estimated Volume of Residual Contamination - soil unknown; groundwater 108,000 cubic meters (3.8 million cubic feet)
Portions Requiring Long-Term Stewardship as of 2006 - 3
Long-Term Stewardship Start-End Years - 1999-in perpetuity
Average Annual Long-Term Stewardship Cost FY 2000-2006 - $84,000
Landlord - U.S. Department of Energy, Office of Defense Program

The Laboratories' original mission continues today, but Sandia now also performs a wide variety of national security research and development work. Mission changes have resulted in a decline in weapons research and development and an increase in work on nuclear safeguards and security, environmental sciences, biomedical systems engineering, advanced manufacturing technology, electronics, information and computational technology, transportation infrastructure and energy technology, and technology transfer to private industry in support of U.S. industrial competitiveness.

DOE's Office of Defense Programs is the landlord of Sandia National Laboratories-California and is expected to continue to use the property in support of its ongoing missions.

1.2 Site Cleanup and Accomplishments

SITE CLEANUP ACCOMPLISHMENTS

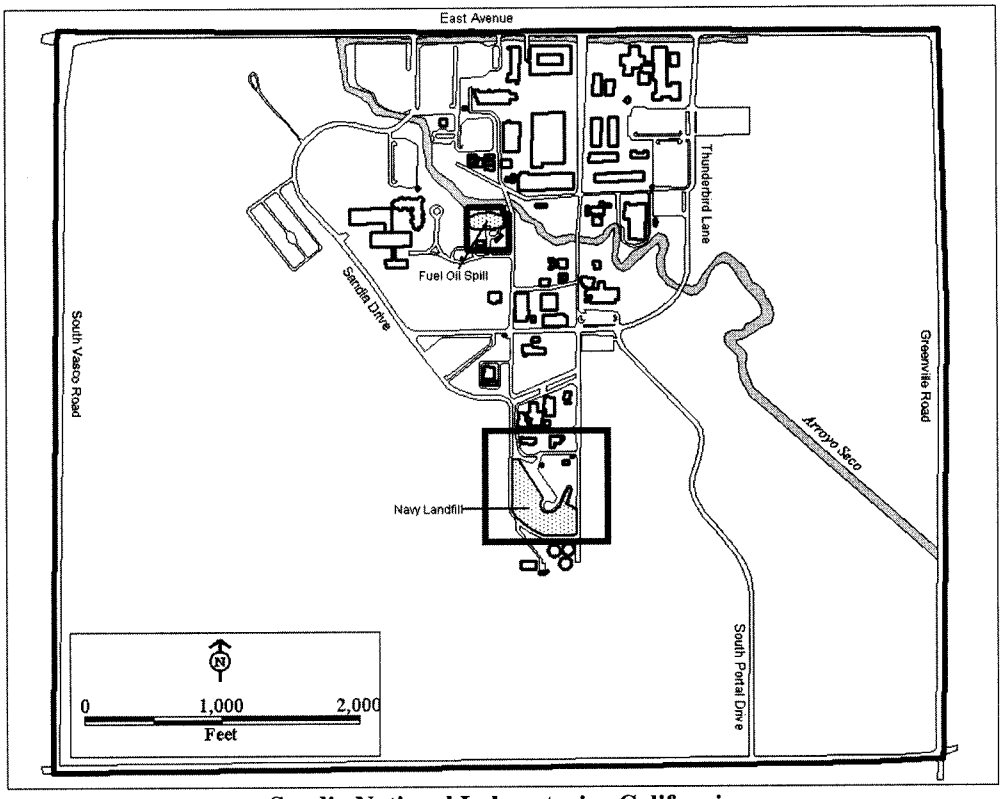
- Remediation of all 21 release sites
- Achievement of long-term stewardship status

ANTICIPATED SITE CLEANUP ACCOMPLISHMENTS AS OF 2006

- Continued long-term stewardship activities

Contamination at the Sandia National Laboratories-California site is the result of hazardous waste disposal and accidental spills. A comprehensive assessment of contamination, begun in 1984, identified the potential for problems at several areas of the site. The Sandia California Environmental Restoration Project consists of 21 Potential Release Sites. Most of these sites are small in area, resulting from relatively small releases of hazardous substances. The small sites include a burn pit, drum storage area and gasoline storage and dispensing facilities. Most of the Sandia-California sites were cleaned up between 1991 and 1995. Only two sites, the Navy Landfill and the Fuel Oil Spill, which were remediated in 1996 and 1999, respectively, contain residual contamination which will require long-term stewardship activities. After 2006, long-term stewardship requirements are anticipated to be as they are currently, i.e., monitoring the groundwater contaminated by the Navy Landfill and Fuel Oil Spill and maintaining

appropriate institutional controls.



Sandia National Laboratories-California

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

The Sandia Environmental Restoration Project is currently responsible for all long-term stewardship activities at Sandia. Residual contamination at Sandia California is confined to the Fuel Oil Spill and the groundwater contaminated by both the Navy Landfill and Fuel Oil Spill. Long-term stewardship activities will be limited to ensuring that the engineering and institutional controls are maintained at the Navy Landfill and the Fuel Oil Spill, and there is continued monitoring of the groundwater for volatile organic compounds (VOCs) and metals until the State of California determines monitoring is no longer necessary.

DOE will close all excess waste management facilities and, because of limited space, plans to decontaminate and decommission all facilities for reuse. DOE assumes that if it relinquishes responsibility for the property, some other government agency will maintain control. The entire 413 acres is designated for industrial use and is expected to remain as such for the foreseeable future.

The Sandia California Environmental Restoration Project records are all being sent to Sandia-New Mexico for inclusion with the Sandia New Mexico Environmental Restoration Project system. These project records are part of the Sandia Records Management system. The Sandia system includes a dedicated Environmental Restoration Records Center, which is a state-of the art system utilizing optical scanners and sophisticated inventory control. The system manages and controls all records and stores them pursuant to applicable Federal records retention

regulations. Records can be retrieved upon receipt of a properly executed request. Records include documents such as work plans, No Further Action Proposals, characterization data, maps, and regulatory correspondence and decisions.

2.2 Long-Term Stewardship Technology Development

In 1994, with the adoption of fast-track field approaches and other programmatic efficiency measures, it was concluded that there were very few critical technology needs required to achieve successful Environmental Restoration Project closure. Consequently, the Environmental Restoration Project has relied almost entirely on proven and accepted methods and existing technologies. The Environmental Restoration Project continues to review its technology needs and stays current with new developments. Potential technology needs include cost-effective monitoring technologies and protocols for monitored natural attenuation.

STAKEHOLDER INVOLVEMENT

Because of the very small size of the long-term stewardship effort, there has been limited citizen interest. Sandia-California communicates to its citizenry via the Site Environmental Report, which includes the Quarterly Groundwater Reports. The Site Environmental Report is made available at reading rooms and libraries and is presented to regulators and city officials.

2.3 Assumptions and Uncertainties

It is not possible at this time to estimate how long stewardship activities will be necessary. Institutional controls, groundwater monitoring, and maintenance of engineering controls for the groundwater and Navy Landfill portions will be required as long as the State of California determines them to be necessary. The state may require long-term stewardship activities through at least 2070. The volume of contaminated groundwater and soil are only estimates based on available data and do not reflect a concerted effort to fully define the extent of contamination.

2.4 Estimated Site-Wide Long Term Stewardship Costs

Site-wide long-term stewardship costs are primarily made up of groundwater sampling and analysis. Costs are also associated with well maintenance, extension and abandonment; and maintaining the Navy Landfill fence.

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	***Amount***	***Year(s)***	***Amount***	***Year(s)***	***Amount***
FY 2000	$84,000	**FY 2008**	$84,000	**FY 2036-2040**	$420,000
FY 2001	$84,000	**FY 2009**	$84,000	**FY 2041-2045**	$420,000
FY 2002	$84,000	**FY 2010**	$84,000	**FY 2046-2050**	$420,000
FY 2003	$84,000	**FY 2011-2015**	$420,000	**FY 2051-2055**	$420,000
FY 2004	$84,000	**FY 2016-2020**	$420,000	**FY 2056-2060**	$420,000
FY 2005	$84,000	**FY 2021-2025**	$420,000	**FY 2061-2065**	$420,000
FY 2006	$84,000	**FY 2026-2030**	$420,000	**FY 2066-2070**	$420,000
FY 2007	$84,000	**FY 2031-2035**	$420,000		

3.0 PORTION OVERVIEW

The Sandia National Laboratories - California site is divided into three portions, as identified in the table below. For purposes of this report, a "portion" is defined as a geographically contiguous and distinct area (which may involve residually contaminated facilities, engineered units, soil, groundwater, and/or surface water/sediment) for which cleanup, disposal, or stabilization will have been completed and long-term stewardship will be required as of 2006.

Long-Term Stewardship Information		
Portion Name	***Long-Term Stewardship Start Year***	***Long-Term Stewardship End Year***
Groundwater Portion	2000	in perpetuity
Navy Landfill Portion	2000	in perpetuity
Fuel Oil Spill Portion	1999	in perpetuity

3.1 Groundwater Portion

Groundwater represents the major area of residual contamination at Sandia-California. There are two sources of groundwater contamination at the site: the Navy Landfill and the Fuel Oil Spill. At the Navy Landfill, the residual contamination is carbon tetrachloride at 1.7 parts per billion, with an estimated potential volume of 8,500 cubic meters (300,000 cubic feet). At the Fuel Oil Spill, the residual contamination is total petroleum hydrocarbons (11,000 parts per billion) and trace amounts of BTEX (benzene, toluene, ethylene and xylene), with an estimated potential volume of 99,000 cubic meters (3,500,000 cubic feet). The near surface aquifer is used only for agricultural purposes.

GROUNDWATER PORTION HIGHLIGHTS

Major Long-Term Stewardship Activities - groundwater monitoring; institutional and engineered controls
Portion Size - 0.8 hectare (2 acres)
Estimated Volume of Residual Contaminants - groundwater 108,000 cubic meters (3,800,000 cubic feet)
Long-Term Stewardship Start-End Years - 2000-in perpetuity
Average Annual Long-Term Stewardship Costs FY 2000-2006 - $84,100

3.1.1 Groundwater

There are currently 13 groundwater monitoring wells at Sandia-California. Monitoring at the Fuel Oil Spill Site will continue until July 2001, at which time the State of California will determine whether final closure of the Fuel Oil Spill Site is appropriate. Monitoring at the Navy Landfill and the other Sandia-California locations will continue until determined by the regulator to be no longer necessary.

3.1.2 Estimated Long-Term Stewardship Costs for Groundwater

The vast majority of long-term stewardship costs are for the groundwater activities. The Navy Landfill and the Fuel Oil Spill costs are negligible and are, thus, not broken out into portion costs. Costs for the groundwater are largely made up of sampling and analysis and well maintenance, destruction, and reinstallation of monitoring wells. Costs are generally constant, with the exception of increases due to periodic major well maintenance or replacement and anticipated decreases in sampling and analysis requirements.

Long-Term Stewardship Costs (Constant Year 2000 Dollars)							
FY 2000 - FY 2010	*FY 2011 - FY 2020*	*FY 2021 - FY 2030*	*FY 2031 - FY 2040*	*FY 2041 - FY 2050*	*FY 2051 - FY 2060*	*FY 2061 - FY 2070*	*Estimated Total*
$925,100	$841,000	$841,000	$841,000	$841,000	$841,000	$841,000	$5,971,100

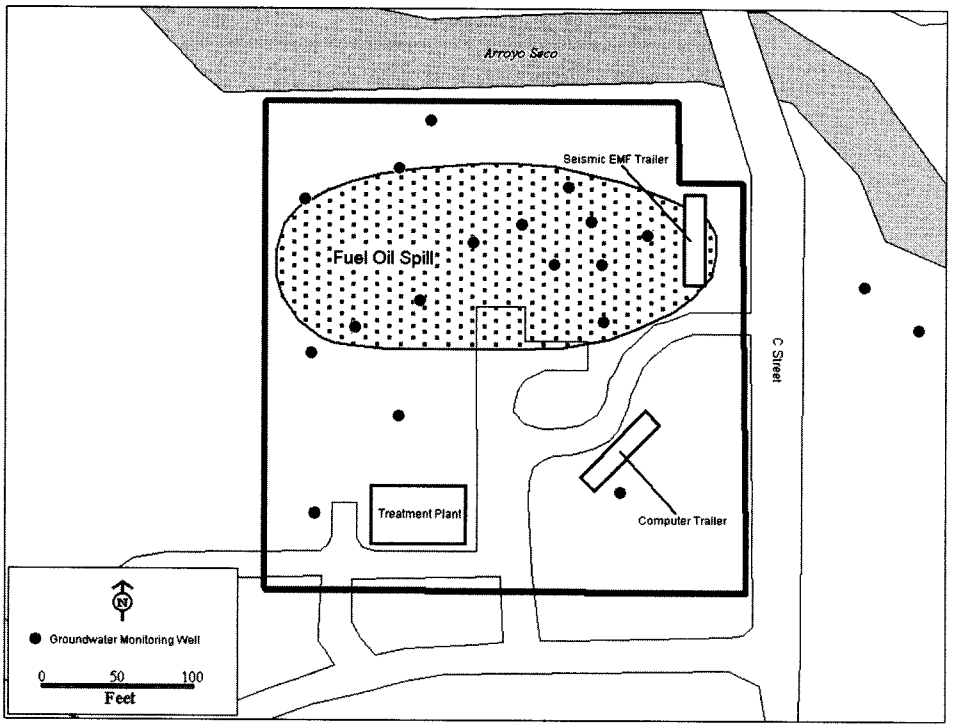
3.2 Fuel Oil Spill Portion

In 1975, an accidental puncture of an underground transfer line buried four feet below the land surface released about 225,000 liters (59,500 gallons) of diesel fuel from an above-ground fuel tank into the soil. The groundwater has been monitored since 1985 and shows occasional low-level contamination with total petroleum hydrocarbons and small amounts of benzene, toluene, ethylene, and xylene (BTEX). The total volume of soil contaminated with diesel oil is estimated to be about 85,600 cubic meters (112,000 cubic yards).

FUEL OIL SPILL PORTION HIGHLIGHTS

Major Long-Term Stewardship Activities - groundwater monitoring; institutional and engineered controls
Portion Size - 0.8 hectare (2 acres)
Estimated Volume of Residual Contaminants - soil 85,600 cubic meters (112,000 cubic yards)
Long-Term Stewardship Start-End Years - 2000-in perpetuity
Average Annual Long-Term Stewardship Costs FY 2000-2006 - n/a

The remedial action chosen for the Fuel Oil Spill was in-place biological remediation, which involves the use of bacteria to digest the contamination, with nutrients and oxygen being added to stimulate the digestion. In July 1999, the State of California Regional Water Quality Control Board agreed that the bioremediation activities could be terminated provided that groundwater monitoring continue.



Fuel Oil Spill Portion

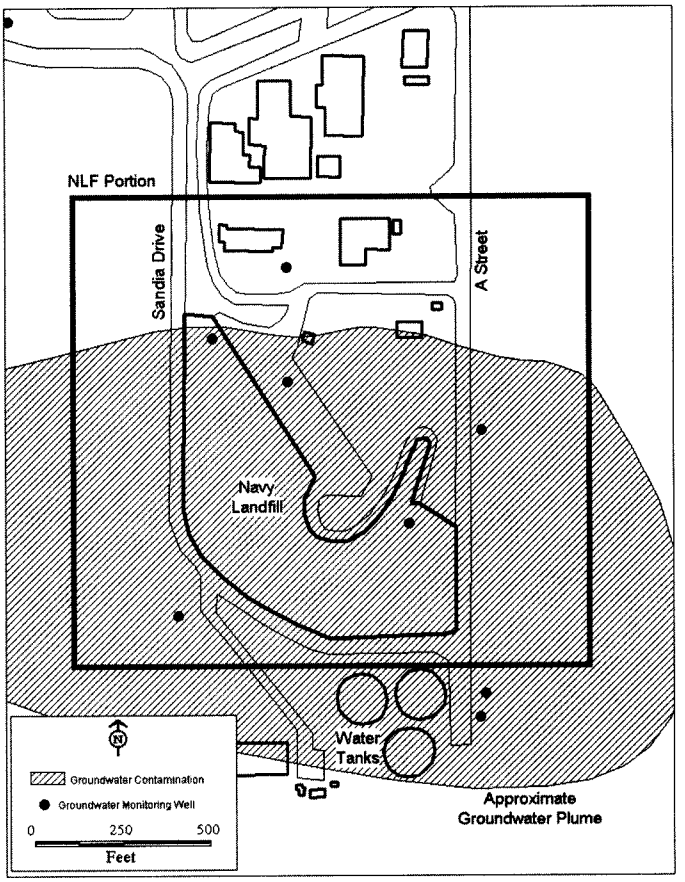
3.3 Navy Landfill Portion

The 0.5 hectare (one-acre) Navy landfill, located at the southern end of the Sandia site, was used intermittently from 1940 to 1960 for the disposal of general construction debris and machine turnings. The landfill is now fenced and capped with an earthen and vegetative cover. Although no residual contamination exists outside the landfill, monitoring of groundwater beneath the landfill has detected groundwater contamination. (For more on the groundwater contamination, please see the explanation under the Groundwater Portion on page 116.)

NAVY LANDFILL PORTION HIGHLIGHTS

Major Long-Term Stewardship Activities - engineered unit monitoring; engineered controls
Portion Size - 0.5 hectare (1 acre)
Estimated Volume of Residual Contaminants - unknown
Long-Term Stewardship Start-End Years - 1999-in perpetuity
Average Annual Long-Term Stewardship Costs FY 2000-2006 - n/a

Long-term stewardship of the Navy Landfill will require monitoring to ensure that the cap integrity and fences are maintained and because the landfill houses a series of explosive bunkers built into steep hills. Both erosion control and storm water runoff will require stewardship, as well. However, it is not possible at this time to determine how long stewardship activities will be required. This will be determined by the State of California and could be required until at least 2070. Because the landfill itself is located on the already fenced and controlled Sandia-California property, no particular institutional controls will be applied to the landfill. The only



Navy Landfill Portion

engineered controls are for the well heads, due to the groundwater contamination. The controls include posts surrounding the well heads and locked collars to protect the well heads. Access to the Sandia-California site itself is controlled by fences and gates staffed by security personnel. If the land associated with the Navy Landfill is transferred, appropriate land or groundwater controls could be imposed.

4.0 FUTURE USE

Sandia assumes its mission will continue for the foreseeable future and that current institutional controls will remain in place. If the Sandia National Laboratories-California mission is terminated, DOE assumes that another government agency will occupy the site.

For more information about the Sandia National Laboratories-California, contact:

John Cormier, Stewardship Project Manager
U.S. Department of Energy, Albuquerque Kirtland Area Office
PO Box 5800
Albuquerque, NM 87185
Phone: (505) 845-5956
or visit the Internet website at http://www.sandia.gov

STANFORD LINEAR ACCELERATOR CENTER

1.0 SITE SUMMARY

1.1 Site Description and Mission

The Stanford Linear Accelerator Center is a high-energy research facility owned by the U.S. Department of Energy (DOE) and operated by Stanford University. DOE leases the property on which the facility was built from Stanford University. DOE's Office of Science, the current site landlord, has an ongoing research mission at the site. The 172-hectare (426-acre) site is located on the San Francisco Peninsula between San Francisco and San Jose, California.

LONG-TERM STEWARDSHIP HIGHLIGHTS

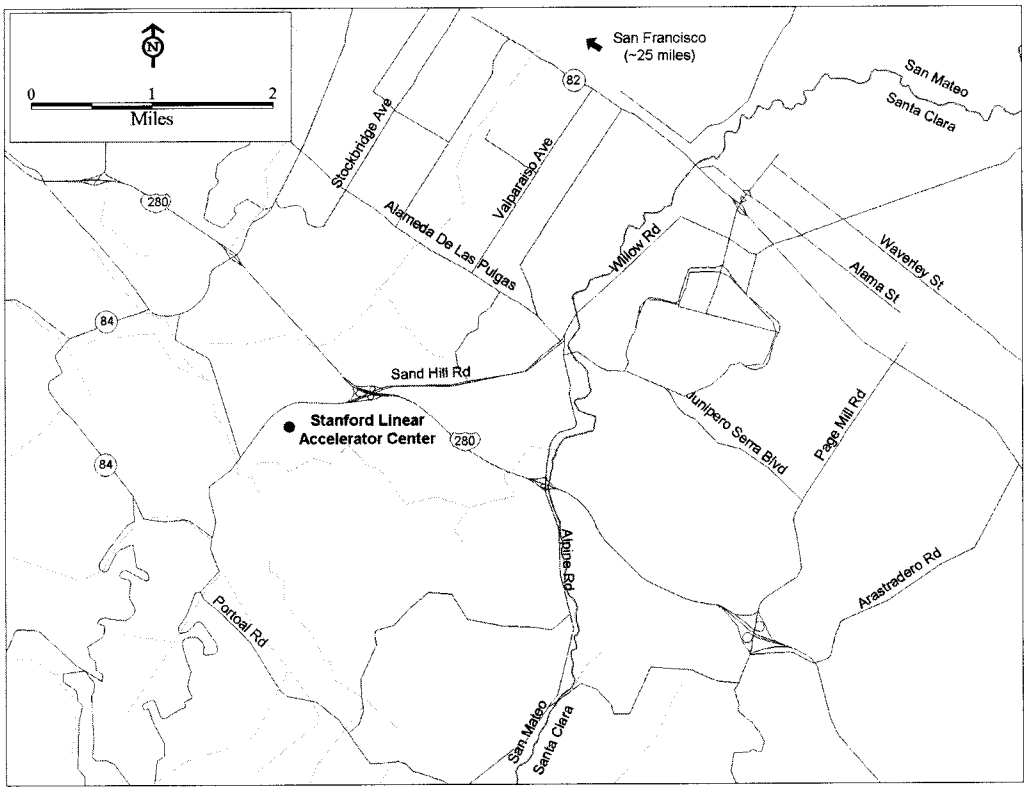
Major Long-Term Stewardship Activities - groundwater monitoring; groundwater plume containment; maintenance of institutional controls
Total Site Area - 172 hectares (426 acres)
Estimated Volume of Residual Contaminants - unknown (site characterization activities in progress)
Long-Term Stewardship Start-End Years - 2004-2062
Average Annual Long-Term Stewardship Cost FY 2004-2006 - $500,000
Landlord - U.S. Department of Energy, Office of Science

The Stanford Linear Accelerator Center was established in 1962 as a research facility for high-energy particle physics. The Center's four major experimental facilities are the Linear Accelerator, the Positron Electron Project Storage Ring, the Stanford Positron Electron Asymmetric Ring, and the Linear Collider. DOE has no plans to change the current mission or the industrial use of the Stanford Linear Accelerator Center.

DOE's Environmental Management program is responsible for remediating the soils and groundwater that are contaminated by past operations. Contamination includes volatile organic compounds, polychlorinated biphenyls, petroleum hydrocarbons, lead, and other metals.

In addition to past contamination, the Laboratory's experiments continue to generate hazardous waste and small amounts of radioactive mixed waste. Hazardous waste is generated by site operations, such as vehicle, equipment, and general facility maintenance and the operations of the plating shop and its associated waste treatment plant. For the most part, radioactive waste is generated from accelerator operations. This waste includes pieces of equipment or metal or large concrete shielding blocks that become slightly radioactive, sealed sources and standards no longer in use, resin-beds used in water recirculation, and personnel protective equipment (such as coveralls and gloves) and wipes that were contaminated when they were used in fabrication or maintenance.

The Stanford Linear Accelerator Center is a large quantity generator, as defined in the *Resource Conservation and Recovery Act* (RCRA). The Center does not have a permit to treat, store, or dispose of hazardous waste onsite. Therefore, all hazardous waste is shipped offsite, within 90 days of generation, to an approved commercial facility for treatment and disposal. Pending offsite shipment, the hazardous waste is stored at the Centralized Waste Management Areas. The Center also ships its radioactive waste offsite, to other designated DOE sites, for treatment and disposal. Pending offsite shipment, the radioactive waste is stored at one of the Center's main onsite storage areas for radioactive waste — either the Radioactive Material Storage Area or the Radioactive Materials Storage Yard.



Stanford Linear Accelerator Center

1.2 Site Cleanup and Accomplishments

DOE expects its environmental management mission at the Stanford Linear Accelerator Center site to be completed in 2003. The two main contaminants of concern are releases of polychlorinated biphenyls (PCBs), which were released into the soil by transformers, and volatile organic compounds, which were release into the soil and groundwater and were used primarily as cleaning agents. Currently, cleanup levels and objectives reflect a goal of meeting unrestricted use criteria. However, it may be infeasible to reach unrestricted release criteria for two reasons: technological limitations due to the site's geology, and inaccessibility to the contamination due to the site's ongoing operations. Therefore, DOE will be working with its regulators to determine the cleanup levels and objectives to allow for continued industrial use of the site. The Stanford Linear Accelerator Center is currently operating its remediation program under a State Board Order from the State Regional Water Quality Control Board. Following cleanup, the Department is still responsible for all long-term stewardship activities at this site.

SITE ACCOMPLISHMENTS

- Six PCB contaminated soil sites and a portion of another site cleaned for unrestricted use
- Completed site investigations for two of four groundwater plumes

ANTICIPATED SITE ACCOMPLISHMENTS AS OF 2006

- Eleven PCB contaminated soil sites cleaned for unrestricted use
- All groundwater plumes cleaned for unrestricted use or hydraulic contained for continued industrial use

DOE has removed source contamination (PCBs) from the soil in several areas: Substation 507, Level C sites,

IR-8 Power Supply, 3.0 Megawatt Power Supply, Master Substation, IR-6 Drainage Channel, and a large portion of the Lower Salvage Yard. DOE also removed the Former Underground Storage Tank, along with approximately 135 cubic yards of contaminated soil. DOE assumes no other soil remediation will be required in this area.

There are four groundwater plumes in the following areas: the Former Solvent Underground Storage Tank Area, Plating Shop, Former Hazardous Waste Storage Area, and the Test Lab/Central Lab (formerly called MW-24 area). The site investigations for the Former Solvent Underground Storage Tank Area and Test Lab/Central Lab have been completed. DOE is planning to use a groundwater extraction system — designed to hydraulically contain and prevent contaminant migration — for the groundwater plume underlying the Former Solvent Underground Storage Tank Area. Based on preliminary information, DOE is considering a similar system for the groundwater plume underlying the Plating Shop Area. DOE has determined that the volatile organic compounds in the groundwater underlying the Test Lab/Central Lab do not impose any significant risk. As a result, DOE plans to obtain from regulators an "unrestricted use" status with only follow-up monitoring required. DOE has not yet completed site investigations for the other two groundwater areas and, therefore, the remedial actions have not been selected.

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

LONG-TERM STEWARDSHIP GOALS

Groundwater monitoring and surveillance to prevent offsite migration of contaminants and maintenance of institutional controls at the Former Solvent Underground Storage Tank Area.

Site long-term stewardship activities are expected to begin in 2004 and include: semi-annual groundwater monitoring to detect movement of plumes and changes in contaminant concentration; operation of hydraulic containment systems; and removal of contaminants that were previously inaccessible or where new technologies permit cleanup; and maintenance of institutional controls at the Former Solvent Underground Storage Tank Area.

The institutional controls at the Former Solvent Underground Storage Tank Area have been established to protect subsurface workers (The site defines a subsurface worker as anyone who disturbs or excavates soil, or works in a trench or pit that has been excavated). These controls include marking the area of contamination with signs, requiring clearance forms, monitoring contamination during subsurface work, and requiring personal protective equipment during subsurface work. These controls only apply to subsurface areas of contamination. These institutional controls will be maintained until the contaminants have been cleaned up and no longer pose a threat to the health of subsurface workers.

Further cleanup by DOE is anticipated prior to returning the Stanford Linear Accelerator Center area to Stanford University.

At present, there is no specific regulation or requirement mandating record-keeping requirements for the Stanford Linear Accelerator Center. However, DOE provides documents and reports developed by the Center to regulators. DOE also maintains copies of these documents and reports in the Stanford Linear Accelerator Center's Environment, Safety and Health document room, which is accessible to the public.

2.2 Specific Long-Term Stewardship Activities

Soil

There are a few small areas contaminated with PCBs, which are currently inaccessible for cleanup activities because of their proximity to energized electrical equipment. The site landlord (DOE Office of Science) will be responsible for remediating these areas when the electrical equipment is shutdown or no longer operating. DOE estimates that the cumulative volume of contaminated soils is less than 574 cubic meters (750 cubic yards). There also will be VOC contaminated soil at depths of three to six meters (10 to 20 feet) below the soil's surface that will remain in the area of the Former Solvent Underground Storage Tank Area, a portion of which is underneath a building. Due to the levels of contamination, institutional controls will be maintained to ensure workers are adequately protected if any subsurface work is required (e.g., utility maintenance). Investigations of soil contamination are not yet complete in other areas of the site.

STAKEHOLDER INVOLVEMENT

DOE and representatives of the Standford Linear Accelerator Center interact with stakeholders via their membership in the San Francisquito Creek Watershed Coordinated Resource Management and Planning Steering Committee task forces. Membership of these task forces is highly diverse, comprising representatives from local, county, regional, state, and federal agencies, and citizen groups. The only stakeholders that have indicated an interest in the Standford Linear Accelerator Center restoration project (e.g., requested to review and comment on documents, to provide input to the development of budgeting priorities, and to participate in discussions with regulators) are members of the company that manages Stanford University properties. They have been invited to attend regular environmental restoration project meetings.

Groundwater

Each of the four groundwater plumes impact an area of about 0.4 hectare (one acre). DOE is planning to install one or more groundwater hydraulic containment systems to prevent the contaminated plume from migrating offsite. DOE is working with regulators to determine the cleanup objectives and levels that will permit the continued industrial use of the site. Long-term surveillance and maintenance will be required to maintain and operate these systems, and DOE will be responsible for implementing any new technologies, if they become available, to reduce the volume of groundwater contamination.

2.3 Regulatory Regime

The regulatory regime has not been determined for the long-term stewardship activities at the site. The Stanford Linear Accelerator Center is proposing to develop and issue a long-term monitoring plan, which would be subject to the Regional Water Quality Control Board's review and approval. Representatives of the Board, Stanford University, DOE's Office of Science, and DOE's Office of Environmental Management are currently discussing this proposal.

2.4 Assumptions and Uncertainties

Cleanup of groundwater is not feasible using currently available technology. The Stanford Linear Accelerator Center project has submitted a technology needs request to the Subsurface Contamination Focus Area (SCFA) asking for help developing a solution to their groundwater problem. The SCFA has indicated that they plan to address this need in an upcoming Industry Programs solicitation. Although there is uncertainty that a solution will be developed, DOE assumes a solution will likely be developed within 10 years than not. The alternative to cleaning up the site in 2012 and 2013 is to continue operating the hydraulic containment system.

If groundwater remediation is effective, the only long-term stewardship activity will be long-term monitoring of groundwater onsite. DOE also assumes that the lease for the Stanford Linear Accelerator Center will be renewed

for the same term as the original 50-year lease and monitoring will continue to be required for the term of the renewed lease.

DOE has not completed its site investigation of two groundwater areas; therefore, the remedial actions have not been selected. The regulators have not yet provided acceptance of DOE's proposed remedial actions for the other two groundwater areas. Also, DOE has not completed investigations of soil contamination in other areas of the site. For those areas contaminated with PCBs and are currently inaccessible, it is uncertain when there will be a window of opportunity to complete the cleanup. These are voluntary cleanups, as the Stanford Linear Accelerator Center is an operating industrial site, and will be done when the operating equipment can be shutdown or removed.

3.0 ESTIMATED LONG-TERM STEWARDSHIP COSTS

Estimated costs for performing long-term stewardship activities at the Stanford Linear Accelerator Center are identified in the table below. Cost estimates are based on historical costs at the site of semi-annual groundwater monitoring, the operation of two hydraulic containment systems, and minor PCB-contaminated soil remediation. DOE estimates annual long-term stewardship costs to be approximately $500,000 per year from fiscal year (FY) 2004 through FY 2011 for operating these systems. In FY 2012 and FY 2013, DOE assumes that new technology will be available and deployed to clean up the groundwater at an estimated additional expenditure of $2,000,000 per year. If this new technology is deployed, then DOE would discontinue operating the hydraulic containment system. Starting in FY 2014, annual costs would be $100,000 per year for monitoring.

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	***Amount***	***Year(s)***	***Amount***	***Year(s)***	***Amount***
FY 2000	$0	**FY 2008**	$500,000	**FY 2036-2040**	$500,000
FY 2001	$0	**FY 2009**	$500,000	**FY 2041-2045**	$500,000
FY 2002	$0	**FY 2010**	$500,000	**FY 2046-2050**	$500,000
FY 2003	$0	**FY 2011-2015**	$5,700,000	**FY 2051-2055**	$500,000
FY 2004	$500,000	**FY 2016-2020**	$500,000	**FY 2056-2060**	$500,000
FY 2005	$500,000	**FY 2021-2025**	$500,000	**FY 2061-2065**	$200,000
FY 2006	$500,000	**FY 2026-2030**	$500,000	**FY 2066-2070**	$0
FY 2007	$500,000	**FY 2031-2035**	$500,000		

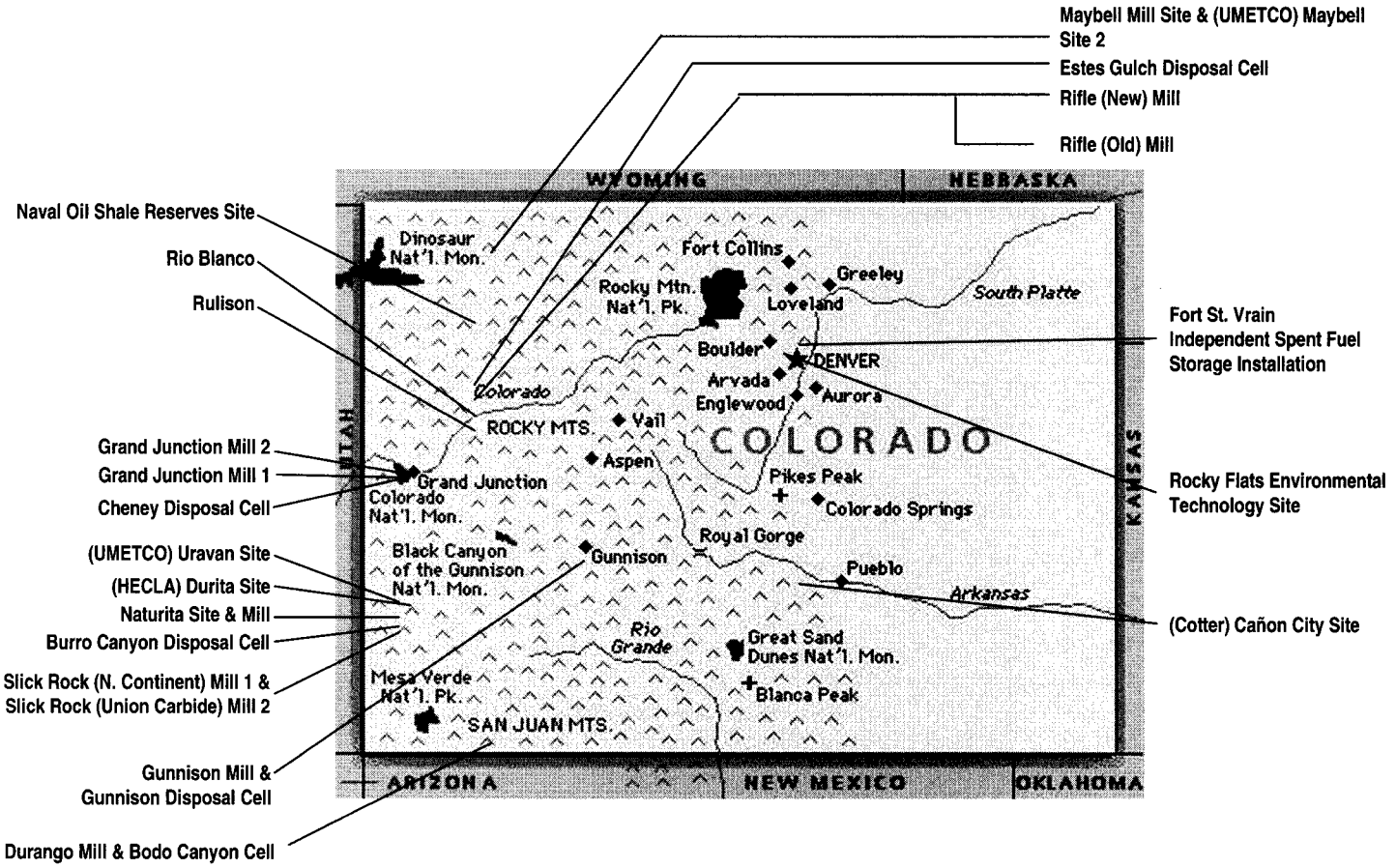
4.0 FUTURE USES

DOE anticipates the Stanford Linear Accelerator Center will continue to be used for industrial purposes. Deed restrictions are unlikely because not all of the involved parties will agree to them. Institutional controls for subsurface workers' protection will remain in effect near the Former Solvent Underground Storage Tank Area. Long-term sampling and monitoring will be required for four groundwater plumes contaminated with organic solvents. In accordance with changing research requirements, some facilities may be decommissioned or converted for new missions. If the lease is not renewed, DOE must shut down the center, dispose of the facilities, and perform site closure and cleanup.

For additional information about the Stanford Linear Accelerator Center, please contact:

Jay Tomlin
U.S. Department of Energy, Oakland Operations Office
Oakland Environmental Program Division
301 Clay St., N700
Oakland, CA 94612
Phone: 510-637-1637
or visit the Internet website at http//www.doe.gov

Colorado



Long-Term Stewardship Site Highlights

Bodo Canyon Cell (page 3)
Major Activities - disposal cell monitoring; access restrictions
Site Size - 49 hectares (120 acres)
Start/End Years - 1990/in perpetuity
Estimated Average Annual Cost FY 2000-2006 - $154,000

Burro Canyon Disposal Cell (page 7)
Major Activities - disposal cell monitoring
Site Size - 25 hectares (61.3 acres)
Start/End Years - 1998/in perpetuity
Estimated Average Annual Cost FY 2000-2006 - $79,000

Cheney Disposal Cell (page11)
Major Activities - disposal cell and groundwater monitoring
Site Size - 145 hectares (360 acres)
Start/End Years - 1994/in perpetuity
Estimated Average Annual Cost FY 2000-2006 - $460,280

(Cotter) Cañon City Site (page15)
Site Size - unknown
Current Landlord - Cotter Corporation
Expected Future Landlord - U.S. Department of Energy

Durango Mill (page 19)
Major Activities - groundwater monitoring
Site Size - 51 hectares (127 acres)
Start/End Years - 1990/2070
Estimated Average Annual Cost FY 2000-2006 - n/a (costs begin FY 2007)

Estes Gulch Disposal Cell (page23)
Major Activities - disposal cell monitoring and maintenance
Site Size - 83 hectare (205 acres)
Start/End Years - 1997/in perpetuity
Estimated Average Annual Cost FY 2000- 2006 - $42,500

Fort Saint Vrain Independent Spent Fuel Storage Installation (page 27)
Major Activities - storage facility monitoring and maintenance
Site Size - 1.5 hectares (3.8 acres)
Start/End Years - 1999/2035
Estimated Average Annual Cost FY 2000-2006 - $3,000,000

Grand Junction Mill 1 (page 31)
Major Activities - groundwater monitoring
Site Size Area - 46 hectare (114 acres)
Start-End Years - 2001/2070
Estimated Average Annual Cost FY 2001-2006 - $17,814

Grand Junction Mill 2 (page 37)
Major Activities - groundwater and surface water monitoring
Site Size - 25 hectares (63 acres)
Start/End Years - 2001/2089
Estimated Average Annual Cost FY 2000-2006 - $121,700

Gunnison Disposal Cell (page 43)
Major Activities -disposal cell monitoring; inspections; access restrictions
Site Size - 47 hectares (115 acres)
Start/End Years - 1995/in perpetuity
Estimated Average Annual Cost FY 2000-2006 - $63,000

Gunnison Mill (page 47)
Major Activities - groundwater monitoring; access restrictions
Site Size - 25 hectares (61 acres)
Start/End Years - 1994/2105
Estimated Average Annual Cost FY 2005-2006 - $20,000

(HECLA) Durita Site (page 51)
Major Activities - access control; monitoring and maintenance of four disposal cells
Site Size - 65 hectares (160 acres)
Start/End Years - 2001/in perpetuity
Estimated Average Annual Cost FY 2000-2006 - $9,900

Long-Term Stewardship Site Highlights

Maybell Mill Site (page 55)
Major Activities - disposal cell monitoring
Site Size - 101.3 hectares (250.4 acres)
Start/End Years - 1999/in perpetuity
Estimated Average Annual Cost FY 2000-2006 - $24,000

Naturita Mill (page 61)
Major Activities - groundwater monitoring; erosion control
Site Size - 21 hectares (53 acres)
Start/End Years - 1997/2103
Estimated Average Annual Cost FY 2000-2006 - n/a (costs begin in FY 2011)

Naturita Site (page 65)
Major Activities - disposal cell monitoring; institutional control enforcement; access restriction
Site Size - 11 hectares (27 acres)
Start/End Years - 1999/in perpetuity
Estimated Average Annual Cost FY 2000-2006 - $29,000

Naval Oil Shale Reserves Site (page 69)
Major Activities - groundwater monitoring
Site Size -5,700 hectares (14,100 acres)
Start/End Years - 2000/unknown
Estimated Average Annual Cost FY 2000-2006 - $3,000

Rifle (New) Mill (page 71)
Major Activities - passive groundwater remediation and monitoring
Site Size - 58 hectares (142 acres)
Start/End Years - 1995/2050
Estimated Average Annual Cost FY 2000-2006 - n/a (costs begin FY 2008)

Rifle (Old) Mill (page 75)
Major Activities - passive groundwater remediation and monitoring
Site Size - 10 hectares (23.6 acres)
Start/End Years - 1995/2050
Estimated Average Annual Cost FY 2000-2006 - n/a (costs begin FY 2008)

Rio Blanco (page 79)
Major Activities - groundwater monitoring; enforcing restrictions for access to and use of the subsurface
Site Size - 10 hectares (25 acres)
Surface *Start/End Years* - 2006/in perpetuity
Subsurface Start/End Years - 2009/in perpetuity
Estimated Average Annual Cost FY 2000-2006 - $38,000

Rocky Flats Environmental Technology Site (page 85)
Major Activities - maintain Buffer Zone and Industrial Area institutional controls; conduct surveillance and maintenance of engineered units, if needed, within the site; conduct groundwater, surface water, soils, and air quality monitoring in Industrial Area & Buffer Zone.
Site Size - 2,536 hectares (6,266 acres)
Start-End Years - 2007-time period to be specified under CERCLA process
Estimated Average Annual Cost Post FY 2006 - $6,100,000 million

Rulison (page 107)
Major Activities - groundwater monitoring; enforcing restrictions for access to and use of the subsurface
Site Size -20 hectares (50 acres)
Surface *Start/End Years* - 1998/in perpetuity
Subsurface Start/End Years - 2010/in perpetuity
Estimated Average Annual Cost FY 2000-2006 - $38,000

Slick Rock (North Continent) Mill 1 (page 113)
Major Activities - groundwater monitoring, maintaining institutional controls
Site Size -7 hectares (17 acres)
Start/End Years - 1996/2109
Estimated Average Annual Cost FY 2000- 2006 - n/a (costs begin 2009)

Slick Rock (Union Carbide) Mill 2 (page 117)
Major Activities - groundwater monitoring, maintaining institutional controls
Site Size - 37 hectares (93 acres)
Start/End Years - 1996/2108
Estimated Average Annual Cost FY 2000- 2006 - n/a (costs begin FY 2009)

(UMETCO)Maybell Site 2 (page 121)
Major Activities - disposal cell and groundwater monitoring
Site Size - 81 hectares (200 acres)
Start/End Years -2001/in perpetuity
Estimated Average Annual Cost FY 2000-2006 - $24,000

(UMETCO) Uravan Site (page 125)
Site Size - 182 hectares (450 acres) (acreage to be transferred to DOE for long-term stewardship is unknown)
Current Landlord - UMETCO Minerals Corporation
Expected Start/End Years - 2010-in perpetuity

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BODO CANYON CELL

1.0 SITE SUMMARY

1.1 Site Description and Mission

> ***LONG-TERM STEWARDSHIP HIGHLIGHTS***
>
> *Major Long-Term Stewardship Activities* - disposal cell monitoring; access restrictions
> *Total Site Area* - 49 hectares (120 acres)
> *Estimated Volume of Residual Contaminants* - disposal cell 1,937,000 cubic meters (2,534,000 cubic yards)
> *Long-Term Stewardship Start-End Years* - 1990-in perpetuity
> *Average Annual Long-Term Stewardship Cost FY 2000-2006* - $154,000
> *Landlord* - U.S. Department of Energy, Grand Junction Office

The Bodo Canyon Cell (also known as Durango) is the location of a disposal cell built by the U.S. Department of Energy (DOE) for the relocation and disposal of uranium mill tailings and contaminated soils and construction debris from the nearby Durango Mill. Uranium ore was processed at the mill between 1942 and 1963. In 1990, the U.S. Department of Energy (DOE) recovered and encapsulated the tailings in an engineered disposal cell located on approximately 49 hectares (120 acres) of land in Bodo Canyon. The site is located in La Plata County, Colorado, approximately 5.6 kilometers (3.5 miles) southwest of the Town of Durango and Durango Mill. Prior to receiving the tailings and contaminated soils from the processing site, the land on which the Bodo Canyon Cell is located was used as range land and was managed by the U.S. Department of the Interior, Bureau of Land Management. The tailings and other contaminated materials are contained in a 24- hectare (60-acre), rock-covered disposal cell located in the center of the site.

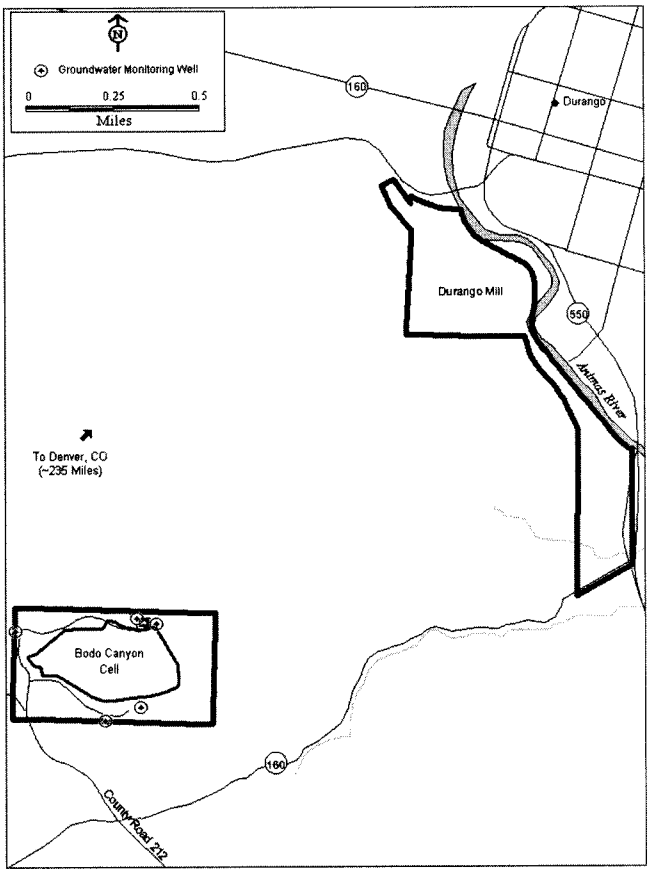
DOE's current mission at the Bodo Canyon Cell is performing long-term stewardship activities, including monitoring the disposal cell and enforcing access restrictions. The disposal cell is subject to Title I of the *Uranium Mill Tailings Radiation Control Act of 1978* (UMTRCA). As such, DOE is responsible for conducting any long-term stewardship activities at the site. These activities are conducted by DOE's Grand Junction Office. The Bodo Canyon Cell did not have a historic mission prior to its use as a disposal site beginning in 1990.

1.2 Site Cleanup and Accomplishments

Milling activities at the Durango Mill, between 1942 and 1963, produced an estimated 917,000 cubic meters (1,200,000 cubic yards) of tailings. Other surface contamination included vicinity property material, contaminated earth, mill debris, slag, and windblown material. The U.S. Nuclear Regulatory Commission (NRC) and the State of Colorado concurred with DOE's remedial action plan to relocate the mill tailings and associated contaminated materials to the Bodo Canyon site for permanent disposal. In March 1987, DOE initiated a remedial action to relocate the approximately 1,937,000 cubic meters (2,534,000 cubic yards) of tailings and contaminated soils and debris from the Durango Mill to the Bodo Canyon Cell. In 1990, the State of Colorado acquired 120 acres of land from the U.S. Bureau of Land Management for the disposal site. Subsequently, the Bodo Canyon Cell site was permanently transferred to DOE. Relocation of the excavated contamination from Durango Mill was completed in the Fall of 1990.

The Bodo Canyon Cell measures approximately 732 meters by 396 meters (2,400 feet by 1,300 feet), including the surrounding rock apron. The disposal cell contains 3,460,000 dry tons of contaminated material, including tailings, building debris from demolished mill structures, and materials from contaminated vicinity properties. The wastes in the cell have a total activity of 1,400 curies of radium-226. The cell occupies approximately 24 hectares (60 acres) of the 49-hectare (120-acre) site. The perimeter of the disposal site is not fenced, but 82 warning signs define the site boundary. The disposal cell is covered with a radon barrier, a rock erosion protection layer on the side slopes of the cell, and a vegetated, soil/rock matrix on the top of the cell to meet U.S.

Environmental Protection Agency (EPA) standards for longevity, radon control, and groundwater protection. In accordance with EPA standards, the cover is designed to remain effective for 200 to 1,000 years. Runoff from the top slope of the cell flows to a surrounding rock apron that carries water away from the cell. The disposal cell was engineered and sited to protect the groundwater, even though the uppermost aquifer beneath the Bodo Canyon Cell is generally not suitable for domestic use because of the relatively high levels of total dissolved solids and the variable quality of the water. In addition, natural vegetation has been re-established in disturbed areas at the site.



Bodo Canyon Cell

Compaction of contaminated materials causes pore water to be expelled as seepage, which is diverted to a holding pond. The water in the pond is treated periodically and discharged, and the drain and pond are inspected monthly in accordance with a stormwater discharge permit issued by the Colorado Department of Public Health and Environment. This pond and treatment system is scheduled to be removed in 2004 when the seepage stops. The zero-valent iron treatment cells will be operated through 2002. The toe drain will then be closed and water levels within the collection gallery will be monitored for two years before the drain is sealed.

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

DOE provides long-term stewardship services as required under the NRC general license to maintain protectiveness and regulatory compliance. DOE manages the site according to a long-term surveillance plan prepared specifically for the Bodo Canyon Cell. Under provisions of the long-term surveillance plan, DOE: (1) conducts annual inspections of this site to evaluate the condition of surface features, (2) performs site maintenance as necessary, (3) monitors the groundwater, and (4) manages transient drainage water and a zero-valent iron water treatment test facility.

Access is restricted through the use of warning signs posted every 152 meters (500 feet) along the site boundary and a locked gate to control vehicle access. DOE staffs a 24-hour phone line for reporting site concerns. Drilling and other intrusive activities are prevented within site boundaries through management control. Long-term stewardship will continue indefinitely.

Site records are kept in permanent storage at the DOE Grand Junction Office in Grand Junction, Colorado. The

types of records kept include characterization data, the remedial action design, the completion report, the long-term monitoring plan, annual inspection reports, and monitoring data. Real property records are maintained at the DOE Albuquerque Operations Office in Albuquerque, New Mexico.

2.2 Specific Long-Term Stewardship Activities

Engineered Units

The disposal cell will require long-term surveillance and maintenance to ensure continued protection of human health and the environment. Long-term stewardship activities will include annual surface inspections to ensure the continued integrity of the cap and other engineered features. Minor repairs will be conducted on an as-needed basis. DOE will be responsible for conducting long-term stewardship activities at the site in perpetuity.

STAKEHOLDER INVOLVEMENT

Community interaction has been minimal since the remedial action was completed. Copies of the annual inspection report for the Bodo Canyon Cell and other sites are distributed to the local library and to stakeholders requesting copies. The annual inspection reports are also published on the DOE Grand Junction Office website at www.doegjpo.com.

Groundwater

The groundwater in the vicinity of the Bodo Canyon Cell is not contaminated. However, the groundwater is monitored periodically to demonstrate the effectiveness of the cell in isolating the encapsulated wastes from the local groundwater system.

2.3 Regulatory Regime

In 1996, the Bodo Canyon Cell came under a general license issued by NRC for custody and long-term care of residually radioactive material disposal sites (Title 10 of the *Code of Federal Regulations,* Section 40.27). The purpose of the general license is to ensure that such sites will be cared for in a manner that protects human health and safety and the environment. The general license went into effect when NRC concurred that the site conformed to cleanup standards and formally accepted Bodo Canyon Cell's long-term surveillance plan.

Long-term stewardship activities at the Bodo Canyon Cell are governed by several requirements in the following regulations: the *Uranium Mill Tailings Radiation Control Act of 1978*; the *Atomic Energy Act of 1954,* as amended; EPA Groundwater Protection Standards, including Subparts A, B, and C of Title 40 of the *Code of Federal Regulations* Part 192; a cooperative agreement between DOE and the State of Colorado; and the *National Environmental Policy Act of 1969,* as amended.

2.4 Assumptions and Uncertainties

The disposal cell cap is not expected to be replaced for at least 200 years.

DOE assumes that the seepage rate will be sufficiently diminished by 2004 and the toe drain will be sealed.

DOE assumes that periodic groundwater monitoring will continue until the disposal cell demonstrates infiltration control.

3.0 Estimated Long-Term Stewardship Costs

The table includes the costs to maintain the disposal cell until fiscal year (FY) 2002, to seal the drain in FY 2004,

and to decommission the monitor wells between 2001 and 2006.

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	***Amount***	***Year(s)***	***Amount***	***Year(s)***	***Amount***
FY 2000	$106,500	**FY 2008**	$45,800	**FY 2036-2040**	$250,900
FY 2001	$166,100	**FY 2009**	$45,800	**FY 2041-2045**	$250,700
FY 2002	$175,900	**FY 2010**	$45,800	**FY 2046-2050**	$250,900
FY 2003	$157,000	**FY 2011-2015**	$228,600	**FY 2051-2055**	$250,700
FY 2004	$237,000	**FY 2016-2020**	$228,300	**FY 2056-2060**	$250,900
FY 2005	$116,700	**FY 2021-2025**	$234,100	**FY 2061-2065**	$250,700
FY 2006	$118,600	**FY 2026-2030**	$248,400	**FY 2066-2070**	$250,900
FY 2007	$82,100	**FY 2031-2035**	$250,700		

4.0 FUTURE USES

DOE controls land use within site boundaries. Land use within site boundaries and access to the disposal site boundary will remain restricted in perpetuity.

For more information about the Bodo Canyon Cell, please contact:

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BURRO CANYON DISPOSAL CELL

1.0 SITE SUMMARY

1.1 Site Description and Mission

> ***LONG-TERM STEWARDSHIP HIGHLIGHTS***
>
> *Major Long-Term Stewardship Activities* - disposal cell monitoring
> *Total Site Area* - 25 hectares (61.3 acres)
> *Estimated Volume of Residual Contaminants* - disposal cell 655,000 cubic meters (857,000 cubic yards)
> *Long-Term Stewardship Start-End Years* - 1998-in perpetuity
> *Average Annual Long-Term Stewardship Cost FY 2000-2006* - $79,000
> *Landlord* - U.S. Department of Energy, Grand Junction Office

The Burro Canyon Disposal Cell is the location of a disposal cell built by the U.S. Department of Energy (DOE) for the relocation and disposal of uranium mill tailings and other contaminated materials from former operations of two nearby uranium processing sites. The site is located on a 25-hectare (61-acre) tract of land in a remote area of southwestern Colorado, approximately eight kilometers (five miles) northeast of Slick Rock, Colorado. The land is owned by DOE and was formerly administered by the U.S. Department of the Interior's Bureau of Land Management. The disposal cell occupies approximately five hectares (12 acres) of land and was built as part of the remediation strategy for the Slick Rock (North Continent) Mill 1 and the Slick Rock (Union Carbide) Mill 2. Approximately 655,000 cubic meters (857,000 cubic yards) of uranium mill tailings and contaminated debris and soils were relocated from the two processing sites, consolidated, and stabilized in the Burro Canyon Disposal Cell in 1997. DOE completed surface remediation activities in 1998.

DOE's current mission at the Burro Canyon Disposal Cell is performing long-term stewardship, including monitoring and maintaining the disposal cell and monitoring the groundwater. The disposal cell is subject to Title I of the *Uranium Mill Tailings Radiation Control Act of 1978* (UMTRCA). As such, DOE is responsible for any remediation and for long-term stewardship activities. The Burro Canyon Disposal Cell did not have a historic mission prior to its use as a disposal site beginning in 1996.

1.2 Site Cleanup and Accomplishments

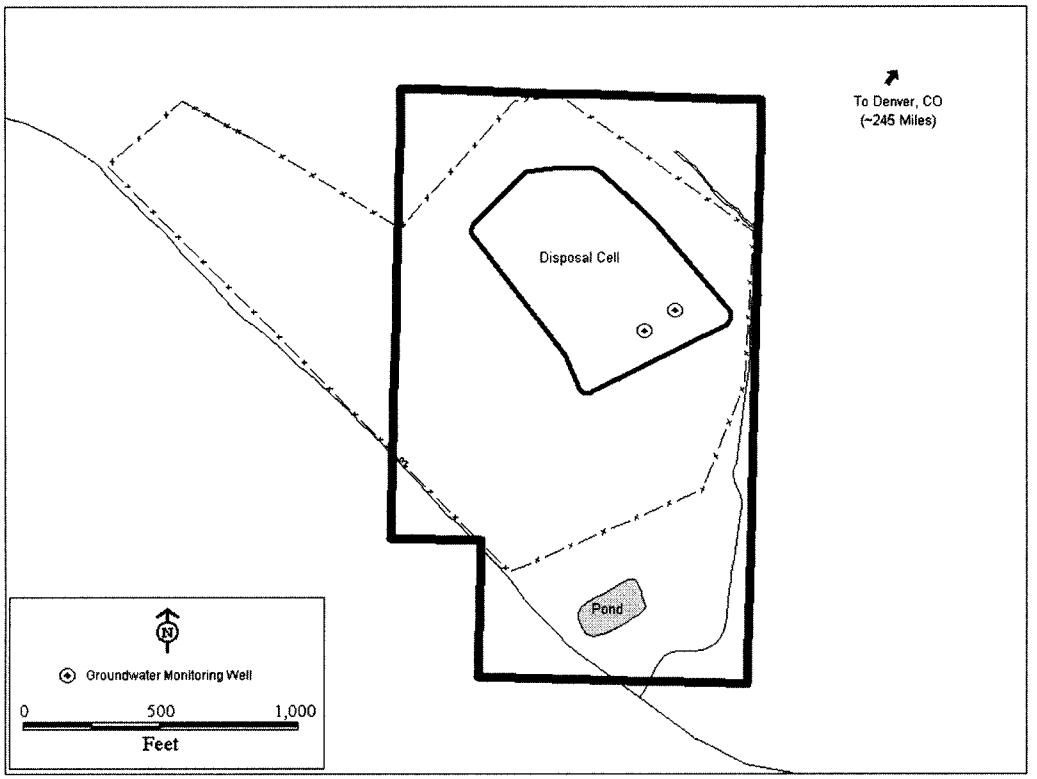
As a result of past milling operations at the two Slick Rock processing sites (North Continent and Union Carbide), contamination at the sites consisted of vanadium and uranium mill tailings, radium, thorium, and uranium in soils, groundwater, and building debris. The contaminants were relocated and stabilized in the Burro Canyon Disposal Cell. The disposal cell is covered with a radon barrier and a rock erosion protection layer to meet U.S. Environmental Protection Agency (EPA) standards for longevity, radon control, and groundwater protection. In accordance with EPA standards, the cover is designed to remain effective for 200 to 1,000 years. After completing surface remediation actions at the site, DOE received concurrence in August 1998 from the U.S. Nuclear Regulatory Commission (NRC) that the site conformed to applicable cleanup standards (Title 40 of the *Code of Federal Regulations,* Part 192).

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

DOE is responsible for long-term stewardship activities at the Burro Canyon Disposal Cell. Under the provisions of the site-specific long-term surveillance plan, DOE conducts annual inspections of this site to evaluate the condition of surface features; performs site maintenance, as necessary; and monitors the water level in two standpipes in the disposal cell. Under the provisions of the plan, DOE monitors transient water levels within the

cell to demonstrate the effectiveness of the cell in isolating the encapsulated wastes from the sandstone layer in the Burro Canyon member. This layer is not a water resource because of low yield, and no down-dip seeps have been observed. Therefore, no groundwater remediation is required.



Burro Canyon Disposal Cell

The Burro Canyon Disposal Cell is surrounded by a wire fence with a locked gate to prevent unauthorized access. Warning signs are posted on the site perimeter at increments of about 150 meters (500 feet). In addition, DOE staffs a 24-hour phone line for reporting site concerns. No drilling or other intrusive activities are allowed on the property unless authorized by DOE.

DOE maintains and updates the specific records and reports required to document long-term stewardship activities at the Burro Canyon Disposal Cell. DOE submits an annual report to the NRC that documents the results of activities implemented in accordance with the site's long-term surveillance plan, as required by NRC regulations in Title 10 of the *Code of Federal Regulations*, Part 27, Appendix A, Criterion 12. Site records are kept in permanent storage at the DOE Grand Junction Office in Colorado, and real property records are retained at the DOE Albuquerque Office in New Mexico. The types of records maintained include site characterization data, remedial action design information, the site completion report, long-term monitoring plans, annual inspection reports, and current and historic monitoring data.

2.2 Specific Long-Term Stewardship Activities

Engineered Units

The site contains one disposal cell, which requires long-term surveillance and maintenance to ensure continued protection of human health and the environment. Long-term stewardship activities for the disposal cell include annual inspections, sign replacements, and other maintenance, as needed. Part of the surveillance includes monitoring the water level in two standpipes in the disposal cell. The water level measurements are automatically recorded daily to verify that the water from precipitation does not infiltrate through the disposal cell cover.

STAKEHOLDER INTERACTION

Since the remedial action was completed, community interaction has been minimal. Copies of the annual inspection report for the Burro Canyon Disposal Cell and other nearby sites are distributed to the local library and to any stakeholders that requests them. The site's annual inspection reports will also be published on the DOE Grand Junction Office website at www.doegjpo.com.

2.3 Regulatory Regime

In August 1998, NRC issued the general license for the Burro Canyon Disposal Cell for custody and long-term care of residual radioactive disposal sites (contained at Title 10 of the *Code of Federal Regulations,* Section 40.27). The purpose of the general license is to ensure that such sites will be cared for in a manner that protects human health and safety and the environment. The general license went into effect when NRC concurred that the site conformed to cleanup standards and formally accepted the site-specific long-term surveillance plan.

Long-term stewardship activities at the Burro Canyon Disposal Cell are governed by several requirements in the following regulations: the *Uranium Mill Tailings Radiation Control Act of 1978*; the *Atomic Energy Act of 1954,* as amended; Environmental Protection Agency Groundwater Protection Standards, including Subparts B and C of Title 40 of the *Code of Federal Regulations,* Part 192; a cooperative agreement between DOE and the State of Colorado; and the *National Environmental Policy Act of 1969,* as amended.

2.4 Assumptions and Uncertainties

Because the site has been monitored since 1998, long-term stewardship activities at the site are well known and are not expected to change dramatically. Sound scope and cost estimates for the long-term stewardship activities at the site have been developed. DOE assumes that monitoring will continue indefinitely, until data demonstrate that the disposal cell provides infiltration control. In addition, the disposal cell cover is not expected to be replaced for a minimum of 200 years.

3.0 Estimated Long-Term Stewardship Costs

Long-term stewardship costs for the Burro Canyon Disposal Cell are based on historic costs incurred while conducting actual surveillance and maintenance activities. Cost estimates reflect the current site agreements and monitoring frequencies. Contingency costs, such as cap replacement, have not been incorporated into the cost estimate. Costs from fiscal years (FY) 2000 through 2006 include prorated costs associated with decommissioning unnecessary monitoring wells at similar sites.

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	***Amount***	***Year(s)***	***Amount***	***Year(s)***	***Amount***
FY 2000	$64,403	**FY 2008**	$24,400	**FY 2036-2040**	$128,000
FY 2001	$88,600	**FY 2009**	$24,400	**FY 2041-2045**	$128,000
FY 2002	$93,800	**FY 2010**	$24,400	**FY 2046-2050**	$128,100
FY 2003	$83,700	**FY 2011-2015**	$116,800	**FY 2051-2055**	$128,000
FY 2004	$94,400	**FY 2016-2020**	$116,700	**FY 2056-2060**	$128,000
FY 2005	$62,200	**FY 2021-2025**	$119,700	**FY 2061-2065**	$128,000
FY 2006	$63,300	**FY 2026-2030**	$126,700	**FY 2066-2070**	$128,100
FY 2007	$24,600	**FY 2031-2035**	$128,000		

4.0 FUTURE USES

Future use of the site will be limited to monitoring and maintaining the disposal cell in perpetuity. Public access to the disposal site will be restricted indefinitely. Land surrounding the site is currently used for grazing, hunting, and other recreational uses. These uses are expected to continue in the future.

For more information about the Burro Canyon Disposal Cell, please contact:

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CHENEY DISPOSAL CELL

1.0 SITE SUMMARY

1.1 Site Description and Mission

The Cheney Disposal Cell (also know as the Grand Junction Disposal Site) is the location of a disposal cell built by the U.S. Department of Energy (DOE) for the relocation and disposal of uranium mill tailings and contaminated building materials from the Grand Junction Mill 1 (also know as the Climax Uranium Mill) and the Grand Junction Mill 2 (also known as the Grand Junction Office) sites. Located in Mesa County, Colorado, approximately 18 miles southeast of Grand Junction, the site covers 145 hectares (360 acres) and the actual disposal cell covers 24 hectares (60 acres).

LONG-TERM STEWARDSHIP HIGHLIGHTS

Major Long-Term Stewardship Activities - disposal cell monitoring; groundwater monitoring
Total Site Area - 145 hectares (360 acres)
Estimated Volume of Residual Contaminants - disposal cell 3,000,000 cubic meters (4,000,000 cubic yards)
Long-Term Stewardship Start-End Years - 1994-in perpetuity
Average Annual Long-Term Stewardship Cost FY 2000-2006 - $460,280
Landlord - U.S. Department of Energy, Grand Junction Office

The current mission of the Cheney Disposal Cell is to accept and dispose of tailings and contaminated materials from *Uranium Mill Tailings Radiation Control Act of 1978* (UMTRCA) sites, and to conduct long-term stewardship activities, including monitoring and maintaining the onsite disposal cell. The Cheney Disposal Cell did not have a historical DOE mission prior to being acquired for use as a disposal site. DOE is responsible for any remediation and for long-term stewardship activities under Title I of UMTRCA.

1.2 Site Cleanup and Accomplishments

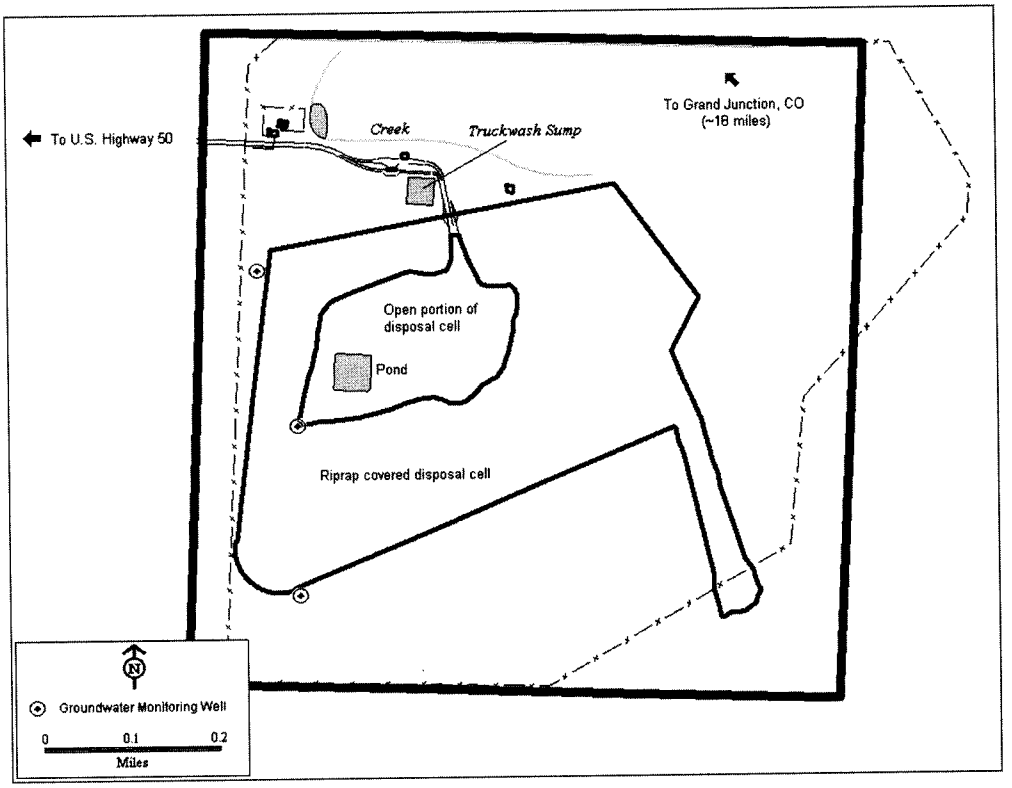
Milling operations at the Grand Junction Mill 1 site created process-related waste and tailings. Because the tailings were an ideal and inexpensive construction material suitable for concrete, mortar, and fill, they were widely used in the Grand Junction area for these purposes. DOE recovered the tailings and other contaminated materials from the mill site and from more than 4,000 vicinity properties in the Grand Junction area and consolidated and stabilized them in the Cheney Disposal Cell. Part of the disposal cell was closed and covered in 1994; the remainder of the cell remains open to receive additional contaminated materials.

The open portion of the disposal cell, which encompasses approximately eight hectares (20 acres), will accept contaminated materials until 2023 or until the design capacity is reached. This part of the cell will include tailings and contaminated materials removed from underground utility lines beneath Grand Junction streets and other sites subject to Title I of UMTRCA, as well as sludge from groundwater treatment plants at the Tuba City, Arizona site and similar sites. The cell will be open for short durations each year to accept the tailings and contaminated materials.

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

The U.S. Nuclear Regulatory Commission (NRC) has conditionally approved the closed portion of the disposal cell, but the site will not be fully licensed until the open part of the disposal cell is closed. Until that time, DOE will be responsible for the closed part of the cell under provisions of the site's long-term surveillance plan.



Cheney Disposal Cell

The disposal site is owned by the Federal Government, which controls land use within the site boundaries. Access is restricted through the use of a wire fence, locked gates, and warning signs posted every 152 meters (500 feet) along the site boundary. DOE staffs a 24-hour phone line for reporting site concerns. Drilling and other intrusive activities are prevented within site boundaries through the use of institutional controls.

Site records are in permanent storage at the DOE Grand Junction Office in Colorado. Types of records maintained include the site characterization data, remedial action design information, the site completion report, long-term monitoring plans, annual inspection reports, and current and historic monitoring data. Real property records for the site are maintained at the DOE Albuquerque Operations Office in New Mexico.

2.2 Specific Long-Term Stewardship Activities

Engineered Units

The 24-hectare (60-acre) disposal cell is 518 meters by 701 meters (1,700 feet by 2,300 feet) and contains three million cubic meters (four million cubic yards) of tailings and vicinity property materials. In the closed part of the disposal cell, tailings were placed in compacted layers to a height of nine meters (30 feet) above the original ground surface. The cell is covered with a multi-component cap constructed of materials

STAKEHOLDER INTERACTION

Community interaction has been minimal. Copies of the annual inspection report for the Cheney Disposal Cell and other sites are distributed to the local library and to any stakeholders that request them. Inspection reports are also published on the DOE Grand Junction Office website at www.doegjpo.com.

removed from the excavation. Radon emissions and precipitation infiltration are minimized by the low-permeability radon barrier. Three additional layers-a soil frost barrier, a sand and gravel bedding layer, and a rock layer-protect the radon barrier from the weather and plant and animal intrusion. The cell design promotes rapid runoff of precipitation to minimize leachate. Erosion control has also been constructed for all potentially vulnerable features, and the site is graded to provide positive drainage. Disturbed areas have been revegetated. The open portion of the cell encompasses approximately eight hectares (20 acres) of the total cell. It measures 366 meters by 229 meters (1,200 feet by 750 feet) and can accommodate up to 191,000 cubic meters (250,000 cubic yards) of additional contaminated materials.

Long-term stewardship of the disposal cell includes continual monitoring of radon concentrations in the air around the disposal cell. DOE conducts an annual inspection to assess the integrity of the completed part of the cell cover and other engineered features, and to ensure that institutional controls are effective and the site complies with applicable requirements. When the cell is not in operation, DOE conducts weekly storm water and security-related inspections of the area.

Groundwater

The groundwater in the vicinity of the Cheney Disposal Cell is not contaminated with materials from the disposal cell. However, the groundwater is monitored quarterly in two wells adjacent to the cell and one well within the cell to demonstrate the effectiveness of the cell in isolating the encapsulated wastes from the local groundwater system. The disposal cell was engineered and located to protect the groundwater. The uppermost aquifer under the site is separated from the radioactive waste materials by a naturally occurring barrier. Once the disposal cell is permanently closed in 2023, groundwater monitoring is expected to occur at a reduced frequency of once every five years.

2.3 Regulatory Regime

Long-term stewardship of the Cheney Disposal Cell is governed by several requirements in the following regulations: the *Uranium Mill Tailings Radiation Control Act of 1978*; the *Atomic Energy Act of 1954,* as amended; Environmental Protection Agency Groundwater Protection Standards, including Subparts B and C of Title 40 of the *Code of Federal Regulations,* Part 192; a cooperative agreement between DOE and the State of Colorado; and the *National Environmental Policy Act of 1969.*

When the open part of the disposal cell is closed, and NRC concurs that the site conforms to cleanup standards, the site will come under a general license for the custody and long-term care of residual radioactive disposal sites (contained at Title 10 of the *Code of Federal Regulations,* Section 40.27). The purpose of the general license is to ensure that such sites will be cared for in a manner that protects human health and safety and the environment.

2.4 Assumptions and Uncertainties

Since DOE has been performing long-term stewardship activities since 1994, long-term stewardship activities at the site are well known and are not expected to change dramatically.

Cost estimates reflect the assumption that the cell will remain partially open until 2023. If the cell capacity is met before that time, the cell will close early and the costs of closing the cell will be shifted to earlier time frames.

3.0 ESTIMATED LONG-TERM STEWARDSHIP COSTS

The costs associated with monitoring and maintaining the disposal cell, which are identified in the table below, are relatively high for the duration of the period that the disposal cell is partially open and accepting waste. Fiscal year (FY) 2000 costs are somewhat elevated from the other operating year costs due to costs incurred for repair work on the cell. These repairs were initiated in FY 1999 but were not completed until FY 2000.

The peak in costs projected include the costs associated with closing the open portion of the cell. These costs will begin in FY 2023 and are expected to continue until approximately FY 2026. After the cell is closed, long-term stewardship costs level out to approximately $22,000 annually, with groundwater monitoring occurring every fifth year.

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	***Amount***	***Year(s)***	***Amount***	***Year(s)***	***Amount***
FY 2000	$574,765	**FY 2008**	$442,700	**FY 2036-2040**	$120,000
FY 2001	$455,600	**FY 2009**	$442,000	**FY 2041-2045**	$120,000
FY 2002	$445,300	**FY 2010**	$442,800	**FY 2046-2050**	$120,100
FY 2003	$429,700	**FY 2011-2015**	$2,117,700	**FY 2051-2055**	$120,000
FY 2004	$434,500	**FY 2016-2020**	$2,115,000	**FY 2056-2060**	$120,000
FY 2005	$442,900	**FY 2021-2025**	$9,654,000	**FY 2061-2065**	$120,000
FY 2006	$439,200	**FY 2026-2030**	$2,297,000	**FY 2066-2070**	$120,100
FY 2007	$445,500	**FY 2031-2035**	$120,000		

4.0 FUTURE USES

The site will continue to accept waste into a portion of the disposal cell, until 2023. After that time, no other mission, other than monitoring of the disposal cell and groundwater, is expected. After 2023, the site's future land use will be restricted to monitoring and maintaining the disposal cell in perpetuity. Access to the disposal cell will be restricted in perpetuity.

For more information about the Cheney Disposal Cell, please contact:

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(COTTER) CAÑON CITY SITE[1]

1.0 SITE SUMMARY

1.1 Site Description and Mission

The (Cotter) Cañon City Site (also known as the Lincoln Park Superfund Site) is the location of a current uranium milling site that processed uranium ore from 1958 to 1979 (and intermittently thereafter). The site is located approximately 3 kilometers (2 miles) southwest of Cañon City, Colorado, in Fremont County, approximately 65 kilometers (40 miles) northwest of the City of Pueblo.

LONG-TERM STEWARDSHIP HIGHLIGHTS

Total Site Area - unknown
Current Landlord - Cotter Corporation
Expected Future Landlord - U.S. Department of Energy
Reason Not Subject to NDAA Requirements - This site is an UMTRCA Title II site that will not be transferred to the U.S. Department of Energy until 2020

The (Cotter) Cañon City Site is subject to Title II of the *Uranium Mill Tailings Radiation Control Act of 1978* (UMTRCA). UMTRCA Title II sites are privately owned and operated sites that were active when UMTRCA was passed, or thereafter. The majority of the mining and milling conducted at these sites was for the private sale of uranium, but a portion of the uranium was sold to the U.S. Government. Under UMTRCA Title II, DOE is responsible for long-term stewardship activities, but not for site remediation.

The (Cotter) Cañon City Site is expected to be transferred to the U.S. Department of Energy (DOE) for long-term-stewardship in 2020. The number of acres that will be transferred to the DOE has not yet been determined. Once the site is transferred to DOE, the only anticipated site mission will be the long-term monitoring and maintenance of the disposal cell, and access restriction enforcement. When remediation activities are completed, the site will have an onsite disposal cell containing approximately 1.3 million cubic meters (1.7 million cubic yards) of uranium mill tailings and contaminated material. The precise size of the disposal cell will not be known until remediation is completed.

The historic mission of the site was to process uranium ore. The Cotter Corporation's first mill at the site was constructed in 1957 and operated from 1958 to 1979, when a new mill was built nearby on the property. Mill products have included refined uranium, vanadium, and molybdenum. Since the mill was acquired by Commonwealth Edison in 1975, and then by General Atomic in 1999, it has primarily produced uranium oxide, or "yellowcake," a raw material used to make fuel for nuclear power plants. The mill has operated only intermittently since 1987 due to economic and other considerations.

1.2 Site Cleanup and Accomplishments

As a result of the uranium milling process, liquid wastes containing radionuclides and heavy metals were

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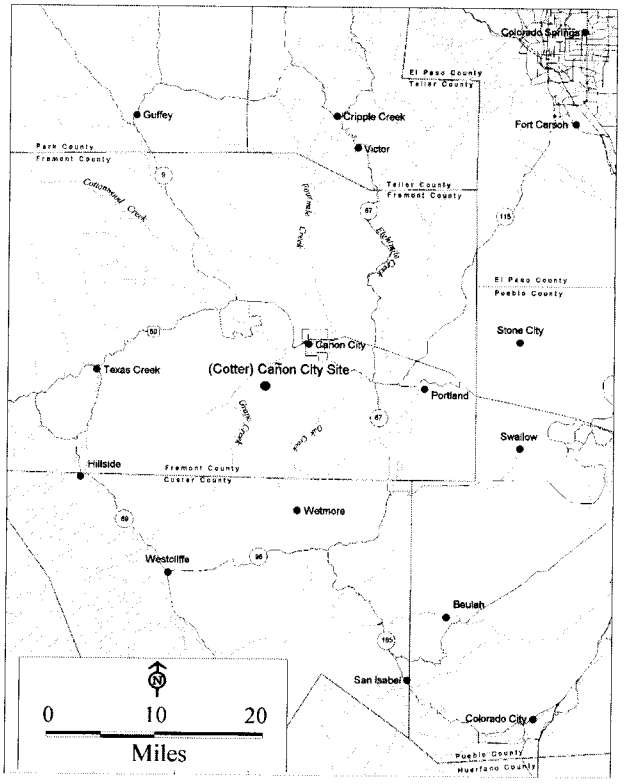
[1]This report is developed in response to a Congressional request in the Fiscal Year (FY) 2000 National Defense Authorization Act (NDAA). As requested by the Act, this report addresses current and anticipated long-term stewardship activities at each site or portion of a site by the end of calendar year 2006 ("Conference Report on S.1059, National Defense Authorization Act for Fiscal Year 2000," *Congressional Record,* August 5, 1999).

Based on current planning, the (Cotter) Cañon City Site is not expected to be transferred to the U.S. Department of Energy (DOE) for long-term stewardship until 2020, and for this reason the site is not the primary focus of this report. This brief summary of the site cleanup activities is provided for background information and potential future long-term stewardship activities. (See Section 3.2 of Volume I).

discharged from 1958 to 1978 into 11 unlined tailings ponds. The ponds were replaced in 1982 with the construction of two lined impoundments. Prior to 1982, a number of groundwater wells in the area showed elevated levels of uranium and molybdenum contamination, and in 1984, the U.S. Environmental Protection Agency placed the site on the National Priorities List of Superfund sites.

In 1988, the State of Colorado and Cotter Corporation signed a Consent Decree, making Cotter Corporation responsible for cleanup at the site. Residences in the area were connected to the Cañon City water supply, and a groundwater interception system was installed to capture contaminated groundwater and transfer the water to onsite evaporation impoundments. Additional remediation of the site has involved revegetating the mill site; diluting the contaminants in Sand Creek below the dam; implementing air quality controls; and initiating grazing restrictions in the area.



(Cotter) Cañon City Site

2.0 POTENTIAL LONG-TERM STEWARDSHIP ACTIVITIES

The potential long-term stewardship activities will predominantly involve groundwater monitoring, monitoring and maintaining the disposal cell, implementing institutional controls, and enforcing access restrictions.

DOE will be responsible for long-term stewardship activities upon site transfer in 2020. When remediation activities are completed, the site will have an onsite disposal cell containing approximately 1.3 million cubic meters (1.7 million cubic yards) of uranium mill tailings and contaminated material. The precise size of the disposal cell will not be known until remediation is completed. The disposal cell will be closed with have a low-permeability radon barrier and an erosion control layer. Erosion control will be provided for all potentially vulnerable features and the site will be graded to provide positive drainage. Disturbed areas will be revegetated. The disposal cell will be similar to other uranium mill tailings disposal cells and will require similar long-term stewardship activities.

Anticipated site-wide stewardship activities include restricting access through the use of fencing and warning signs posted along the site boundary. DOE will staff a 24-hour phone line for reporting site concerns, and drilling and other intrusive activities will be prevented within site boundaries through management controls.

Groundwater at the site is known to be contaminated as a result of the site's historic uranium processing activities. The extent of groundwater contamination that will be present at the time of site transfer cannot be reasonably estimated at this time. DOE assumes that groundwater will require monitoring on a periodic basis. The precise monitoring requirements will be prescribed in the long-term surveillance plan that will be developed and approved by the Nuclear Regulatory Commission (NRC) at the time of site transfer. Upon NRC concurrence that the site conforms to cleanup standards, the site will come under a general license issued by NRC under Title 10, *Code of Federal Regulations*, Section 40.28.

Site records will be permanently stored at the DOE Grand Junction Office in Colorado. The types of records that will be maintained include site characterization data, remedial action design information, the site completion report, long-term monitoring plans, annual inspection reports, and current and historic monitoring data.

3.0 EXPECTED FUTURE USES

The site's end use is unknown at this time, but it will largely depend on how much of the site is ultimately transferred to DOE in 2020. It is anticipated that, at a minimum, access to the disposal cell will remain restricted and that long-term stewardship will continue in perpetuity.

For additional information about the (Cotter) Cañon City Site, please contact:

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DURANGO MILL

1.0 SITE SUMMARY

1.1 Site Description and Mission

> ***LONG-TERM STEWARDSHIP HIGHLIGHTS***
>
> *Major Long-Term Stewardship Activities* - groundwater monitoring
> *Total Site Area* - 51 hectares (127 acres)
> *Estimated Volume of Residual Contaminants* - groundwater 378,500 cubic meters (100 million gallons)
> *Long-Term Stewardship Start-End Years* - 1990-2070
> *Average Annual Long-Term Stewardship Cost FY 2000-2006* - n/a (costs begin FY 2007)
> *Landlord* - U.S. Department of Energy, Grand Junction Office

The Durango Mill site is the location of a former uranium milling site that operated from 1949 to 1965. The site is located in La Plata County, Colorado, just southwest of the City of Durango, and occupies property on the west side of the Animas River, extending from the floodplain to the base of Smelter Mountain. Milling activities generated tailings which were deposited in piles. These piles resulted in the contamination of 13 hectares (33 acres) of millsite property. The site consisted of two areas: the tailings area and the raffinate ponds area about 0.8 kilometers (0.5 miles) southeast of the tailings area. Mill tailings and contaminated materials and construction debris were removed from the 51-hectare (127-acre) site and associated vicinity properties to the Bodo Canyon Cell located approximately 5.6 kilometers (3.5 miles) southeast of the Durango Mill.

The U.S. Department of Energy's (DOE) current mission at the Durango Mill is to finish remediating the contaminated groundwater on the site. Surface remediation of the site was completed in 1990. DOE is responsible for conducting remediation and long-term stewardship activities at the site under Title I of the *Uranium Mill Tailings Radiation Control Act of 1978* (UMTRCA). Groundwater remediation is being completed through DOE's Uranium Mill Tailings Remediation Action Groundwater Project. Long-term stewardship activities at the site include groundwater monitoring.

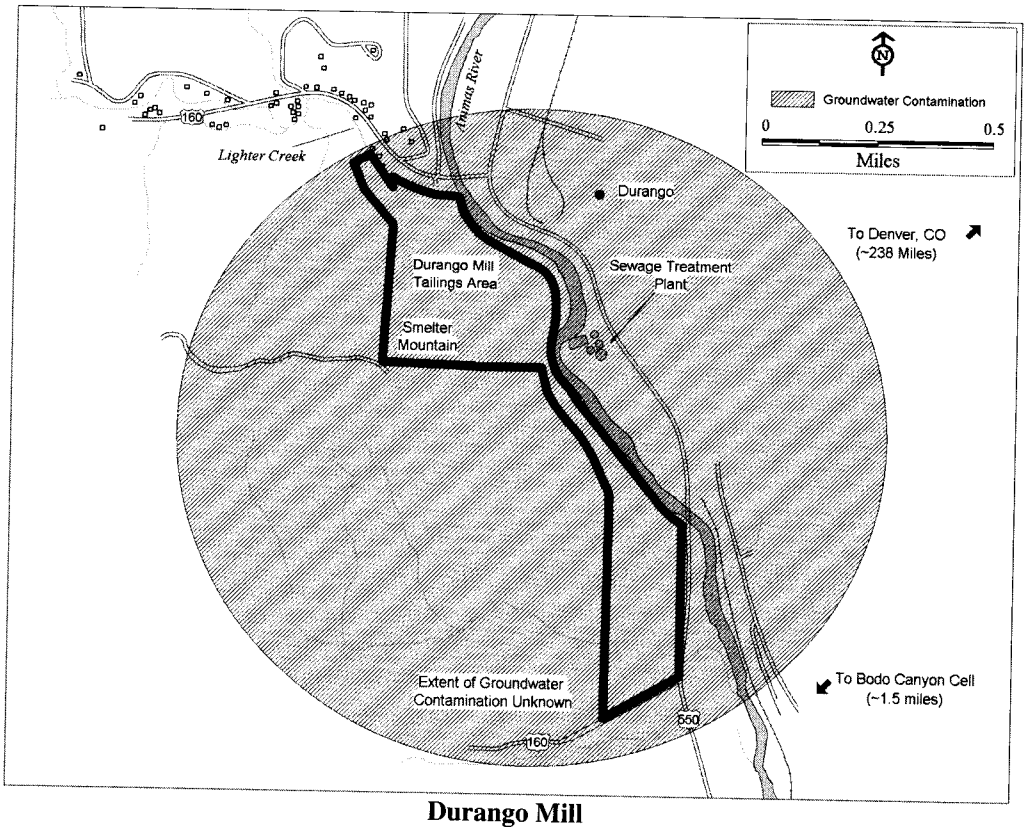
The Durango Mill's historic mission was to produce uranium oxide for the U.S. Government. Vanadium Corporation of America built the Durango Mill in 1942 to produce vanadium during World War II. The mill was built on the site of an old lead smelter that had operated from 1880 to 1930. In 1943, Vanadium Corporation began reprocessing vanadium tailings to recover uranium for use in the Manhattan Project. The mill shut down its operation in 1946, but re-opened in 1949 when Vanadium Corporation of America was contracted to sell uranium oxide to the U.S. Atomic Energy Commission (the predecessor agency to DOE) to support the national defense program. Uranium processing activities at the Durango Mill continued until March 1963, when the mill was shut down permanently. Various owners held the site property until the State of Colorado obtained ownership in 1990.

1.2 Site Cleanup and Accomplishments

As at other uranium milling sites, operations at Durango Mill site resulted in migration of low-level radioactive and other hazardous substances from the mill tailings piles to the surrounding soil and eventually the groundwater. DOE is responsible for cleaning up surface and groundwater contamination at the Durango Mill. Surface remedial action at the site began in 1987 and was completed in 1990. The site was addressed as two parcels during the surface remedial action: the tailings area and the raffinate ponds area.

Approximately 1,937,000 cubic meters (2,534,000 cubic yards) of residually radioactive materials were remediated, including material from 129 vicinity properties, and were relocated to and disposed of in the Bodo

Canyon Cell. The disturbed areas of the site were backfilled with uncontaminated soil to a level even with the surrounding terrain, recontoured to promote surface drainage, and then revegetated. The soil was remediated to U.S. Environmental Protection Agency (EPA) standards.



Durango Mill

Seepage from the tailings piles and raffinate ponds has contaminated the alluvial groundwater underlying the site. Seven hazardous constituents (cadmium, lead, molybdenum, net gross alpha, radium (226 and 228), selenium, and uranium) have exceeded the EPA maximum concentration limits in the aquifer beneath both areas of the site. The estimated amount of contaminated groundwater at the Durango site is 378,500 cubic meters (100 million gallons). The groundwater underlying the site is not used for human consumption, and there is no evidence of elevated hazardous constituents in the Animas River as a result of discharge from the alluvial aquifer into the river. The City of Durango and properties near the site are served by a municipal water supply system. Water for this system is withdrawn from the Animas River upstream of the Durango Mill site. The water intake for a planned irrigation project will be located in the river in the southern portion of the site (downstream from most of the site). Groundwater monitoring has been conducted at the Durango Mill site for many years. Groundwater characterization and modeling began in 2000 and will continue through 2002 as part of the Uranium Mill Tailings Remediation Action Groundwater Project. DOE will propose a compliance strategy upon completion of the effort. The expected compliance strategy will be natural flushing. The compliance period is up to 100 years after approval of the groundwater compliance plan.

The processing site was acquired by the State of Colorado before remediation commenced in 1987, but was then transferred to the La Plata County government for public use. Since then the mill site was transferred to the City of Durango and the raffinate ponds area were transferred to the Animas-La Plata Water Conservancy District.

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

DOE's Grand Junction Office is responsible for funding and conducting long-term stewardship activities at the Durango Mill. DOE will conduct groundwater-related, post-closure, long-term stewardship activities in accordance with a U.S. Nuclear Regulatory Agency (NRC)-approved plan until the groundwater complies with applicable EPA standards. DOE will staff a 24-hour phone line for reporting site concerns. The long-term stewardship activities will be limited to routine sampling once every five years, provided that the compliance strategy for remediating the contaminated groundwater in the alluvial aquifer is natural flushing. Sampling will continue indefinitely or until cleanup levels are achieved – which is expected to be before 2070.

The site records for the Durango Mill are kept in permanent storage at the DOE Grand Junction Office in Grand Junction, Colorado. The types of records kept include characterization data, the remedial action design, the completion report, the groundwater compliance plan, annual inspection reports, and groundwater monitoring results.

STAKEHOLDER INVOLVEMENT

Community interaction has been minimal since the surface remedial action was completed. Copies of the annual inspection report for the Durango Mill and other sites will be distributed to the local library and to any stakeholder requesting a copy. The annual inspection reports will also be published on the Grand Junction Office website at www.doegjpo.com.

2.2 Regulatory Regime

UMTRCA authorizes DOE to care for the uranium mill tailings sites under a license issued by NRC. UMTRCA stipulates that NRC will promulgate regulations to ensure the permanent disposal sites are monitored and maintained in accordance with the general license. However, for the actual processing site where the residual radioactive materials were relocated off the processing site, NRC will not license the original processing site. Compliance with EPA groundwater standards will require NRC concurrence.

Long-term stewardship activities at the Durango Mill are governed by several requirements in the following regulations: the *Uranium Mill Tailings Radiation Control Act of 1978*; the *Atomic Energy Act of 1954,* as amended; EPA Groundwater Protection Standards, including Subparts B and C of Title 40 of the *Code of Federal Regulations*, Part 192; a cooperative agreement between DOE and the State of Colorado; and the *National Environmental Policy Act of 1969,* as amended.

2.3 Assumptions and Uncertainties

DOE assumes that groundwater compliance will be achieved through natural flushing and that active groundwater remediation will not be required. In addition, DOE assumes that groundwater monitoring will continue indefinitely or until cleanup standards are achieved. DOE expects that cleanup standards will be reached before 2070.

3.0 ESTIMATED LONG-TERM STEWARDSHIP COSTS

Characterization and modeling of the groundwater will continue through fiscal year (FY) 2002 and is funded as part of the groundwater remediation activity. Costs for long-term stewardship activities begin in FY 2007 and are associated primarily with groundwater monitoring.

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	*Amount*	*Year(s)*	*Amount*	*Year(s)*	*Amount*
FY 2000	$0	**FY 2008**	$0	**FY 2036-2040**	$7,000
FY 2001	$0	**FY 2009**	$17,000	**FY 2041-2045**	$13,000
FY 2002	$0	**FY 2010**	$0	**FY 2046-2050**	$7,000
FY 2003	$0	**FY 2011-2015**	$13,000	**FY 2051-2055**	$13,000
FY 2004	$0	**FY 2016-2020**	$7,000	**FY 2056-2060**	$7,000
FY 2005	$0	**FY 2021-2025**	$13,000	**FY 2061-2065**	$13,000
FY 2006	$0	**FY 2026-2030**	$7,000	**FY 2066-2070**	$7,000
FY 2007	$24,000	**FY 2031-2035**	$13,000		

4.0 FUTURE USES

The site has been deeded to the local government with deed restrictions that require approval from the State of Colorado before construction or other intrusive activities may commence. Groundwater use will be restricted until compliance with EPA standards is achieved. La Plata County has proposed to allow a portion of the land (i.e., surface only) to be used surface for recreation and open space purposes, with public access unrestricted. The raffinate ponds area is owned by the Animas La Plata Water Conservancy District.

For more information about the Durango Mill, please contact:

Art Kleinrath, Long-Term Surveillance and Maintenance Program Manager
U.S. Department of Energy, Grand Junction Office
2597 B3/4 Road, Grand Junction, CO 81503
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or visit the Internet website at http://www.doegjpo.com

ESTES GULCH DISPOSAL CELL

1.0 SITE SUMMARY

1.1 Site Description and Mission

The Estes Gulch Disposal Cell was constructed by the U.S. Department of Energy (DOE) to stabilize waste from two former uranium processing sites near Rifle, Colorado. The 83-hectare (205-acre) site contains a 28.7-hectare (71-acre) disposal cell. The site is located in Garfield County in west-central Colorado on the western slope of the Rocky Mountains, approximately ten kilometers (six miles) north of the town of Rifle, Colorado. The two former uranium processing sites (called Rifle (Old) Mill and Rifle (New) Mill) are located on the floodplain of the Colorado River Valley, north of the Colorado River. The Rifle (Old) Mill site is just east of the Rifle township limits. The Rifle (New) Mill site is west of the town of Rifle, approximately three kilometers (two miles) from the Rifle (Old) Mill site.

LONG-TERM STEWARDSHIP HIGHLIGHTS

Major Long-Term Stewardship Activities - disposal cell monitoring and maintenance
Total Site Area - 83 hectare (205 acres)
Estimated Volume of Residual Contaminants - disposal cell 3,435,000 cubic meters (3,757,000 cubic yards)
Long-Term Stewardship Start-End Years - 1997-in perpetuity
Average Annual Long-Term Stewardship Cost FY 2000-2006 - $42,500
Landlord - U.S. Department of Energy, Grand Junction Office

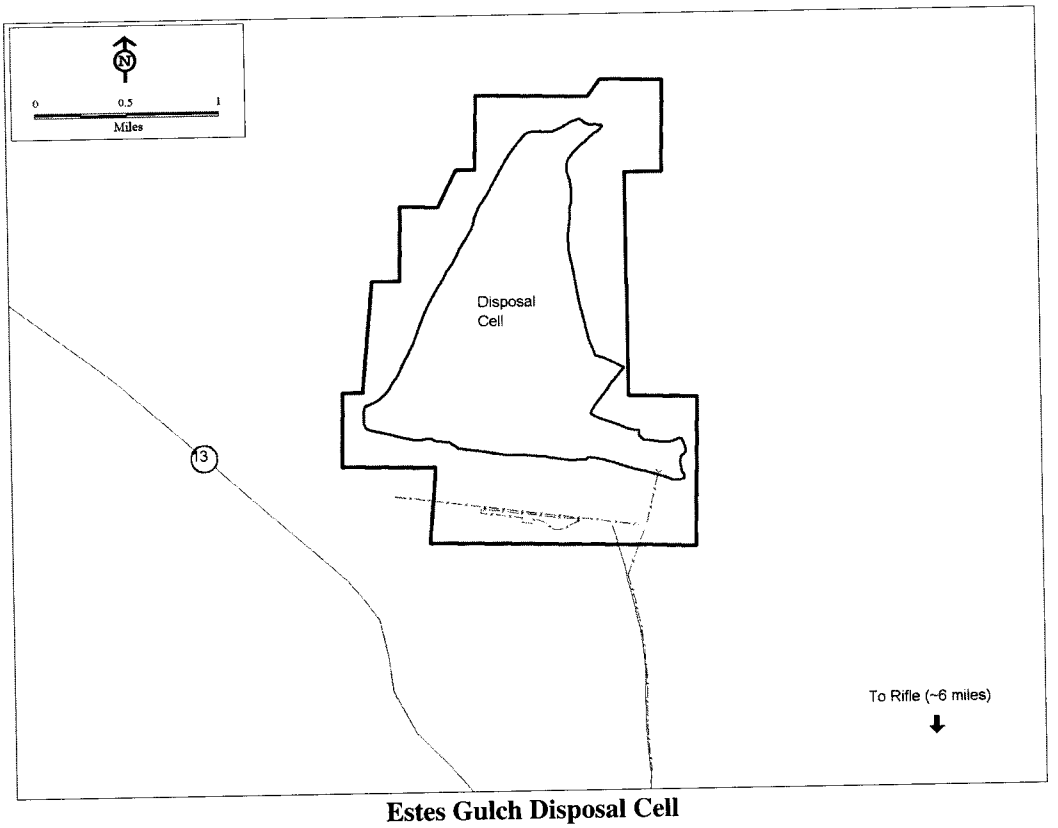
DOE's current mission at the Estes Gulch Disposal Cell is long-term stewardship, including monitoring and maintaining the disposal cell. DOE is responsible for any remediation and long-term stewardship activities under Title I of the *Uranium Mill Tailings Radiation Control Act of 1978* (UMTRCA). The Estes Gulch Disposal Cell did not have a historic mission prior to its use as a disposal site beginning in 1993.

Historical mill operations at the Rifle (Old and New) Mills resulted in uranium mill tailings. DOE was given the authority to perform remedial action at both Rifle sites. DOE evaluated the environmental impacts associated with site remedial action in an environmental impact statement. The U.S. Nuclear Regulatory Commission (NRC) and the State of Colorado concurred with DOE's remedial action plan, which called for the removal and relocation of the tailings and other contaminated materials to a new disposal cell to be constructed by DOE at a nearby site.

1.2 Site Cleanup and Accomplishments

DOE began constructing the Estes Gulch Disposal Cell in 1993. During 1994 and 1995, DOE relocated uranium mill tailings and other residual radioactive materials, such as contaminated mill buildings and associated debris, windblown materials, and about 18,400 cubic meters (24,000 cubic yards) of vicinity property materials from the Rifle (Old and New) Mills, and placed them in the Estes Gulch Disposal Cell.

Disposal cell construction was completed in 1996. Approximately 3,435,000 cubic meters (3,757,000 cubic yards) of tailings and contaminated material were disposed of at the Estes Gulch Disposal Cell. The disposal cell has a radon/infiltration barrier cover and rock surface layer to control erosion, and during the final site grading, all areas were contoured to promote drainage away from the disposal cell. A mix of grasses and sagebrush was planted to revegetate all disturbed areas of the disposal site not covered by riprap. The Estes Gulch Disposal Cell is partially fenced, and its perimeter is marked with warning signs. No soil contamination exists at this disposal site and the site groundwater is not contaminated. The NRC concurred with DOE that the cell complied with U.S. Environmental Protection Agency (EPA) standards and accepted the disposal site under the general license for residual radioactive disposal sites contained in Title 10, *Code of Federal Regulations*, Part 40, Section 40.27.



Estes Gulch Disposal Cell

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

DOE manages the site according to a long-term surveillance plan prepared specifically for the Estes Gulch Disposal Cell and approved by the NRC. Under provisions of the plan, DOE conducts annual inspections of this site to evaluate the condition of surface features and performs site maintenance, as necessary. In addition, DOE is responsible for monitoring water levels in two standpipes installed in the lower part of the disposal cell, as well as access restrictions and institutional controls at the site. No drilling or other intrusive activities are allowed within the property. Access is restricted through the use of locked gates, wire fencing, and warning signs posted every 152 meters (500 feet) along the site boundary. DOE staffs a 24-hour phone line for reporting site concerns.

DOE maintains a permanent file containing site inspection reports and other supporting documentation of long-term surveillance program activities. The information placed in the site file includes documentation of disposal site performance, demonstration that licensing provisions were met, information needed to forecast future site surveillance and monitoring needs, reports to stakeholders regarding disposal cell integrity, copies of site documentation required by the long-term surveillance program, and copies of all deeds, custody agreements, and other property documents. Real property files are maintained at the DOE Albuquerque Operations Office in New Mexico.

2.2 Specific Long-Term Stewardship Activities

Engineered Units

The Estes Gulch Disposal Cell measures approximately 914 meters (3,000 feet) in length by 884 meters (2,900 feet) in width at its base and covers an area of 29 hectares (71 acres) on the 83-hectare (205-acre) site. The volume of residual contamination encapsulated in the cell is approximately 3,435,000 cubic meters (3,757,000 cubic yards) of uranium mill tailings and contaminated material. The cover of the Estes Gulch Disposal Cell is a multi-component cover designed to isolate the contaminated materials from the environment for 200-1,000 years. The cell design promotes rapid runoff of precipitation to minimize leachate. In addition, a riprap apron and ditch at the toe of the disposal cell carry water away from the cell. An unlined interceptor ditch abuts the up-slope portion of the disposal cell to divert surface flow away from the cell. A leachate collection system, installed at the toe of the cell, will be decommissioned after transient pore water seepage has ceased. Furthermore, all disturbed areas at the site have been replanted with natural vegetation. DOE is responsible for conducting annual inspections, monitoring water levels in two standpipes installed in the lower part of the disposal cell, and enforcing access restrictions and institutional controls.

> ***STAKEHOLDER INVOLVEMENT***
>
> Community interaction has been minimal since the remedial action was completed. Copies of the annual inspection report for the Estes Gulch Disposal Cell and other sites are distributed to the local library and to any stakeholders that request copies. The report is also published on the DOE Grand Junction Office website at www.doegjpo.com.

2.3 Regulatory Regime

In1997, the Estes Gulch Disposal Cell came under a general license issued by NRC for custody and long-term care of residual radioactive disposal sites (under Title 10 of the *Code of Federal Regulations,* Section 40.27). The purpose of the general license is to ensure that such sites will be cared for in a manner that protects human health and safety and the environment. The general license went into effect when NRC concurred that the site conformed to cleanup standards and formally accepted the site-specific long-term surveillance plan.

Long-term stewardship of the Estes Gulch Disposal Cell is governed by several requirements in the following regulations: the *Uranium Mill Tailings Radiation Control Act of 1978*; the *Atomic Energy Act of 1954*, as amended; EPA Groundwater Protection Standards, including Title 40 of the *Code of Federal Regulations* Part 192; a cooperative agreement between DOE and the State of Colorado; and the *National Environmental Policy Act of 1969,* as amended.

2.4 Assumptions and Uncertainties

DOE assumes that the transient drainage water volumes will not exceed regulatory thresholds and, therefore, will not require treatment. DOE also assumes that monitoring will continue indefinitely, and that the caps will not require replacement for a minimum of 200 years. Because DOE is already conducting long-term stewardship at the site, activities are well known and are not expected to change dramatically.

3.0 Estimated Long-Term Stewardship Costs

The following table shows the estimated costs of long-term stewardship of the Estes Gulch Disposal Cell. These costs include inspection of the site, monitoring and maintenance of the disposal cell, and enforcement of access and deed restrictions. Fiscal Years (FY) 2001 through 2006 include costs to decommission groundwater monitoring wells. Cost estimates reflect the current site agreements and monitoring frequencies. Because DOE

is already conducting long-term stewardship at the site, cost estimates are based on the actual cost of long-term stewardship activities at this site.

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	*Amount*	*Year(s)*	*Amount*	*Year(s)*	*Amount*
FY 2000	$24,000	**FY 2008**	$13,700	**FY 2036-2040**	$72,000
FY 2001	$49,800	**FY 2009**	$13,700	**FY 2041-2045**	$72,000
FY 2002	$52,800	**FY 2010**	$13,700	**FY 2046-2050**	$72,000
FY 2003	$47,100	**FY 2011-2015**	$65,700	**FY 2051-2055**	$72,000
FY 2004	$53,100	**FY 2016-2020**	$65,600	**FY 2056-2060**	$72,000
FY 2005	$35,000	**FY 2021-2025**	$67,400	**FY 2061-2065**	$72,000
FY 2006	$35,600	**FY 2026-2030**	$71,300	**FY 2066-2070**	$72,000
FY 2007	$13,800	**FY 2031-2035**	$72,000		

4.0 FUTURE USES

The disposal site and most of the surrounding area are owned by the Federal Government, which controls land use within site boundaries. The Bureau of Land Management permanently transferred administration of public land to DOE in August 1991 for use as the Estes Gulch Disposal Cell. DOE will provide long-term stewardship services as required under the NRC license to maintain protectiveness and regulatory compliance. Long-term stewardship will continue indefinitely and land use within the disposal site boundary will not change.

For more information about the Estes Gulch Disposal Cell, please contact:

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U.S. Department of Energy, Grand Junction Office
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Phone: 970-248-6037
or visit the Internet website at http://www.doegjpo.com

FORT ST. VRAIN INDEPENDENT SPENT FUEL STORAGE INSTALLATION

1.0 SITE SUMMARY

1.1 Site Description and Mission

The Fort St. Vrain Independent Spent Fuel Storage Installation (FSV ISFSI) site is located in Weld County, Colorado, about six kilometers (four miles) northwest of Platteville and approximately 56 kilometers (35 miles) north of Denver. The U.S. Department of Energy (DOE) owns the 1.5 hectares (3.8 acres) of land on which the ISFSI facility is located. The facility is approximately 460 meters (1,500 feet) northeast of a power plant owned by the Public Service Company of Colorado.

LONG-TERM STEWARDSHIP HIGHLIGHTS

Major Long-Term Stewardship Activities - storage facility monitoring and maintenance
Total Site Area - 1.5 hectares (3.8 acres)
Estimated Volume of Residual Contaminants - 243 fuel storage containers of spent nuclear fuel elements
Long-Term Stewardship Start-End Years - 1999-2035
Average Annual Cost FY 2000-2006 - $3,000,000
Landlord - U.S. Department of Energy

Originally, the power plant was a nuclear generating facility that operated from 1976 to 1989. In 1989, the nuclear power plant was decommissioned and the plant was converted to a natural gas power plant. Currently, 243 fuel storage containers hold the spent nuclear fuel elements from the nuclear plant; these containers are temporarily stored at the FSV ISFSI facility until a permanent national repository is available. In 1999, the U.S. Nuclear Regulatory Commission (NRC) transferred the license for the FSV ISFSI facility to DOE.

The facility has no active ongoing mission other than storage of spent nuclear fuel that resulted from operation of the Fort St. Vrain reactor. Necessary activities for safely maintaining the FSV ISFSI facility, such as surveillance, monitoring, and maintenance, are ongoing and will last until 2035, by which time the spent nuclear fuel will have been removed from the site. Upon removal of the spent nuclear fuel, the facility will be decommissioned.

In 1965, the U.S. Atomic Energy Commission (AEC) (a predecessor agency to DOE) agreed to provide permanent storage for a large portion of the Fort St. Vrain's spent nuclear fuel at AEC's Idaho site (later the Idaho National Engineering and Environmental Laboratory). Three shipments of the material were sent to Idaho before the Governor of Idaho, in 1990, refused to permit any further shipment or storage of Fort St. Vrain spent fuel in the State of Idaho. Subsequently, the Public Service Company of Colorado constructed a temporary spent fuel storage facility so the plant's reactor could be decommissioned and the reactor building could be decontaminated and dismantled. In September 1991, the FSV ISFSI facility was completed. The license to the FSV ISFSI facility was officially transferred by NRC to DOE on June 4, 1999. DOE is now responsible for managing the storage facility and the spent nuclear fuel.

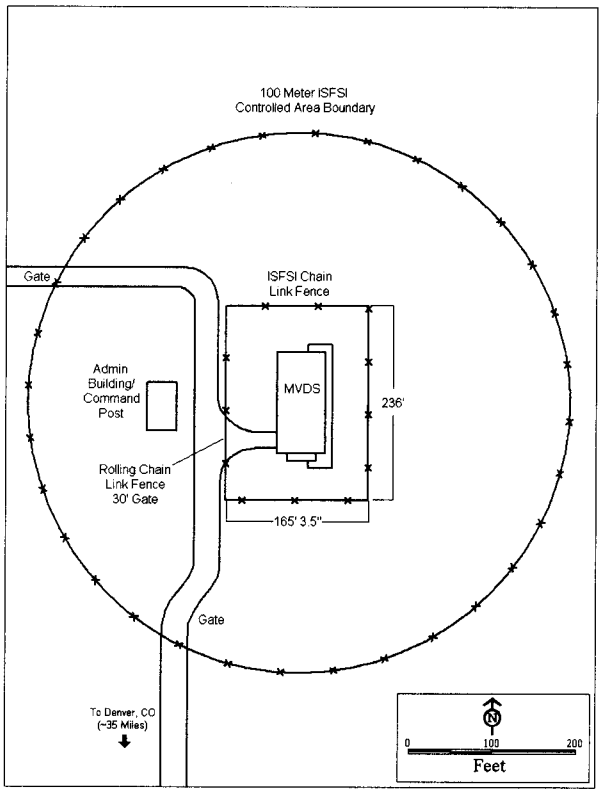
The FSV ISFSI facility Modular Vault Dry Store (MVDS) system was designed to store up to 1,482 fuel elements. The entire FSV ISFSI is a heavily reinforced concrete building, 44 meters (143 feet) long, 22 meters (72 feet) wide, and 45 meters (81 feet) tall. The FSV ISFSI structure is comprised of vault modules, a transfer cask reception bay, and a foundation structure. The foundation structure is designed to withstand tornado wind speeds of up to 580 kilometers (360 miles) per hour, flooding up to two meters (six feet) deep, and earthquakes. The spent fuel is stored in a dry environment cooled by natural air circulation. Specially designed shielding prevents harmful amounts of radioactivity from escaping to the environment.

There are minimal quantities of solid or liquid radioactive wastes generated at the FSV ISFSI facility. There are no gaseous or liquid wastes produced under normal operation.

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Goals and Activities

The long-term stewardship activities conducted at the site include annual inspections; site maintenance, as necessary; institutional controls; and storage facility monitoring. Annual inspections of the storage facility are conducted to detect progressive change caused by slow-acting natural processes and to identify potential problems before extensive maintenance, repairs, or corrective actions are needed. DOE does not plan to conduct significant maintenance at the FSV ISFSI site. However, DOE will perform minor maintenance (e.g., fence repairs) or repairs, as needed, or determined from site inspections.



Fort St. Vrain Independent Fuel Storage Installation

The FSV ISFSI site is surrounded by inner and outer wire fences with locked gates to prevent unauthorized access. Warning signs are posted on the site perimeter. There are security guards on the site 24 hours per day, and security surveillance equipment is in place to assist in controlling access.

DOE maintains and updates the specific records and reports required to document long-term stewardship activities at the FSV ISFSI site. DOE submits an annual Radiological and Environmental Monitoring Report to the NRC that documents the results of the site's long-term surveillance plan, as required by NRC regulations in Title 10 of the *Code of Federal Regulations*, Part 27, Appendix A, Criterion 12. Site records are kept in permanent storage at Fort St. Vrain, and real property records are retained at DOE's Idaho Office in Idaho Falls. Types of records maintained include annual inspection reports and current and historic monitoring data.

2.2 Specific Long-Term Stewardship Activities

Facilities

The site has one storage facility that contains the spent nuclear fuel elements; therefore, the FSV ISFSI facility requires long-term surveillance and maintenance to ensure continued protection of human health and the environment. Long-term surveillance and maintenance activities at the storage facility include radiation monitoring inside and outside of the facility (dosimetry) and periodic tritium monitoring in the "chimney" air duct. No groundwater monitoring is required because no pathway currently exists for contaminants to reach the groundwater.

2.3 Regulatory Regime

NRC has issued a general license for the long-term stewardship of the FSV ISFSI facility, in accordance with the AEA and the NRC regulations in Title 10 of the *Code of Federal Regulations*, Part 72. The purpose of the license is to ensure that the facility will be cared for in a manner that protects human health and safety and the environment. The license also means the NRC formally accepts the site-specific long-term surveillance plan.

STAKEHOLDER INVOLVEMENT

Community interaction consists of an annual meeting to discuss any issues related to the FSV ISFSI. In addition, funds are provided to the local community to train emergency responders. Copies of the annual inspection report and other relevant information on the FSV ISFSI site are distributed to Colorado state officials, area municipal and county officials, emergency response authorities, and other interested stakeholders.

2.4 Assumptions and Uncertainties

Based on an agreement with the State of Colorado, the spent nuclear fuel will be shipped offsite for final disposition by 2035. The canisters at the FSV ISFSI will be disposed of in an appropriate manner and no residual contamination is anticipated. Therefore, DOE's long-term stewardship responsibilities at the site will conclude at that time.

3.0 Estimated Long-Term Stewardship Costs

The current costs for the FSV ISFSI facility are based on the costs incurred to date while operating and maintaining the stored spent nuclear fuel until final disposition. Once final disposition occurs in FY 2035, DOE estimates that it will cost $1.6 million to decontaminate and decommission the remaining storage canisters. This cost is not included in the estimated below. Since no residual contamination is anticipated, long-term stewardship activities are assumed to be complete by 2035.

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	***Amount***	***Year(s)***	***Amount***	***Year(s)***	***Amount***
FY 2000	$3,000,000	**FY 2008**	$3,000,000	**FY 2036-2040**	$0
FY 2001	$3,000,000	**FY 2009**	$3,000,000	**FY 2041-2045**	$0
FY 2002	$3,000,000	**FY 2010**	$3,000,000	**FY 2046-2050**	$0
FY 2003	$3,000,000	**FY 2011-2015**	$12,000,000	**FY 2051-2055**	$0
FY 2004	$3,000,000	**FY 2016-2020**	$12,000,000	**FY 2056-2060**	$0
FY 2005	$3,000,000	**FY 2021-2025**	$12,000,000	**FY 2061-2065**	$0
FY 2006	$3,000,000	**FY 2026-2030**	$12,000,000	**FY 2066-2070**	$0
FY 2007	$3,000,000	**FY 2031-2035**	$12,000,000		

4.0 Future Uses

The spent nuclear fuel will remain in the interim storage facility (i.e., the FSV ISFSI) until a permanent spent nuclear fuel repository is available to receive the Fort St. Vrain spent fuel. DOE will maintain responsibility for the FSV ISFSI until such time as the spent fuel is permanently disposed of and the ISFSI has been determined suitable for release, through the appropriate regulatory processes.

For more information about the Fort St. Vrain Independent Spent Fuel Storage Installation site, please contact:

Mark Gardner, Fort St. Vrain Facility Director
U.S. Department of Energy, Idaho Operations Office
850 Energy Drive, MS 1154
Idaho Falls, ID 83401-1563
Phone: 208-526-5655
or visit the Internet website at http://www.inel.gov

GRAND JUNCTION MILL 1

1.0 SITE SUMMARY

1.1 Site Description and Mission

The Grand Junction Mill 1 (also known as the Climax Uranium Mill and the Grand Junction UMTRCA site) is the location of a former uranium/vanadium mill that operated from 1951 to 1970. The site occupies 46 hectares (114 acres) of land in Mesa County, Colorado, in an industrial area of the City of Grand Junction, on the north bank of the Colorado River. The mill began as a sugar beet mill before operating as a uranium/vanadium mill. The Climax Corporation demolished most of the mill buildings and seeded the tailings piles before leaving the site in 1976. From the late 1980s to 1994, the site was an interim repository for mill tailings removed from the Grand Junction uranium milling site's vicinity properties. By the end of 1994, all tailings and contaminated buildings (which were demolished) were relocated to the Cheney Disposal Cell (also known as the Grand Junction Disposal Site) for disposal. The Cheney Disposal Cell is located 18 miles (29 kilometers) southeast of Grand Junction on U.S. Highway 50.

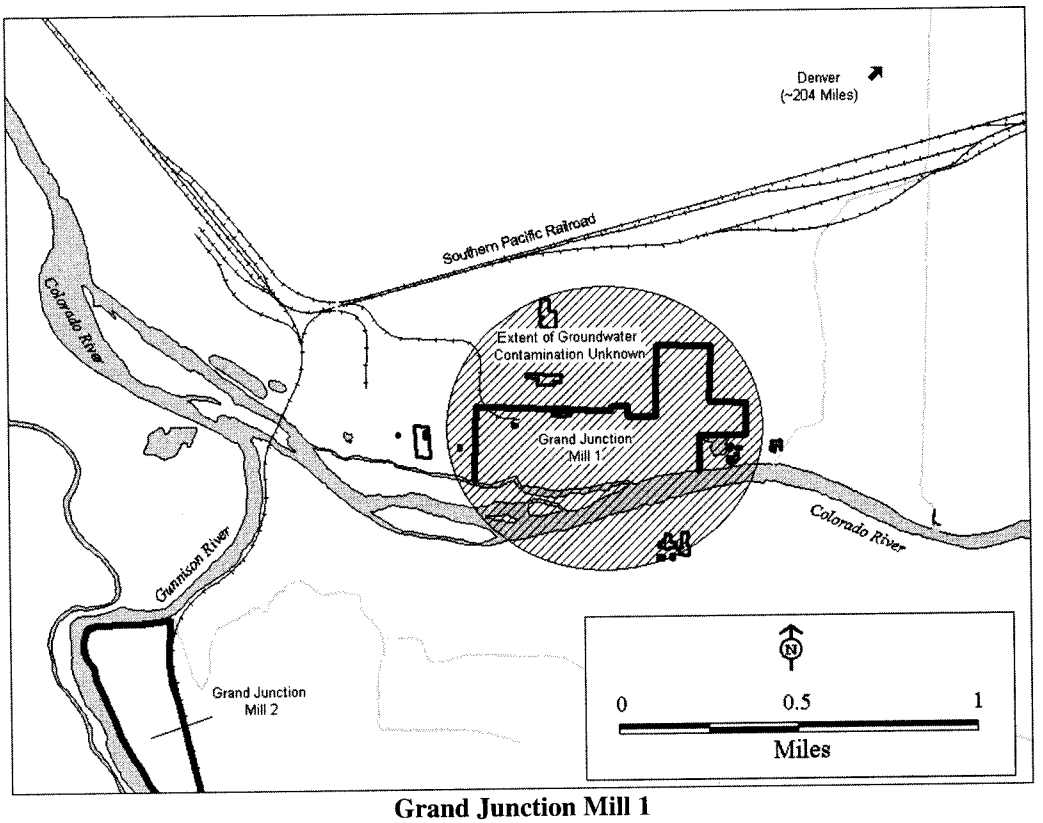
LONG-TERM STEWARDSHIP HIGHLIGHTS

Major Long-Term Stewardship Activities - groundwater monitoring
Total Site Area - 46 hectare (114 acres)
Estimated Volume of Residual Contaminants - groundwater 1,249,000 cubic meters (1,634,000 cubic yards)
Long-Term Stewardship Start-End Years - 2001-2070
Average Annual Long-Term Stewardship Cost FY 2001-2006 - $17,814
Landlord - U.S. Department of Energy, Grand Junction Office

The U.S. Department of Energy's (DOE) current mission at the Grand Junction Mill 1 is conducting long-term stewardship activities, including the monitoring of the groundwater at the former mill site. DOE is responsible for any remediation and long-term stewardship activities under Title I of the *Uranium Mill Tailings Radiation Control Act of 1978* (UMTRCA) that are required at the site. The original mission of the Grand Junction Mill 1 was to process uranium ore and provide uranium for sale to the U.S. Government for its national defense program. In 1951, Climax Uranium Company, a division of American Metals Climax, Inc. (now known as AMAX, Inc.), started milling operations at the site and continued to do so until the mill shut down in 1970. During this time, the mill processed more than 0.8 million metric tons (two million tons) of ore, which in turn produced about 5.4 million kilograms (12 million pounds) of uranium oxide and 21 million kilograms (46 million pounds) of vanadium oxide. The ore was crushed and ground, underwent salt roasting and water leaching to remove the vanadium, and then sulfuric acid leaching to separate the uranium. A solvent extraction process was used to separate the leftover uranium from the vanadium. The solvent extraction raffinate solution and other intermediate products were treated with acid again to remove additional uranium and vanadium. This mill was the first in the United States that was designed for uranium production, with vanadium as a by-product.

1.2 Site Cleanup and Accomplishments

The Grand Junction Mill 1 was shut down in 1970, and the site was closed in March 1971. During 1970 and 1971, the Climax Uranium Company demolished eight of the twelve main mill buildings and, as part of its interim remediation, sold slimes in the northernmost settling ponds to the Union Carbide Corporation. The bottoms of the large evaporation ponds were plowed, and the dikes surrounding them were leveled. Equipment that could be decontaminated was sold, and other equipment that could not be decontaminated was buried in the tailings piles along with building rubble. Some of the building rubble was used as riprap along the river. Climax personnel experimented with planting different types of grasses directly on the tailings and found that crested wheat grass grew well if irrigated sufficiently.



Grand Junction Mill 1

The State of Colorado acquired 16 hectares (40 acres) of the site, where the three evaporation ponds had been located, from Climax. This area was the temporary (or interim) repository for vicinity property tailings during the first phase of DOE's surface remedial action. By 1976, Climax sold 34 hectares (85 acres) of the original mill site for an industrial park, and the remaining four hectares (ten acres) to a private citizen by 1976.

DOE began surface remediation of the former mill site in the mid-1980s. This cleanup was conducted in two phases. Phase I, completed in 1989, consisted of installing fences, demolishing the remaining buildings (except the old sugar beet warehouse), constructing lined retention ponds, and preparing the wastewater treatment plant foundation. Phase II began in 1990, and included constructing and filling the Cheney Disposal Cell and constructing the wastewater treatment plant. By the end of 1994, all contaminated site materials were removed from the Grand Junction Mill 1 site. Approximately 3.1 million cubic meters (4.1 million cubic yards) of contaminated materials were transported 27 kilometers (17 miles) to the Cheney Disposal Cell. Restoration of the site's surface, including seeding and wetlands establishment, was completed in August 1994. Erosion control has been constructed for all potentially vulnerable features, and the site has been graded to provide positive drainage. The only building left within the site's original boundaries was the original sugar beet warehouse that was cleaned, fitted with a new roof, and sold to the private sector in 1995. It is now located outside of the fenced enclosure of the current Grand Junction Mill 1 site property. Upon achieving compliance with surface-level cleanup standards, the State of Colorado turned over the site's deed to the City of Grand Junction.

Groundwater contamination at the Grand Junction Mill 1 is present in alluvial sand and gravel (uppermost aquifer) associated with the Colorado River. The contamination extends approximately 1,006 meters (3,300 feet) downgradient from the site. Approximately 1,249,000 cubic meters (1,634,000 cubic yards)of water have exceeded maximum concentration limits for molybdenum, selenium, uranium, and net gross alpha at least once

since 1990. The risk to human health or the environment is limited because water used for domestic and most other purposes is taken upgradient of the processing site. DOE has proposed supplemental standards, as defined in Title 40 of the *Code of Federal Regulations* Part 192.22, for site groundwater because the ambient water quality is poor due to naturally high concentrations of sulfate. Water in the adjacent Colorado River has not been affected by site contaminants. Consequently, no groundwater remediation will be conducted. However, DOE expects that processing-related contaminant concentrations will diminish through natural attenuation and flushing.

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

Long-term stewardship activities at the Grand Junction Mill 1 are the responsibility of DOE. DOE will manage the site according to a groundwater compliance action plan prepared specifically for Grand Junction Mill 1. Under provisions of this plan, DOE will monitor the groundwater and maintain institutional controls. The site's groundwater compliance action plan has been submitted to the U.S. Nuclear Regulatory Commission (NRC), but is not yet been approved. The plan requests the application of supplemental standards, as defined in Title 40 of the *Code of Federal Regulations* Part 192.22, for the contaminated groundwater underlying the site. Site deed restrictions require approval from the State of Colorado before construction or other intrusive activities commence.

Site records for the Grand Junction Mill 1 are kept in permanent storage at the DOE Grand Junction Office in Grand Junction, Colorado. The types of records kept include characterization data, remedial action design, the completion report, the groundwater compliance plan, annual inspection reports, and groundwater monitoring results.

2.2 Specific Long-Term Stewardship Activities

Groundwater

Institutional controls in the form of a deed restriction will prohibit groundwater use during the period of natural flushing. Groundwater monitoring will be conducted annually as a best management practice in accordance with an NRC-approved groundwater compliance action plan. DOE expects that NRC will approve the site's plan and the supplemental standards, as defined in Title 40 of the *Code of Federal Regulations* Part 192.22, requested within it. DOE currently plans to conduct annual groundwater monitoring until 2070. However, if the supplemental standards, as defined in Title 40 of the *Code of Federal Regulations* Part 192.22, that are requested in the submitted groundwater compliance action plan are accepted, groundwater monitoring could cease as early as 2010. Even if supplemental standards are approved and applied, DOE will continue monitoring water use restrictions. The City of Grand Junction will require that treated municipal water be used for domestic purposes, and will impose deed restrictions that prohibit domestic use of groundwater within the processing site boundaries.

STAKEHOLDER INVOLVEMENT

Community interaction has been minimal since the surface remedial action was completed. Copies of the annual groundwater report for the Grand Junction Processing Site and other sites will be distributed to the local library and to any stakeholder requesting them. The annual groundwater reports are also published on the Grand Junction Office website at www.doegjpo.com.

2.3 Regulatory Regime

UMTRCA authorized DOE to care for the uranium mill tailings sites under a general license issued by NRC for the custody and long-term care of residual waste disposal cells. However, for those processing sites where the residual radioactive materials were relocated and disposed of offsite, NRC will not license them. Compliance with EPA groundwater standards will require NRC concurrence.

Long-term stewardship activities at the Grand Junction Mill 1 are governed by several requirements in the following regulations: UMT*RCA*; the *Atomic Energy Act of 1954, as amended;* U.S. Environmental Protection Agency groundwater protection standards, including Subparts B and C of Title 40 of the *Code of Federal Regulations* Part 192; a cooperative agreement between DOE and the State of Colorado; and the *National Environmental Policy Act of 1969,* as amended.

2.4 Assumptions and Uncertainties

DOE assumes that active groundwater remediation will not be required and that the application of supplemental standards, as defined in Title 40 of the *Code of Federal Regulations* Part 192.22, will be approved by regulators. DOE also assumes it will conduct annual groundwater monitoring through 2070, although its planning models suggest the groundwater will be cleaned up long before 2070, and possibly as early as 2010.

3.0 Estimated Long-Term Stewardship Costs

Estimated costs for the Grand Junction Mill 1 are identified in the table below. The cost estimates are provided through 2070 in case the supplemental standards, as defined in Title 40 of the *Code of Federal Regulations* Part 192.22, are not approved and groundwater monitoring is required through 2070.

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	***Amount***	***Year(s)***	***Amount***	***Year(s)***	***Amount***
FY 2000	$49,700	**FY 2008**	$4,400	**FY 2036-2040**	$24,300
FY 2001	$46,300	**FY 2009**	$4,400	**FY 2041-2045**	$24,300
FY 2002	$11,100	**FY 2010**	$4,400	**FY 2046-2050**	$24,300
FY 2003	$4,400	**FY 2011-2015**	$21,500	**FY 2051-2055**	$24,000
FY 2004	$4,400	**FY 2016-2020**	$21,500	**FY 2056-2060**	$24,300
FY 2005	$4,400	**FY 2021-2025**	$21,500	**FY 2061-2065**	$24,000
FY 2006	$4,400	**FY 2026-2030**	$24,300	**FY 2066-2070**	$24,300
FY 2007	$4,400	**FY 2031-2035**	$24,000		

4.0 Future Uses

The State of Colorado turned over the Grand Junction Mill 1 site's deed to the City of Grand Junction. The deed specifies that groundwater from the site cannot be used for any purpose without written approval from DOE and the Colorado Department of Public Health and the Environment. The City of Grand Junction is developing a master future land-use plan for use of the land as an open park area. The potential future uses being considered are a city pedestrian park with trees, sidewalks, and grassy areas; a recreational area, including ball fields; and

an engineered area for holding ponds and wetlands that temporarily store excess storm flow before it is released to the river. The City of Grand Junction recently named the land occupied by the former mill site "Las Colonias Park," for a Latino community that had previously existed in that part of town. It is anticipated that the State of Colorado will impose land-use restrictions, as necessary, to protect the public health, safety, and the environment.

For more information about Grand Junction Mill 1, please contact:

Art Kleinrath, Long-Term Surveillance and Maintenance Program Manager
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GRAND JUNCTION MILL 2

1.0 SITE SUMMARY

1.1 Site Description and Mission

The Grand Junction Mill 2 (also known as the Grand Junction Office Facility) is the site of a former uranium refinery, concentrate procurement facility, and research mills located south of the City of Grand Junction, in Mesa County, Colorado. The facility occupies approximately 25 hectares (63 acres) of land along a bend of the Gunnison River. The site is bounded on the west and south by the river and on the north and east by public and private properties. Approximately 233,400 cubic meters (255,250 cubic yards) of contaminated material were remediated from 9.3 hectares (23 acres) of the site. During the site's surface remedial action, all the contaminated soil was excavated and moved to the Cheney Disposal Cell located 29 kilometers (18 miles) southeast of the Grand Junction Mill 2 site.

LONG-TERM STEWARDSHIP HIGHLIGHTS

Major Long-Term Stewardship Activities - groundwater and surface water monitoring; maintaining institutional controls for buildings and well
Total Site Area - 25 hectares (63 acres)
Estimated Volume of Residual Contaminants - groundwater unknown; surface water unknown; facilities unknown
Long-Term Stewardship Start-End Years - 2001-2089
Average Annual Long-Term Stewardship Cost FY 2000-2006 - $121,700
Landlord - U.S. Department of Energy, Grand Junction Office

The current mission is to continue remediation of site buildings and underground utilities and to conduct the long-term stewardship and Uranium Mill Tailings Remedial Action groundwater programs. Beginning in 2001, after remediation is complete, the U.S. Department of Energy's (DOE) mission at the site will include conducting these programs and conducting long-term stewardship activities related to the site's contaminated groundwater, surface water, and facilities. Since the current mission of the site has decreased over the past several years, DOE has determined that it no longer needs to own the Grand Junction Mill 2 site to perform its assigned missions. To lower its operating costs, DOE intends to transfer the facility to non-DOE ownership in 2000.

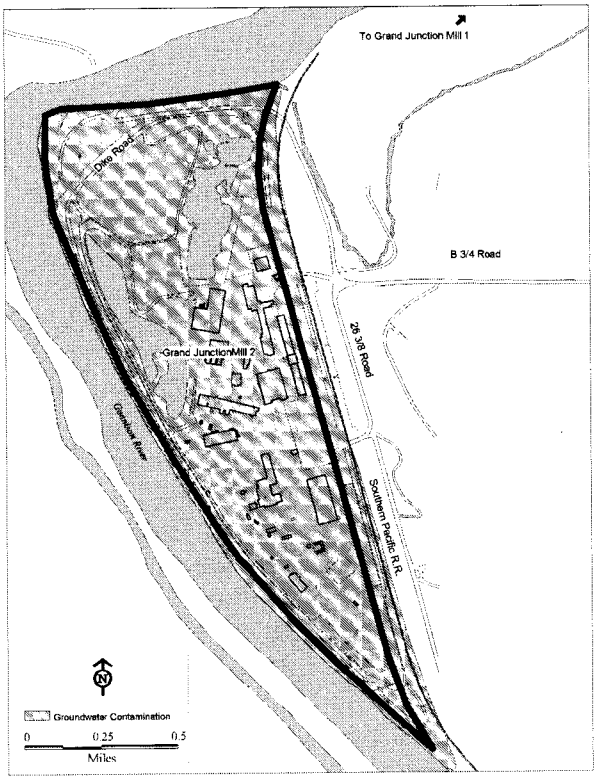
Formerly a gravel pit and farmland, the Grand Junction Mill 2 lands were acquired by the U.S. War Department in August 1943, to process uranium for the Manhattan Project. Under contract with the Federal Government, U.S. Vanadium Corporation constructed and operated a refinery at the site from 1943 to 1946. Approximately 1,060 metric tons (1,170 tons) of uranium oxide and a similar amount of vanadium concentrate were produced for sale to the U.S. Government. Wastes from the refinery consisted of several hundred tons of alumina cake, liquid discharges, and dust.

In December 1947, the U.S. Atomic Energy Commission (AEC), a predecessor agency to DOE, established the Colorado Raw Materials Office at the Grand Junction Area Office Facility to manage domestic uranium exploration and procurement programs. This program was responsible for the receipt, sampling, and analysis of uranium and vanadium concentrates purchased from ore-processing operations in the western United States. Between 1948 and 1971, a total of 157,533 metric tons (173,650 tons) of uranium oxide and 12,973 metric tons (14,300 tons) of vanadium oxide were received and stockpiled in steel drums at the facility.

In 1953, DOE constructed a small plant and initiated a pilot-scale milling research program to investigated the development of a resin-in-pulp uranium milling process. After 1954, the pilot-scale program was dedicated to amenability testing of uranium ores and to the development and testing of new uranium milling processes. A new larger pilot plant, consisting of two mill buildings that housed a crushing and sampling plant, office, laboratory, warehouse, and maintenance shop, was constructed in the southern area of the Grand Junction Mill 2 site. This pilot plant operated until 1958 and uranium mill tailings from its operation were deposited in a tailings pile on

the site.

After the pilot plant closed in 1958, the Grand Junction Mill 2 was used as a regional office for a variety of AEC programs directed toward uranium procurement, domestic uranium resource evaluation, and the advancement of geological and geophysical techniques. In recent years, the Grand Junction Office has provided technical and administrative support personnel for various DOE, U.S. Department of Defense (DoD), and U.S. Environmental Protection Agency (EPA) programs, including laboratory and construction services that are required to support environmental restoration activities.



Grand Junction Mill 2

1.2 Site Cleanup and Accomplishments

In 1984, DOE began site characterization and remedial action studies to assess the extent of radiological contamination on the site from early operations. The studies and subsequent cleanup were conducted under the Grand Junction Office Remedial Action Project. The studies showed that the site did not meet the criteria for placement on the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) National Priorities List. However, DOE conducted a voluntary CERCLA cleanup in accordance with DOE policy. A Remedial Investigation/Feasibility Study-Environmental Assessment was prepared to determine cleanup strategies and to satisfy regulatory requirements. DOE issued a Finding Of No Significant Impact for the cleanup in 1989, and a Record of Decision was finalized and approved by the DOE Idaho Operations Office in April 1990.

Removal of uranium mill tailings and associated radioactive materials from the Grand Junction Mill 2 site began in 1989 under the Decontamination and Decommissioning Program. By July 1, 1994, all known exterior (i.e., open-land area) uranium mill tailings waste had been removed from the facility and disposed at the Cheney Disposal Cell. Since 1988, the Grand Junction Office has been decontaminating and releasing the site's buildings through the Defense Decontamination and Decommissioning Program. Currently, one building has been surveyed and released by DOE for reuse. Another building is currently being cleaned up for eventual transfer to the U.S. Army Reserve. Nine contaminated buildings have been demolished and the underlying soils have been remediated. One building remaining at the site is contaminated and requires remediation. Another building, which currently houses the Analytical Chemistry Laboratory, is also contaminated; and will be demolished when abandoned. All other buildings have either been surveyed and released for unrestricted use or still require a release survey.

Groundwater in the alluvial aquifer is contaminated, above State and EPA limits, with low levels of arsenic, radium, uranium, selenium, and molybdenum from past uranium processing activities on the site. Of the components measured in 1998, concentrations of arsenic, molybdenum, nitrate, selenium, total dissolved solids, uranium-234 and -238, and net gross alpha exceeded EPA or State standards. Groundwater monitoring data suggest that contamination levels may be declining over time, and continued monitoring will verify if this is the

case. The remedy selected was natural attenuation (flushing). No active groundwater remediation was required. Groundwater modeling of the alluvial aquifer predicts that the groundwater will be cleaned to below standards within 50 to 80 years after the removal of the exterior uranium mill tailings waste, which was completed in July 1994.

Site surface waters exceed State of Colorado surface water quality standards for chloride, sulfide, and uranium. Current elevated contaminant concentrations are probably due to evaporation and hydrological connections to the site's groundwater.

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

The Grand Junction Mill 2 is owned by the Federal Government, which controls land use within site boundaries. Because DOE has determined that it no longer needs to own the facility to perform its ongoing missions, transfer of real and personal property to non-DOE ownership is expected to begin by October 2000. DOE intends to lease office space at the Grand Junction Mill 2 site from the new owner. Potential future users of the site could be other Federal agencies, state/local quasi governmental agencies, or the private sector. DOE and its contractors plan to remain at the site as a tenant through the completion of its mission. As of 2000, two portions of the facility have already been leased to other entities.

STAKEHOLDER INTERACTION

DOE has been working extensively with the local community to transition the Grand Junction Mill 2 to community control and ownership. Facility reuse and transition plans for the Grand Junction Mill 2 are distributed to the local library and stakeholders that request one. In addition, the reports can be accessed on the DOE Grand Junction Office website at www.doegjpo.com.

Long-term stewardship activities at the site will become the responsibility of the Grand Junction Office Long-Term Surveillance and Maintenance Program in 2000. The Long-Term Surveillance and Maintenance Program provides long-term stewardship services, including inspections, access controls, environmental monitoring, site maintenance, regulatory compliance, compliance reporting, records management, public relations, emergency response, and further remedial action, if required.

DOE will reserve access to the site to conduct groundwater monitoring and to restrict groundwater and surface water use. Drilling and other intrusive activities are controlled within site boundaries through institutional controls, such as deed restrictions. DOE will control exposure to the radiological contamination beneath two buildings until they are demolished or remediated by DOE.

Site records for the Grand Junction Project Office are kept in permanent storage on site. The types of records kept include characterization data, the remedial action design, the completion report, annual inspection reports, and groundwater monitoring results. Real property records are maintained at the DOE Albuquerque Operations Office in New Mexico.

2.2 Specific Long-Term Stewardship Activities

Groundwater

Groundwater monitoring will be conducted annually. DOE will maintain restrictions on groundwater use and continue monitoring until DOE can verify that natural flushing has achieved the site's groundwater cleanup

objectives and the groundwater complies with EPA standards. Groundwater monitoring may continue up to 2089. Groundwater monitoring will end earlier if DOE can verify that natural flushing has achieved the site's groundwater cleanup objectives.

Surface Water

Surface water must meet EPA and State of Colorado cleanup standards. Current elevated concentrations in the wetland area, exceeding State limits, are probably due to evaporation. However, public water supplies and the Gunnison River are unaffected. DOE will maintain restrictions on surface water use until acceptable levels are reached - even after transfer of the facility to non-DOE ownership in 2000. The Grand Junction Office will continue conducting surface water monitoring at the site annually up to 2089. Surface water monitoring will end earlier if DOE can verify that natural flushing has achieved the site's surface water cleanup objectives.

Facilities

An onsite well sealed with concrete, contains radium foil. Two buildings have radiological contamination in subgrade structures and soils. DOE will prevent access to the well and buildings through deed restrictions, regular monitoring, and other institutional controls. One building, a laboratory, will be demolished when it is abandoned Another building, which DOE will lease for office space, will be remediated when it is vacated by DOE. A third building with radiological contamination is scheduled for remediation in 2001.

2.3 Regulatory Regime

Long-term stewardship activities at the Grand Junction Mill 2 are governed by several requirements in the following regulations: DOE Order 5400.5; the *Atomic Energy Act of 1954*, as amended; EPA Groundwater Protection Standards, including Subparts B and C of Title 40 of the *Code of Federal Regulations*, Part 192; and the *National Environmental Policy Act of 1969,* as amended.

2.4 Assumptions and Uncertainties

DOE assumes that the groundwater and surface water will not require active remediation and that no additional remediation will be required for buildings or open lands except as described. Remediation and demolition costs are provided through a separate funding stream.

Annual groundwater monitoring is currently scheduled until 2089. DOE expects that the surface and groundwater target cleanup levels will be reached before 2089.

3.0 Estimated Long-Term Stewardship Costs

These estimated costs are based on the actual cost of long-term stewardship activities at other similar sites. Fiscal years (FY) 2001 through 2002 include costs for the decommissioning of 42 wells. Groundwater monitoring will end in 2089, or sooner if it is verified that natural flushing has achieved cleanup goals.

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	*Amount*	*Year(s)*	*Amount*	*Year(s)*	*Amount*
FY 2000	$0	**FY 2008**	$122,100	**FY 2036-2040**	$640,200
FY 2001	$125,700	**FY 2009**	$121,900	**FY 2041-2045**	$640,100
FY 2002	$122,900	**FY 2010**	$122,200	**FY 2046-2050**	$640,300
FY 2003	$118,500	**FY 2011-2015**	$584,200	**FY 2051-2055**	$640,100
FY 2004	$119,900	**FY 2016-2020**	$583,400	**FY 2056-2060**	$640,200
FY 2005	$122,200	**FY 2021-2025**	$598,700	**FY 2061-2065**	$640,100
FY 2006	$121,200	**FY 2026-2030**	$633,700	**FY 2066-2070**	$640,300
FY 2007	$122,900	**FY 2031-2035**	$640,100		

4.0 FUTURE USES

Except as noted, DOE expects to have removed all radiological contamination and waste from the site and will release the site surface and improvements (i.e., built structures) for unrestricted use by the end of 2001. Access to the site's groundwater and surface water will remain restricted until the groundwater and surface water conform to regulatory standards. Access to the well containing radium foil will be restricted in perpetuity. Access to the buildings with radiological contamination will be restricted until they are demolished or remediated.

For more information about the Grand Junction Mill 2, please contact:

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GUNNISON DISPOSAL CELL

1.0 SITE SUMMARY

1.1 Site Description and Mission

The Gunnison Disposal Cell was built by the U.S. Department of Energy (DOE) for the relocation and disposal of uranium mill tailings and other contaminated materials from former operations at the nearby Gunnison Mill site. The Gunnison Disposal Cell site is located on approximately 47 hectares (115 acres) of land in Gunnison County in southwestern Colorado. The disposal cell itself occupies approximately 12 hectares (29 acres) at the center of the site. The site is approximately 10 kilometers (six miles) southeast of the town of Gunnison, Colorado. The U.S. Bureau of Land Management transferred responsibility for the land to the U.S. Department of Energy (DOE) in 1992.

LONG-TERM STEWARDSHIP HIGHLIGHTS

Major Long-Term Stewardship Activities - disposal cell monitoring; inspections; access restrictions
Total Site Area - 47 hectares (115 acres)
Estimated Volume of Residual Contaminants - disposal cell 565,800 cubic meters (740,000 cubic yards)
Long-Term Stewardship Start-End Years - 1995-in perpetuity
Average Annual Long-Term Stewardship Cost FY 2000-2006 - $63,000
Landlord - U.S. Department of Energy, Grand Junction Office

DOE's current mission at the Gunnison Disposal Cell is to conduct long-term stewardship activities, including disposal cell and groundwater monitoring. DOE is responsible for any long-term stewardship activities required at the site under Title I of the *Uranium Mill Tailings Radiation Control Act of 1978* (UMTRCA).

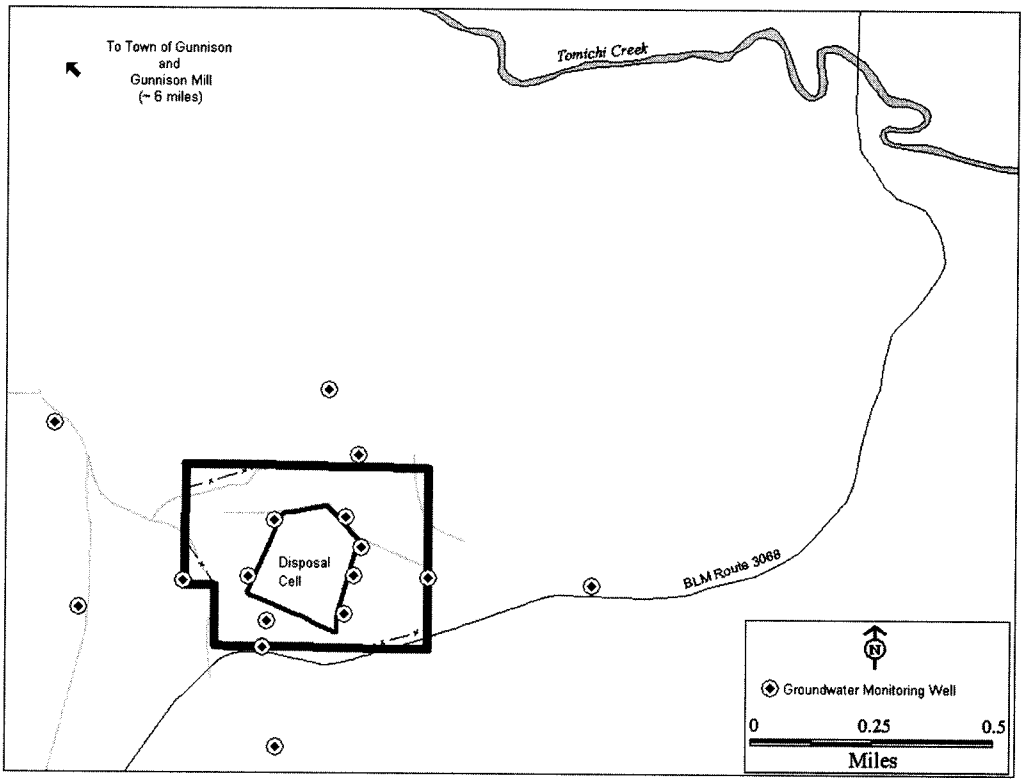
The Gunnison Disposal Cell did not have a historic mission prior to its use as a disposal site. All the mill tailings and other contaminated materials in the cell were moved from the Gunnison Mill site as part of the mill site's remediation. The mill at the Gunnison Mill site, located approximately 10 kilometers (6 miles) southeast of the disposal cell, operated between 1958 and 1962. During its operational life, the mill processed 540,000 tons of uranium ore. Mill operations resulted in uranium mill tailings and other contaminated materials, which remained on approximately 15.8 hectares (39 acres) of the former mill site. The U.S. Nuclear Regulatory Agency (NRC) and the State of Colorado concurred with DOE's remedial action plan and began constructing the Gunnison Disposal Cell in 1992.

1.2 Site Cleanup and Accomplishments

During 1993 and 1994, DOE relocated the contaminated materials (e.g., mill tailings, debris from demolished mill structures, and materials removed from contaminated vicinity properties) from the Gunnison Mill site and placed them in the Gunnison Disposal Cell. The cell was closed in 1995. The roughly pentagonal-shaped disposal cell measures approximately 366 meters by 347 meters (1,200 feet by 1,140 feet), including the toe apron. It occupies 12 hectares (29 acres) of the 47-hectare (115-acre) site. The disposal cell is constructed partially below grade and rises to 15.2 meters (50-feet) above the surrounding ground surface. The disposal cell contains approximately 565,800 cubic meters (740,000 cubic yards) of waste, with a total activity of 175 curies of radium-226 and a weight of 1,140,000 dry tons.

The disposal cell cap is a multi-component system designed to encapsulate and isolate the contaminated materials for 1,000 years. The low-permeability radon barrier (the first layer placed over the compacted tailings) reduces radon emissions and minimizes the precipitation percolating through the contaminated materials into the underlying soil. This layer consists of compacted clayey soil amended with bentonite. Next, a bedding layer consisting of sand and gravel acts as a capillary break beneath the frost-protection layer. The frost-protection

layer consists of compacted soil and was designed to protect the underlying radon barrier from freeze/thaw damage. Another bedding layer consisting of coarse sand and fine gravel lies over the frost-protection layer and is covered by a rock (riprap) erosion-protection layer. The upper bedding layer promotes rapid runoff of precipitation to minimize leachate. The riprap protects the cell against erosion. A riprap apron around the perimeter of the disposal cell provides erosion protection at the toe of the cell and channels runoff away from the cell. A rock-lined interceptor ditch drains the up-slope portion of the disposal cell to divert surface flow away from the cell. All previously disturbed areas not covered by riprap were revegetated with native grasses.



Gunnison Disposal Cell

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

Long-term stewardship of the Gunnison Disposal Cell is the responsibility of the DOE Grand Junction Office, which manages the site according to an NRC-approved long-term surveillance plan that was prepared specifically for the Gunnison Disposal Cell. Under provisions of the plan, DOE conducts annual inspections of this site to ensure the site complies with applicable requirements and evaluates the condition of surface features, including the integrity of the cell cover and other engineered features; and performs site maintenance, as necessary. In addition DOE is responsible for monitoring groundwater at the Gunnison Disposal cell to demonstrate disposal cell performance and comply with applicable groundwater protection standards. DOE will be responsible for the safety and integrity of the Gunnison Disposal Cell in perpetuity.

After completion of remedial action (closure of the disposal cell), DOE documented final disposal site conditions with site maps, as-built drawings, and ground and aerial photographs. Original drawings, site maps, well logs,

and photographs are part of the Gunnison Disposal Cell's permanent site file located at the DOE Grand Junction Office in Grand Junction, Colorado. Real property records are maintained at the DOE Albuquerque Operations Office in New Mexico.

Access is restricted through the use of locked gates, barbed-wire fencing, and warning signs posted every 152 meters (500 feet) along the site boundary. Boundary markers and survey monuments are also placed around the perimeter of the site. DOE staffs a 24-hour phone line for reporting site concerns. Drilling and other intrusive activities are prevented within site boundaries through management control.

2.2 Specific Long-Term Stewardship Activities

Groundwater

The Gunnison Disposal Cell is located on a drainage divide. Ephemeral drainages bound the disposal site on the west and east. The disposal cell rests on a thin veneer of alluvial and colluvial materials that overlay a sequence of Tertiary sands and gravels separated by lower permeability volcaniclastic mudflow and ash fall tuffs. The lower Tertiary gravels constitute the uppermost regional aquifer beneath the disposal site.

> ***STAKEHOLDER INVOLVEMENT***
>
> Community interaction has been minimal since the remedial action was completed at the Gunnison Mill site. Copies of the annual inspection report for the Gunnison Disposal Cell and other sites are distributed to the local library and to any stakeholder requesting them. They are also published on the Grand Junction Office website at www.doegjpo.com.

Groundwater at the site is not contaminated. Periodic groundwater monitoring is conducted at six wells around the cell periphery to ensure the cell's performance. Groundwater monitoring has been conducted at the Gunnison Disposal Cell since 1988. Water levels are also monitored in the local groundwater system. Groundwater monitoring will continue in perpetuity to ensure the continued integrity of the disposal cell.

Engineered Units

DOE will conduct annual inspections of the disposal cell to ensure the integrity of the cap and other engineered features. Maintenance and repairs will be conducted on an as-needed basis. Long-term stewardship activities will continue for the disposal cell in perpetuity.

2.3 Regulatory Regime

Long-term stewardship activities at the Gunnison Disposal Cell are governed by several regulations, including the *Uranium Mill Tailings Radiation Control Act of 1978*; the *Atomic Energy Act of 1954,* as amended; U.S. Environmental Protection Agency groundwater protection standards, including Subpart A of Title 40 of the *Code of Federal Regulations,* Part 192; a cooperative agreement between DOE and the State of Colorado; and the *National Environmental Policy Act of 1969,* as amended.

2.4 Assumptions and Uncertainties

DOE assumes that the cell will continue to perform as designed and the disposal cell cap will not need to be replaced for at least 200 years. In addition, DOE assumes that groundwater monitoring will be required in perpetuity to ensure the disposal cell's integrity.

3.0 ESTIMATED LONG-TERM STEWARDSHIP COSTS

Estimated costs for the Gunnison Disposal Cell are identified in the table below. The cost estimates are based on the actual costs of conducting long-term stewardship activities at the Gunnison Disposal Cell site and other similar Grand Junction Office disposal sites. Fiscal years (FY) 2001 through 2006 include costs for decommissioning unnecessary monitoring wells.

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	***Amount***	***Year(s)***	***Amount***	***Year(s)***	***Amount***
FY 2000	$37,300	**FY 2008**	$25,200	**FY 2036-2040**	$80,000
FY 2001	$55,400	**FY 2009**	$15,200	**FY 2041-2045**	$80,000
FY 2002	$58,700	**FY 2010**	$15,300	**FY 2046-2050**	$80,000
FY 2003	$93,200	**FY 2011-2015**	$73,000	**FY 2051-2055**	$80,000
FY 2004	$89,700	**FY 2016-2020**	$72,900	**FY 2056-2060**	$80,000
FY 2005	$69,500	**FY 2021-2025**	$74,800	**FY 2061-2065**	$80,000
FY 2006	$39,600	**FY 2026-2030**	$79,200	**FY 2066-2070**	$80,000
FY 2007	$15,400	**FY 2031-2035**	$80,000		

4.0 FUTURE USES

The disposal site is owned by the Federal Government, which controls land use within the site boundaries. DOE will provide long-term stewardship services, as required under the NRC general license to maintain protectiveness and regulatory compliance. Long-term stewardship activities will continue indefinitely and land use within the disposal site boundary will not change.

For more information about the Gunnison Disposal Cell, please contact:

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or visit the Internet website at http://www.doegjpo.com

GUNNISON MILL

1.0 SITE SUMMARY

1.1 Site Description and Mission

The Gunnison Mill is the location of a former uranium milling site. The site is on a 25-hectare (61-acre) tract of land adjacent to the Gunnison County Airport southwest of the Town of Gunnison, Colorado. The former mill produced about 540,000 tons of uranium ore during its operational life. The mill ground the ore and then leached it with sulfuric acid and sodium chlorate. After leaching, the uranium-rich solutions and waste solids were separated. The solutions were then treated with sodium carbonate to extract the uranium, and the washed solids were dumped on the tailings pile located on site. Prior to remediation efforts, the mill tailings pile at the site covered approximately 16 hectares (39 acres). In 1992, the U.S. Department of Energy (DOE) began constructing a disposal cell at the Gunnison Disposal Cell site ten kilometers (six miles) southeast of mill site, so that it could begin remediation of the Gunnison Mill site. The disposal cell received and encapsulated the tailings and other contaminated materials from the Gunnison Mill, and was closed in 1995.

LONG-TERM STEWARDSHIP HIGHLIGHTS

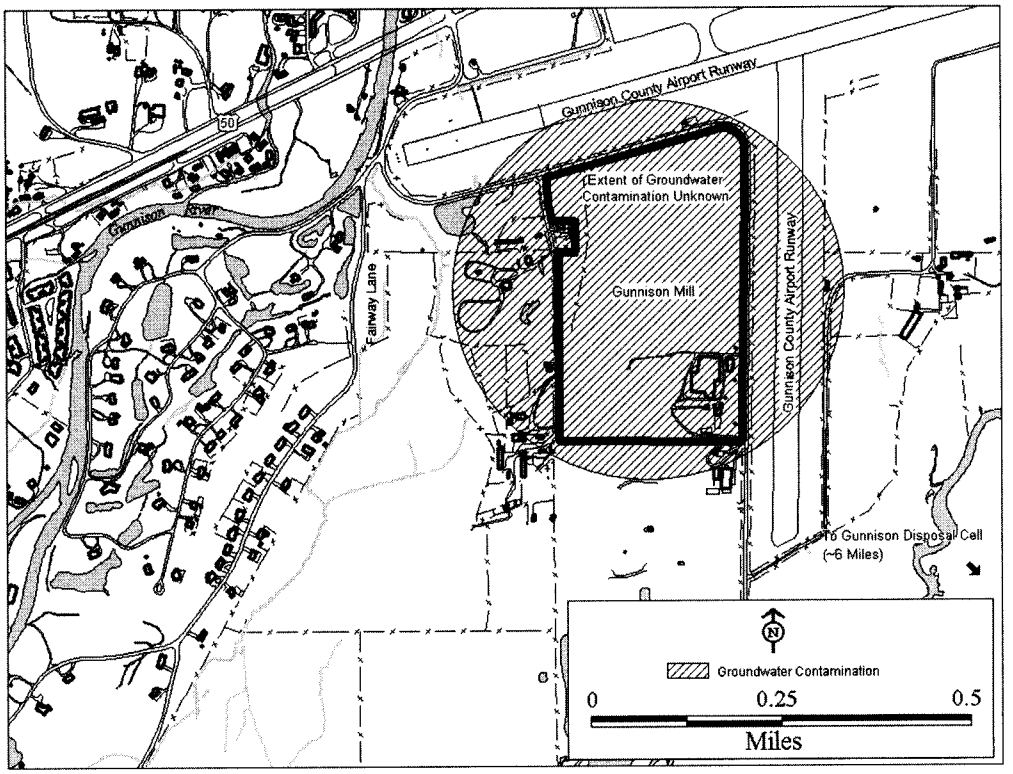
Major Long-Term Stewardship Activities - groundwater monitoring; access restrictions
Total Site Area - 25 hectares (61 acres)
Estimated Volume of Residual Contaminants - groundwater 7.2 million cubic meters (9.4 million cubic yards)
Long-Term Stewardship Start-End Years - 1994-2105
Average Annual Long-Term Stewardship Cost FY 2005-2006 - $20,000
Landlord - U.S. Department of Energy, Grand Junction Office

DOE's current mission at the Gunnison Mill is to enforce access restrictions and conduct passive groundwater remediation activities. Beginning in 2005, after a groundwater compliance strategy has been implemented, DOE's sole mission at the site will be to conduct long-term stewardship activities related to the site's contaminated groundwater. DOE's Grand Junction Office is responsible for conducting long-term stewardship and groundwater compliance activities at the site.

The historic mission of the Gunnison Mill site was to provide uranium to process uranium ore and to provide uranium for sale to the United States Government for its national defense program. Between 1958 and 1962, the Gunnison mill processed uranium ore and produced uranium concentrate that was sold to the Atomic Energy Commission (a predecessor agency to DOE) for the production of nuclear weapons. Over the years, various companies owned and operated the mill. The last owner, before the mill was closed in 1962, was Kermac, a subsidiary of Kerr-McGee Oil Industries. Before remediation in 1992, the State of Colorado acquired ownership of the Gunnison Mill site.

1.2 Site Cleanup and Accomplishments

In 1991, DOE designated the Gunnison Mill for environmental cleanup and stabilization. Approximately 549,700 cubic meters (719,000 cubic yards) of contaminated surface materials were excavated and stabilized in the Gunnison Disposal Cell. Surface remediation activities for the Gunnison Mill and 12 vicinity properties were completed in 1994. The Nuclear Regulatory Commission (NRC) and the State of Colorado concurred with the surface remedial action. DOE will submit a groundwater compliance action plan to NRC and Colorado to address groundwater compliance. In 1990, the State of Colorado obtained ownership of the inactive mill property and has since assigned ownership of the site to Gunnison County. The State of Colorado is responsible for imposing restrictions as necessary to protect public health and safety and the environment.



Gunnison Mill

As a result of former milling operations, the groundwater beneath the Gunnison Mill is contaminated. Approximately 7.2 million cubic meters (9.4 million cubic yards) of groundwater are contaminated and have exceeded maximum concentration limits for net gross alpha, radium, and uranium at least twice since 1990. Other contaminants of potential concern include cadmium, lead-210, iron, cobalt, manganese, sulfate, uranium, thorium-230, and polonium-210. An alternate water system was built as part of the Uranium Mill Tailings Remedial Action Surface Project. Residences with domestic wells in the aquifer downgradient from the processing site that are or could be affected by contamination are now using this alternate water system. Therefore, local populations are not threatened by the contamination. Water in the adjacent Gunnison River has not been degraded by site contaminants. Characterization of the contaminant plume is complete, but a groundwater compliance strategy has not yet been approved.

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

As a result of the site's historic mission, the groundwater within the shallow alluvial aquifer beneath the former mill site is contaminated with processing-related constituents at concentrations exceeding U.S. Environmental Protection Agency (EPA) maximum concentration limits. Long-term stewardship activities for groundwater include institutional controls and periodic compliance monitoring until the groundwater meets EPA regulatory limits. DOE will submit a groundwater compliance action plan to regulators in 2000. If approved, the plan should be fully implemented by 2004. Groundwater monitoring may be required until 2105. No drilling or other intrusive activities are allowed on the property unless approved by DOE.

The site records for the Gunnison Mill are kept in permanent storage at the DOE Grand Junction Office in Grand Junction, Colorado. The types of records kept include characterization data, remedial action design, the completion report, the groundwater compliance plan (once approved), annual inspection reports, and groundwater monitoring results.

2.2 Regulatory Regime

Long-term stewardship activities at the Gunnison Mill are governed by several requirements in the following regulations: *Uranium Mill Tailings Radiation Control Act of 1978*; the *Atomic Energy Act of 1954,* as amended; EPA Groundwater Protection Standards, including Subparts B and C of the *Code of Federal Regulations*, Title 40, Part 192; a cooperative agreement between DOE and the State of Colorado; and the *National Environmental Policy Act of 1969,* as amended.

2.3 Assumptions and Uncertainties

DOE assumes that compliance with the EPA water standards can be achieved through natural flushing. However, the hydrology/geochemistry beneath the site may not be suitable to reduce the concentrations of all the constituents of concern to within regulatory limits. Therefore, active groundwater remediation is also being considered.

3.0 Estimated Long-Term Stewardship Costs

DOE will monitor the site's groundwater starting in 2005. Monitoring will be conducted again in 2008. Additional monitoring may be required after that time. This cost estimate assumes that no active groundwater remediation will be necessary. Costs will be significantly greater after 2002 if active remediation is required.

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	***Amount***	***Year(s)***	***Amount***	***Year(s)***	***Amount***
FY 2000	$0	**FY 2008**	$7,000	**FY 2036-2040**	$0
FY 2001	$0	**FY 2009**	$0	**FY 2041-2045**	$0
FY 2002	$0	**FY 2010**	$0	**FY 2046-2050**	$0
FY 2003	$0	**FY 2011-2015**	$0	**FY 2051-2055**	$0
FY 2004	$0	**FY 2016-2020**	$0	**FY 2056-2060**	$0
FY 2005	$20,000	**FY 2021-2025**	$0	**FY 2061-2065**	$0
FY 2006	$0	**FY 2026-2030**	$0	**FY 2066-2070**	$0
FY 2007	$0	**FY 2031-2035**	$0		

4.0 Future Uses

The State of Colorado will impose restrictions as necessary to protect public health and safety and the environment. The State has assigned ownership of the processing site to Gunnison County. A portion of the Gunnison Mill has been incorporated into the Gunnison County Airport operations area, and access to this portion is controlled by the airport authority. Public access to the remainder of the site is not restricted; however, the land can only be used for public purposes such as parks or municipal infrastructure. Proposed future uses

for the site include expansion of public works facilities and commercial development.

For more information about the Gunnison Mill, please contact:

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(HECLA) DURITA SITE

1.0 SITE SUMMARY

1.1 Site Description and Mission

The (HECLA) Durita Site is the location of a former uranium milling site that extracted uranium and vanadium from mill tailings originally processed through the Naturita Mill. The site is located in Montrose County, Colorado, approximately five kilometers (three miles) west of the town of Naturita, on arid gently sloping terrain at the southeast end of the Paradox Valley. The (HECLA) Durita Site occupies 65 hectares (160 acres), and includes four disposal cells which occupy 17.4 hectares (43 acres) on the site. Most of the site is covered with a layer of sand mixed with silt and clay up to six meters (20 feet) thick, and is underlain by a layer of shale called the Mancos Formation. The nearest residence to the site is the Coke Oven Ranch, about 0.8 kilometer (0.5 mile) from the site. Dry Creek passes near the northeast corner of the site and has seasonal flows.

LONG-TERM STEWARDSHIP HIGHLIGHTS

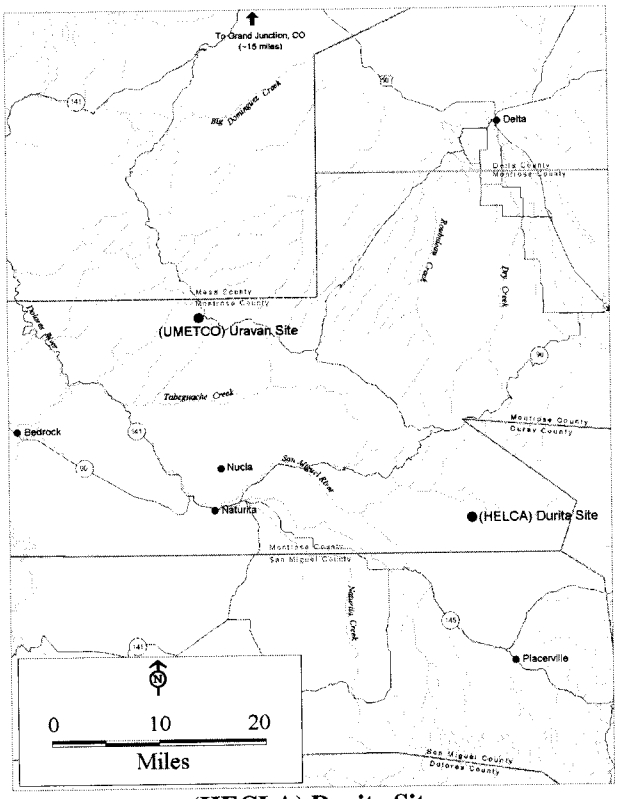
Major Long-Term Stewardship Activities - access control; monitoring and maintenance of four disposal cells
Total Site Area - 65 hectares (160 acres)
Estimated Volume of Residual Contaminants - disposal cells 550,000 cubic meters (720,000 cubic yards)
Long-Term Stewardship Start-End Years - 2001-in perpetuity
Average Annual Long-Term Stewardship Cost FY 2000-2006 - $9,900
Landlord - U.S. Department of Energy, Grand Junction Office (beginning in 2001)

The current mission at the (HECLA) Durita Site is the remediation and disposal of mill tailings. The U.S. Department of Energy (DOE) expects the state license for the Durita site to be terminated by the Colorado Department of Public Health and Environment (which is responsible for overseeing the cleanup) in 2001. Upon termination of the state license, and under provisions of the *Uranium Mill Tailings Radiation Control Act of 1978*, the U.S. Nuclear Regulatory Commission (NRC) will issue DOE a general license for the site and the site will be transferred to DOE for long-term stewardship. The DOE Grand Junction Office will be the custodian for the site and will be responsible for long-term stewardship activities at the site.

The milling operations created process-related waste and uranium and vanadium mill tailings. During operation, the tailings were trucked to the (HECLA) Durita Site from the Naturita mill, mixed with acid, and then placed in three 6-hectare (15-acre) heaps for leaching of uranium and vanadium. The acid solution collected at the bottom of the heaps was piped to an onsite processing mill where uranium and vanadium were extracted and recovered. In addition to the leach heaps, the site consisted of a tailings preparation and acid treatment area, an extraction plant, four process-liquid storage ponds, and six waste-liquid evaporation ponds occupying approximately 11 hectares (28 acres). After operations ceased, temporary interim soil covers were placed over an estimated 400,000 cubic meters (520,000 cubic yards) of uranium mill tailings contained in heaps at the site (weighing approximately 700 tons); as well as 152,000 cubic meters (200,000 cubic yards) of debris from building demolition, raffinate ponds, and wind-blown contamination. The site remained in this interim condition until 1993, when reclamation of the site was initiated by the HECLA Mining Company.

The historic mission of the (HECLA) Durita Site was the recovery of uranium and vanadium from tailings originally processed through the Naturita uranium milling site. The HECLA Durita Site facility was constructed in 1977 as a secondary-extraction heap leach and processing mill by Ranchers Exploration and Development Corporation, which operated the mill until May 1979. HECLA Mining Company merged with Ranchers Exploration and Development Corporation in 1984 and became the owner of the site.

1.2 Site Cleanup and Accomplishments



(HECLA) Durita Site

The HECLA Mining Company submitted a final reclamation plan for the (HECLA) Durita Site in 1993. The plan was approved by the Colorado Department of Public Health and Environment in May 1993, and decommissioning of the site began shortly after with the demolition of the process mill and tailings preparation equipment. After heap drainage ceased, the collection pipes at the base of the heaps were plugged with concrete. The interim top and outslope covers over the heaps were replaced with engineered earthen radon barriers, and the outslopes received 15.2-centimeter (6-inch) layers of rock for erosion protection. The tops of the heaps were revegetated as part of the site reclamation. Liquids in the process-liquid storage ponds and evaporation ponds were neutralized and solidified with Mancos Shale, and the solidified material was consolidated in a 3.2-hectare (8-acre) engineered closure cell built to isolate the contaminated material from the environment. Demolition debris and radionuclide-contaminated soils were also placed in one of the disposal cells, which was covered with a rock cap for erosion protection. The cap is designed to remain effective for 200 to 1,000 years, in accordance with U.S. Environmental Protection Agency (EPA) standards. The HECLA Mining Company plans to transfer title to the reclaimed site to DOE after the Colorado license is terminated, which is anticipated in 2001.

Because of past milling operations, groundwater on the site is contaminated by radionuclides, including radium and uranium. The extent of contamination is currently unknown. However, because the uranium levels do not exceed maximum concentration limits set forth by EPA, no groundwater remediation has occurred. A monitoring program, in effect since 1991, has identified no increase in radionuclide concentrations in the groundwater. In addition, the groundwater is neither a current nor potential source of drinking or irrigation water due to high levels of background radiation. As a result, no long-term groundwater monitoring will be required. The monitoring wells will be plugged before the site is transferred to DOE in 2001.

2.0 Site-Wide Long-Term Stewardship

2.1 Long-Term Stewardship Activities

Because of the nature of the contaminants present, residual contamination will remain onsite in the engineered disposal cells after remediation is complete. Upon transfer to DOE, the DOE Grand Junction Office will be responsible for providing stewardship activities for the four disposal cells at the (HECLA) Durita Site.

Prior to transfer, DOE will prepare a draft long-term surveillance plan for the (HECLA) Durita Site. NRC approval of the draft plan is required prior to termination of the state license and transfer of the site to DOE. Site records for the (HECLA) Durita Site will be maintained in permanent storage at the DOE Grand Junction Office

in Colorado. Types of records to be maintained include the characterization data, remedial action design, completion report, long-term monitoring plan, annual inspection reports, and monitoring data. In addition, DOE will submit an annual report to the NRC that summarizes, describes, and evaluates all surveillance and maintenance actions as required by NRC regulations (Title 10 of the *Code of Federal Regulations*, Part 40) and the approved long-term surveillance plan.

Institutional Controls

Upon NRC licensing, the disposal site will be owned by the Federal Government, which will control land use within the site boundaries. DOE will provide long-term stewardship services as required under the NRC license to maintain protectiveness and regulatory compliance. Access will be restricted through the use of fencing and warning signs posted, as necessary, along the site boundary. Fencing surrounding the disposal cell will be maintained and repaired, as needed. DOE maintains a 24-hour phone line for reporting site concerns. Drilling and other intrusive activities will be prevented within site boundaries through management control. Once the site is transferred, DOE will conduct annual inspections to ensure the integrity of cell covers and other engineered features, and to ensure that institutional controls are effective and the site complies with applicable requirements. At least one metal sign with DOE's 24-hour emergency phone number and a granite monument will be placed at the site to warn against restricted activities and to identify the materials in the disposal cells.

2.2 Specific Long-Term Stewardship Activities

Engineered Units

Four low-level radioactive waste disposal cells encompass approximately 17.4 hectares (43 acres) of the 65- hectare (160-acre) (HECLA) Durita Site. The cells are lined with natural materials and contain approximately 550,000 cubic meters (720,000 cubic yards) of uranium mill tailings, as well as soils and construction debris contaminated with uranium, radium, and thorium. The disposal cells are capped with a rock and grass cap. The caps will require annual inspections to evaluate the condition of surface features. In addition, DOE will be responsible for performing maintenance and vegetation control, as necessary. A fence will surround the cells and help restrict access in perpetuity.

> ***STAKEHOLDER INVOLVEMENT***
>
> When the (HECLA) Durita Site is licensed by the NRC and transferred to DOE, copies of the annual inspection report will be distributed to the local library and to stakeholders requesting them. The report also will be published on the DOE Grand Junction Office website at www.doegjpo.com.

2.3 Regulatory Regime

DOE is completing groundwater reclamation at the (HECLA) Durita Site. Colorado, as an NRC Agreement State, licenses the byproduct material aspects of the (HECLA) Durita Site. Remediation (which is regulated by the State of Colorado) and subsequent licensing for long-term stewardship activities by the NRC have not been completed. NRC licensing for long-term stewardship activities is expected in 2001.

Following cleanup, the (HECLA) Durita Site will come under a general license issued by NRC for custody and long-term care of residual radioactive disposal sites (contained at Title 10 of the *Code of Federal Regulations,* Section 40.28, *General License for Custody and Long-term Care of Uranium or Thorium Byproduct Materials Disposal Sites*). The purpose of the general license is to ensure that such sites will be cared for in a manner that protects human health and safety and the environment. The general license will go into effect when NRC concurs that the site conforms to cleanup standards and formally accepts the site-specific long-term surveillance plan.

2.4 Assumptions and Uncertainties

DOE expects the (HECLA) Durita Site to be transferred for long-term stewardship in 2001. However, the exact date of the transfer depends on the completion of remedial activities being conducted by the HECLA Mining Company. Cleanup levels will be achieved before the site is transferred to DOE for long-term stewardship. Groundwater monitoring will be conducted to verify continued compliance with cleanup levels. Groundwater monitoring may or may not continue indefinitely, depending upon site-specific circumstances and hydrology and whether or not the cell demonstrates infiltration control.

3.0 Estimated Long-Term Stewardship Costs

Estimated costs for long-term stewardship of the (HECLA) Durita Site are identified in the table below. Cost estimates are based on comparisons of the actual costs of long-term stewardship activities at other sites that are currently being managed by DOE and have similar long-term stewardship requirements and comparable sizes. For the site to be transferred to DOE, the site owner must demonstrate full funding for inspections and ongoing maintenance at the site. At the time of transfer to DOE, the owner of the site will be required to provide a one-time payment to DOE to cover long-term stewardship activity costs.

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	*Amount*	*Year(s)*	*Amount*	*Year(s)*	*Amount*
FY 2000	$3,900	**FY 2008**	$10,500	**FY 2036-2040**	$51,100
FY 2001	$12,500	**FY 2009**	$10,500	**FY 2041-2045**	$51,100
FY 2002	$10,800	**FY 2010**	$10,300	**FY 2046-2050**	$51,200
FY 2003	$10,500	**FY 2011-2015**	$49,100	**FY 2051-2055**	$51,100
FY 2004	$10,600	**FY 2016-2020**	$47,800	**FY 2056-2060**	$51,100
FY 2005	$10,700	**FY 2021-2025**	$47,900	**FY 2061-2065**	$51,100
FY 2006	$10,500	**FY 2026-2030**	$50,600	**FY 2066-2070**	$51,200
FY 2007	$10,600	**FY 2031-2035**	$51,100		

4.0 Future Uses

All 65 hectares (160 acres) of the site will be transferred to DOE. The site will be a permanent uranium mill tailings repository, and public access to the entire site will be restricted in perpetuity.

For more information about the (HECLA) Durita Site, please contact:

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2597 B3/4 Road, Grand Junction, CO 81503
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MAYBELL MILL SITE

1.0 SITE SUMMARY

1.1 Site Description and Mission

> ***LONG-TERM STEWARDSHIP HIGHLIGHTS***
>
> *Major Long-Term Stewardship Activities* - disposal cell monitoring
> *Total Site Area* - 101.3 hectares (250.4 acres)
> *Estimated Volume of Residual Contaminants* - disposal cell 2.7 million cubic meters (3.5 million cubic yards)
> *Long-Term Stewardship Start-End Years* - 1999-in perpetuity
> *Average Annual Long-Term Stewardship Cost FY 2000-2006* - $24,000
> *Landlord* - U.S. Department of Energy, Grand Junction Office

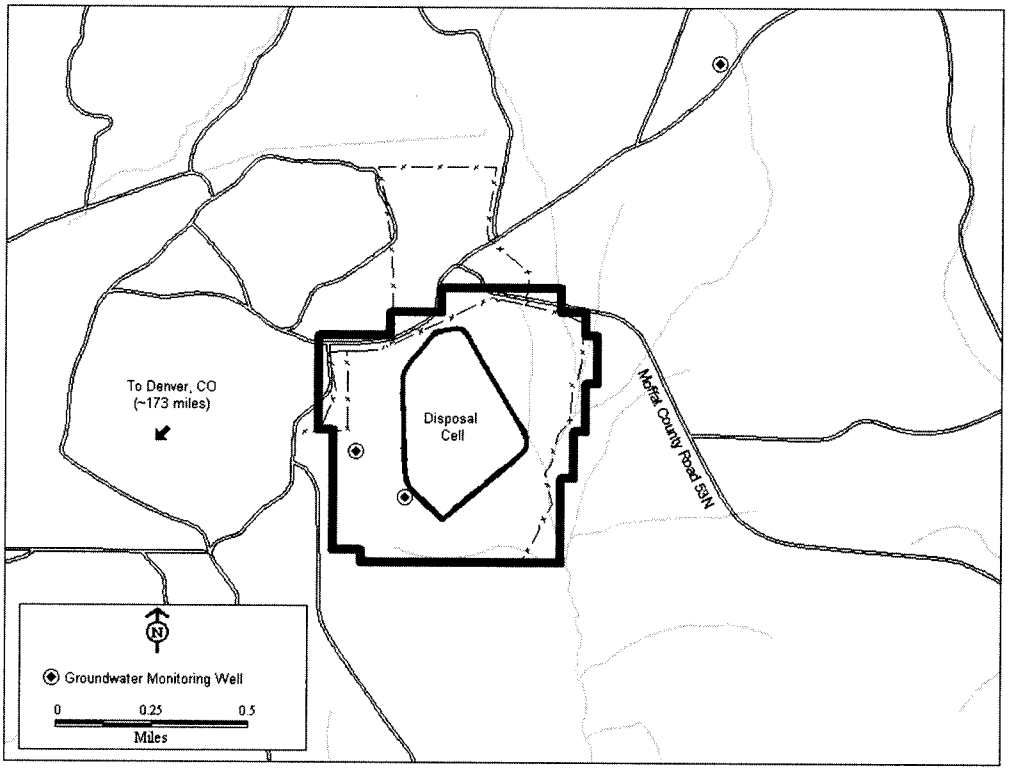
The Maybell Mill Site is the location of a former uranium milling site that processed uranium ore between 1957 and 1964. The 101.3-hectare (250.4-acre) site contains a disposal cell for uranium mill tailings and other contaminated materials due to historic operations. The site is located in Moffat County, Colorado, 40 kilometers (25 miles) west of the city of Craig, and eight kilometers (five miles) northeast of the unincorporated village of Maybell. Approximately 2,700,000 cubic meters (3,500,000 cubic yards) of process-related contaminated materials were disposed at the site. Approximately 87 hectares (214 acres) are contaminated due to wind transport of tailings. In addition, three kilometers (two miles) of Johnson Wash and almost two kilometers (one mile) of Lay Creek were contaminated by the inadvertent discharge of 90,000 to 180,000 kilograms (200,000 to 400,000 pounds) of tailings and the routine discharge of tailings pond effluent into these streams in the early 1960s.

The current mission of the Maybell Mill Site is long-term stewardship and monitoring of the disposal cell and groundwater. The disposal site is subject to Title I of the *Uranium Mill Tailings Radiation Control Act of 1978* (UMTRCA). As such, the U.S. Department of Energy (DOE) is responsible for remediation and long-term stewardship activities at the site.

The historic mission of the Maybell Mill Site began in 1955 with the Trace Element Corporation. In 1957, Union Carbide Corporation (now UMETCO) assumed control of the site and began milling operations using uranium ore from nearby open pit mines. During the 7 years of operation by UMETCO, the mill processed approximately 2.6 million tons of ore. All uranium produced at the Maybell Mill Site was sold to the U.S. Atomic Energy Commission (a predecessor agency to DOE). After the mill shut down in November of 1964, UMETCO dismantled the mill. In 1971, UMETCO began stabilizing the tailings in accordance with Colorado regulations.

1.2 Site Cleanup and Accomplishments

As a result of the historic mission, the Maybell Mill Site was contaminated, and parts of the Johnson Wash and Lay Creek were contaminated by mill tailings and the routine discharge of tailings pond effluent. DOE began remedial action at the processing site in 1995, in accordance with a remedial action plan approved by the U.S. Nuclear Regulatory Commission (NRC). Contaminated materials (including mill tailings, debris from demolished mill structures, and materials removed from contaminated vicinity properties) were placed in the onsite disposal cell. The cell was closed in July 1998. During final site grading, all areas were contoured to promote drainage way from the disposal cell. DOE used a mix of grasses indigenous to the area to revegetate all disturbed areas of the disposal site not covered by riprap. The NRC concurred with DOE that the cell complied with U.S. Environmental Protection Agency (EPA) standards and accepted the disposal site under the general license for residual radioactive disposal sites contained in Title 10, *Code of Federal Regulations*, Section 40.27.



Maybell Mill Site

Groundwater in the vicinity of the former mill is not a potential or current drinking water source due to naturally occurring regional uranium mineralization. In addition, groundwater beneath the site complies with EPA standards through the application of supplemental standards, as defined in Title 40 of the *Code of Federal Regulations* Part 192.22. Consequently, active groundwater remediation will not be required.

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

Long-term stewardship of the Maybell Mill Site is the responsibility of the DOE Grand Junction Office. DOE is managing the site in accordance with an NRC approved long-term surveillance plan prepared specifically for the Maybell site. Under provisions of the plan, annual inspections of the site are conducted to evaluate the condition of surface features and to determine whether any actions are required to maintain site integrity and security. As part of these inspections, DOE will monitor for occurrence of the following potential concerns at the Maybell Mill Site: settlement of the tailings within the cell due to large quantities of encapsulated moisture from processing residues, and seeps from the moisture. These inspections will continue indefinitely. DOE will also measure groundwater levels downgradient of the Maybell Mill Disposal Cell to monitor for potential transient drainage from the cell and the dissipation of the processing-related groundwater mound.

After completion of the remedial action, DOE documented the final disposal site conditions with site maps, as-built drawings, and ground and aerial photographs. These drawings, maps, and photographs, along with the characterization data, the remedial action design, the completion report, the long-term monitoring plan, the annual inspection reports, and the monitoring data, are part of the permanent site file located at the Grand Junction

Office in Grand Junction, Colorado. DOE maintains and updates the specific records and reports required to document long-term surveillance program activities at the Maybell site. DOE submits an annual report to the NRC documenting the results of the program. Real property records are maintained by DOE Albuquerque Office in New Mexico.

2.2 Specific Long-Term Stewardship Activities

Engineered Units

This site has one roughly pentagonal-shaped disposal cell that measures approximately 488 meters by 732 hectares (1,600 feet by 2,400 feet) and rises nine meters (30 feet) above the surrounding terrain. It occupies 27 hectares (66 acres) of the 101-hectare (250-acre) site and contains approximately 4,300,000 dry tons of contaminated material with a total activity of 455 curies of radium-226. The existing tailings pile and additional residual radioactive material was placed in the cell. A posted wire fence surrounds the site. The cover of the disposal cell is a multi-component system designed to encapsulate and isolate the contaminated materials for 1,000 years. A low-permeability radon barrier (the first layer placed over the compacted tailings) reduces radon emissions and minimizes the precipitation that percolates through the contaminated materials and into the underlying soils. This layer consists of compacted clayey soils amended with bentonite. A frost-protection layer of compacted soil protects the radon barrier from freeze-thaw damage, and a bedding layer of coarse sand and fine gravel was placed over the frost-protection layer and covered with a riprap erosion-protection layer. This final rock layer protects the cell against wind and water erosion and discourages cell intrusion.

> ***STAKEHOLDER INVOLVEMENT***
>
> Community interaction has been minimal since the remedial action was completed. Copies of the annual inspection report for the Maybell Mill Site and other sites are distributed to the local library and to any stakeholders that request copies. The report is also published on the DOE Grand Junction Office website at www.doegjpo.com.

Maximum cell surface grades are three percent on the top slope and 20 percent on the side slopes. A riprap apron was placed around the perimeter of the disposal cell to provide added protection at the toe of the cell and to channel runoff water away from the cell. A rock-lined interceptor ditch abuts the west up-slope portion of the disposal cell to divert surface flow away from the cell and toward Johnson Wash to the east. Disturbed areas were graded to promote positive drainage and were reseeded with native grasses.

Long-term surveillance and maintenance activities for the disposal cell include annual surface inspections and vegetation and erosion control, including reseeding the site, controlling deep-rooted vegetation, and replacing or repairing of signs and fences. According to the long-term surveillance plan for the site, DOE does not plan to conduct routine maintenance at the site, but will conduct additional maintenance as indicated by the results of site inspections.

Groundwater

There are four groundwater monitoring wells in the monitoring network for the Maybell Mill Site, and these wells are being used to monitor water levels only to detect potential transient drainage related to disposal cell construction. Water-level monitoring will be conducted at the site for a limited time. Groundwater monitoring to demonstrate compliance with EPA groundwater protection standards is not required at the Maybell site because the groundwater in the uppermost aquifer at the site is of limited use and is not a current or potential source of drinking water. The groundwater is contaminated not only from activities that occurred at the Maybell site, but also by naturally occurring minerals and active and former exploration and mining activities in the vicinity of the site. The NRC and EPA are aware that monitoring water levels to detect transient effects of

construction may not provide definitive results because of interference from precipitation and other factors.

2.3 Regulatory Regime

In October 1999, the Maybell Mill Site came under a general license issued by NRC for custody and long-term care of residual radioactive disposal sites (contained at Title 10 of the *Code of Federal Regulations,* Section 40.27). The purpose of the general license is to ensure that such sites will be cared for in a manner that protects human health and safety and the environment. The general license went into effect when NRC concurred that the site conformed to cleanup standards and formally accepted the site-specific long-term surveillance plan.

Long-term stewardship of the Maybell Mill Site is governed by several other requirements in the following regulations: the *Uranium Mill Tailings Radiation Control Act of 1978*; the *Atomic Energy Act of 1954,* as amended; Environmental Protection Agency Groundwater Protection Standards, including Subparts A, B, and C of Title 40 of the *Code of Federal Regulations,* Part 192; a cooperative agreement between DOE and the State of Colorado; and the *National Environmental Policy Act of 1969,* as amended.

2.4 Assumptions and Uncertainties

DOE assumes that monitoring will continue indefinitely. Because DOE is already conducting long-term stewardship at the site, activities are well known and are not expected to change dramatically. Caps are not expected to be replaced for a minimum of 200 years.

3.0 Estimated Long-Term Stewardship Costs

The following table shows the estimated costs of the long-term stewardship at the Maybell Mill Site. These include the cost of annual inspections, groundwater monitoring, vegetation and erosion control, maintenance activities, and replacing and repairing signs and fences. Cost estimates reflect the current site agreements and monitoring frequencies. Because DOE is already conducting long-term stewardship at the site, cost estimates are based on the actual cost of long-term stewardship activities at this site.

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	***Amount***	***Year(s)***	***Amount***	***Year(s)***	***Amount***
FY 2000	$2,000	**FY 2008**	$26,300	**FY 2036-2040**	$127,800
FY 2001	$31,200	**FY 2009**	$26,300	**FY 2041-2045**	$127,800
FY 2002	$27,100	**FY 2010**	$25,700	**FY 2046-2050**	$127,800
FY 2003	$26,100	**FY 2011-2015**	$122,700	**FY 2051-2055**	$127,800
FY 2004	$26,400	**FY 2016-2020**	$119,400	**FY 2056-2060**	$127,800
FY 2005	$26,600	**FY 2021-2025**	$119,800	**FY 2061-2065**	$127,800
FY 2006	$26,100	**FY 2026-2030**	$126,500	**FY 2066-2070**	$127,800
FY 2007	$26,500	**FY 2031-2035**	$127,800		

4.0 Future Uses

Numerous abandoned uranium mines remain near the site. Land surrounding the disposal site is used primarily

for livestock grazing. Land at the Maybell Mill Site was originally owned by both public and private entities. The portion of the disposal site located on property administered by the U.S. Department of Interior Bureau of Land Management was permanently withdrawn and transferred to DOE in 1995. The State of Colorado purchased the privately held portion of the disposal site and transferred the title to DOE. Public access to the disposal site is restricted. The disposal cell on the site is fenced and access is restricted. Part of the site outside of the disposal site boundary has been reclaimed and may be accessed for grazing; however, access to this area is controlled by a locked gate and fence. Future land use within the disposal site boundary will not change.

For more information about the Maybell Mill Site, please contact:

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NATURITA MILL

1.0 SITE SUMMARY

1.1 Site Description and Mission

> ***LONG-TERM STEWARDSHIP HIGHLIGHTS***
>
> *Major Long-Term Stewardship Activities* - groundwater monitoring; erosion control
> *Total Site Area* - 21 hectares (53 acres)
> *Estimated Volume of Residual Contaminants* - groundwater 379,000 cubic meters (495,000 cubic yards)
> *Long-Term Stewardship Start-End Years* - 1997-2103
> *Average Annual Long-Term Stewardship Cost FY 2000-2006* - n/a (costs begin in FY 2011)
> *Landlord* - U.S. Department of Energy, Grand Junction Office

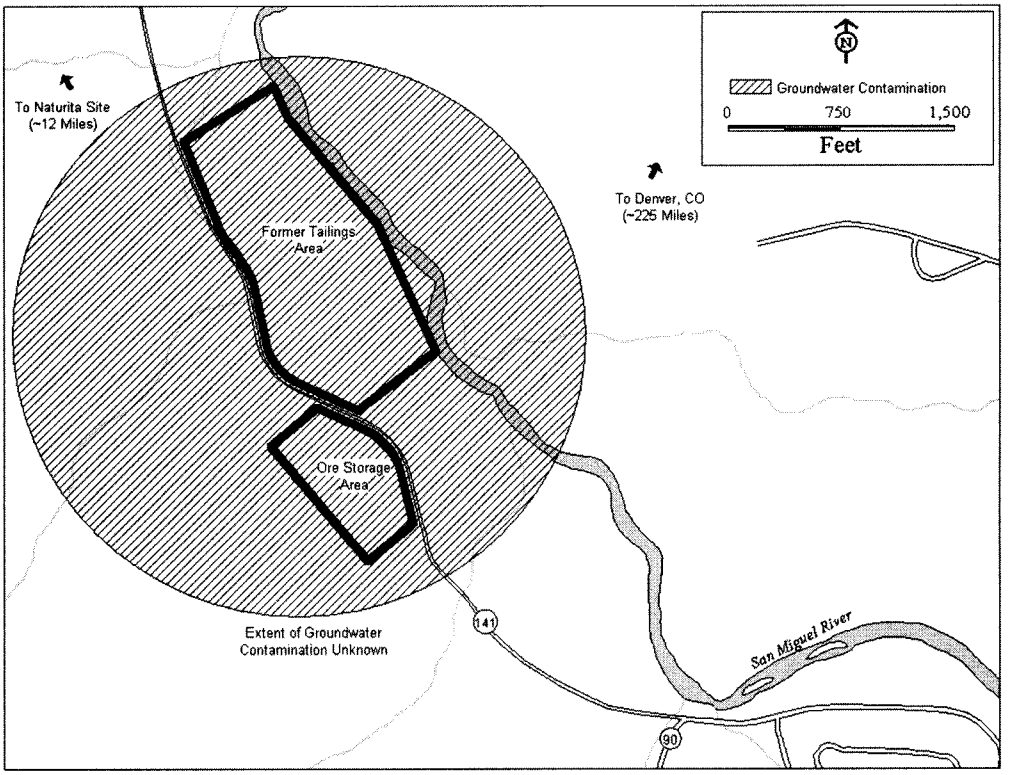
The Naturita Mill site is the location of a former uranium and vanadium mill which operated from 1930 to 1963. The site is located on a 21-hectare (53-acre) tract of land in Montrose County, approximately 3 kilometers (2 miles) northwest of the rural town of Naturita, Colorado. As a result of past milling operations, contamination was generated at the site consisting of uranium and vanadium mill tailings, radium, thorium, and uranium in soils, and building debris. The mill tailings were relocated to the (HECLA) Durita Site for reprocessing. Initially, a total of 100 hectares (247 acres) of land associated with the site contained contaminated soil, structures, or wind-blown or water-borne material from the mill processing activities. In 1997, approximately 612,000 cubic meters (800,000 cubic yards) of the contaminated materials were relocated offsite to the disposal cell at the Naturita Site near Uravan, Colorado. The U.S. Department of Energy (DOE) completed surface remediation activities at the Naturita Mill in 1997.

The current mission of the Naturita Mill is groundwater characterization and remediation. Although the land currently is privately owned, mostly by Cyprus/Foote Mineral Company, the former mill site is subject to Title I of the *Uranium Mill Tailings Radiation Control Act of 1978* (UMTRCA). As such, DOE is responsible for remediation and long-term stewardship activities. Surface remediation has been completed. However, subsurface characterization and remediation is ongoing. Pending approval of a groundwater cleanup strategy, DOE will begin long-term stewardship activities for the subsurface in 2009.

The historic mission of the site was to process vanadium and uranium for the United States national defense program. Rare Metals Company built the mill in 1930, but it did not become operational until 1939, when Vanadium Corporation of America acquired it and converted it for vanadium recovery. The mill was shut down at the end of World War II, but reopened in 1947. It produced uranium concentrates that were shipped to the United States Atomic Energy Commission (a predecessor agency to DOE) until the mill was shut down in 1958. From 1961 until 1963, Vanadium Corporation of America operated a uranium upgrader at the site. In 1967, Vanadium Corporation of America merged with Foote Mineral Company, and ownership of the site was passed to Foote. Between 1977 and 1979, Rancher's Exploration of Albuquerque, later acquired by HECLA Mining Company, removed the mill tailings to its processing site for reprocessing. Therefore, only contaminated soil and structures remained on the surface at the Naturita Mill when DOE began remedial action in June 1996.

1.2 Site Cleanup and Accomplishments

The milling operations at the Naturita Mill caused both surface and subsurface (groundwater) contamination. Remedial action at the site consisted of demolishing existing facilities, excavating sub-pile and wind-blown material from the site and adjacent properties, and relocating approximately 612,000 cubic meters (800,000 cubic yards) of the residual radioactive materials to the disposal cell at the Naturita Site, located 21 kilometers (13 miles) away. The disturbed areas at the Naturita Mill were graded and revegetated, and the soil was remediated to U.S. Environmental Protection Agency (EPA) standards.



Naturita Mill

Approximately 379,000 cubic meters (495,000 cubic yards) of groundwater are contaminated with materials from processing ores to recover vanadium and uranium. Specifically, the identified constituents of concern include uranium, arsenic, molybdenum, selenium, radium, and net gross alpha. Full characterization of the contaminant plume is not complete and, therefore, a groundwater compliance strategy has not been approved. There are no known uses of this groundwater and local populations are not threatened by the contamination. Water in the adjacent San Miguel River has not been degraded by the site contaminants. Consequently, the likely remediation strategy is natural flushing. If this strategy is chosen, active groundwater remediation will not be required, but monitoring will be necessary until site groundwater complies with EPA water quality standards.

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

DOE's Grand Junction Office is responsible for long-term surveillance and monitoring activities at the Naturita Mill. These activities include monitoring the revegetation of the former mill site and monitoring the groundwater. DOE conducts routine sampling of ground and surface water. Surface water is only monitored to ensure that groundwater contaminants do not impact the San Miguel River. Long-term stewardship activities will continue at the site until 2103 or sooner, depending on when groundwater complies with EPA standards (Title 40 of the *Code of Federal Regulations*, Part 192).

The only permanent surveillance features at the Naturita Mill are two DOE-owned monitoring wells. Since the land is privately owned, DOE has an access agreement to enter the property and conduct long-term surveillance

and monitoring activities.

DOE maintains and updates the specific records and reports required to document long-term stewardship activities at the Naturita Mill. The site records are kept in permanent storage at the DOE Grand Junction Office in Colorado. Types of records maintained include site characterization data, remedial action design information, the site completion report, and current and historic monitoring data.

2.2 Specific Long-Term Stewardship Activities

Groundwater

Site groundwater will be characterized and DOE will develop a groundwater compliance action plan that defines the groundwater compliance strategy. Upon U.S. Nuclear Regulatory Commission (NRC) approval of the plan, DOE will implement the strategy. The anticipated remediation strategy is natural flushing (i.e., no active remediation). Consequently, long-term stewardship activities for groundwater are expected to begin in 2009 to ensure that natural flushing is removing contamination in accordance with the EPA's limit of remediation within 100 years. DOE will conduct groundwater monitoring every three years until EPA water quality standards are met. Once the NRC certifies compliance with Subpart B of the EPA's Groundwater Protection Standards (Title 40 of the *Code of Federal Regulations*, Part 192), the site will be released for unrestricted use to its owner.

STAKEHOLDER INVOLVEMENT

Since the surface remedial action was completed, community interaction has been minimal. Copies of the annual inspection report for the Naturita Mill and other sites will be distributed to the local library and to any stakeholders that request them. The report is also published on the DOE Grand Junction Office website at www.doegjpo.com.

2.3 Regulatory Regime

The *Uranium Mill Tailings Radiation Control Act of 1978* (UMTRCA) authorized DOE to care for the uranium mill tailings disposal sites under a general license issued by NRC for the long-term care of residual radioactive material disposal cells (contained at Title 10 of the *Code of Federal Regulations,* Section 40.27). However, when the residual radioactive materials were relocated off the processing site, NRC will not license the original site. Compliance with EPA groundwater standards will require NRC concurrence.

Several requirements in the following regulations govern long-term stewardship of the Naturita Mill: the *Uranium Mill Tailings Radiation Control Act of 1978*; the *Atomic Energy Act of 1954*, as amended; Environmental Protection Agency Groundwater Protection Standards, including Subparts B and C of Title 40 of the *Code of Federal Regulations*, Part 192; a cooperative agreement between DOE and the State of Colorado; and the *National Environmental Policy Act of 1969,* as amended.

2.4 Assumptions and Uncertainties

DOE assumes that groundwater compliance will be achieved through natural flushing and that active remediation will not be required. Long-term stewardship activities for groundwater are expected to begin in 2009 to ensure that natural flushing is removing contamination in accordance with the EPA's limit of remediation within 100 years. Groundwater monitoring will occur at three-year intervals until 2103 or sooner, depending on when EPA water quality standards are met.

3.0 ESTIMATED LONG-TERM STEWARDSHIP COSTS

DOE will continue groundwater characterization and finalization of a groundwater remediation strategy in coordination with NRC during fiscal years (FY) 2000 through 2009. Significant long-term stewardship costs will

not be incurred until FY 2011 when groundwater monitoring begins in three year intervals. Thereafter, long-term stewardship costs for the site are relatively constant, with slight spikes every three years due to the costs associated with groundwater monitoring. For purposes of this report, long-term stewardship costs are shown until FY 2070; however, it is anticipated that the costs will continue until 2103.

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	***Amount***	***Year(s)***	***Amount***	***Year(s)***	***Amount***
FY 2000	$0	**FY 2008**	$0	**FY 2036-2040**	$7,000
FY 2001	$0	**FY 2009**	$0	**FY 2041-2045**	$14,000
FY 2002	$0	**FY 2010**	$0	**FY 2046-2050**	$7,000
FY 2003	$0	**FY 2011-2015**	$14,000	**FY 2051-2055**	$14,000
FY 2004	$0	**FY 2016-2020**	$7,000	**FY 2056-2060**	$7,000
FY 2005	$0	**FY 2021-2025**	$14,000	**FY 2061-2065**	$14,000
FY 2006	$0	**FY 2026-2030**	$7,000	**FY 2066-2070**	$7,000
FY 2007	$0	**FY 2031-2035**	$14,000		

4.0 FUTURE USES

The land is currently privately owned, mostly by Cyprus/Foote Mineral Company. Once NRC certifies compliance with EPA's Groundwater Protection Standards (Title 40 of the *Code of Federal Regulations*, Part 192), the site will be released for unrestricted use to its owners.

For more information about the Naturita Mill, please contact:

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or visit the Internet website at http://www.doegjpo.com

NATURITA SITE

1.0 SITE SUMMARY

1.1 Site Description and Mission

The Naturita Site (also known as the Upper Burbank disposal cell) contains a 4-hectare (10-acre) disposal cell built by the U.S. Department of Energy (DOE) to retain contaminated building debris and soils from past operations at the Naturita Mill. The disposal site is located on an 11-hectare (27-acre) tract of land near the town of Uravan in western Colorado. Approximately 612,000 cubic meters (800,000 cubic yards) of contaminated materials from Naturita Mill were relocated, consolidated, and disposed in the Naturita Site disposal cell in 1998. DOE completed surface remediation activities at the Naturita Site in late 1998.

LONG-TERM STEWARDSHIP HIGHLIGHTS

Major Long-Term Stewardship Activities - disposal cell monitoring; institutional control enforcement; access restriction
Total Site Area - 11 hectares (27 acres)
Estimated Volume of Residual Contaminants - disposal cell 612,000 cubic meters (800,000 cubic yards)
Long-Term Stewardship Start-End Years - 1999-in perpetuity
Average Annual Long-Term Stewardship Cost FY 2000-2006 - $29,000
Landlord - U.S. Department of Energy, Grand Junction Office

The current mission of the Naturita Site is performing long-term stewardship activities, including monitoring and maintaining the disposal cell. The disposal site is subject to Title I of the *Uranium Mill Tailings Radiation Control Act of 1978* (UMTRCA). As such, DOE is responsible for any remediation and for long-term stewardship activities, which began in 1999. Surface remediation has been completed at the site and no further remediation is required. DOE currently owns the site, but it was formerly owned by the UMETCO Minerals Corporation for mining and processing purposes until June 1997.

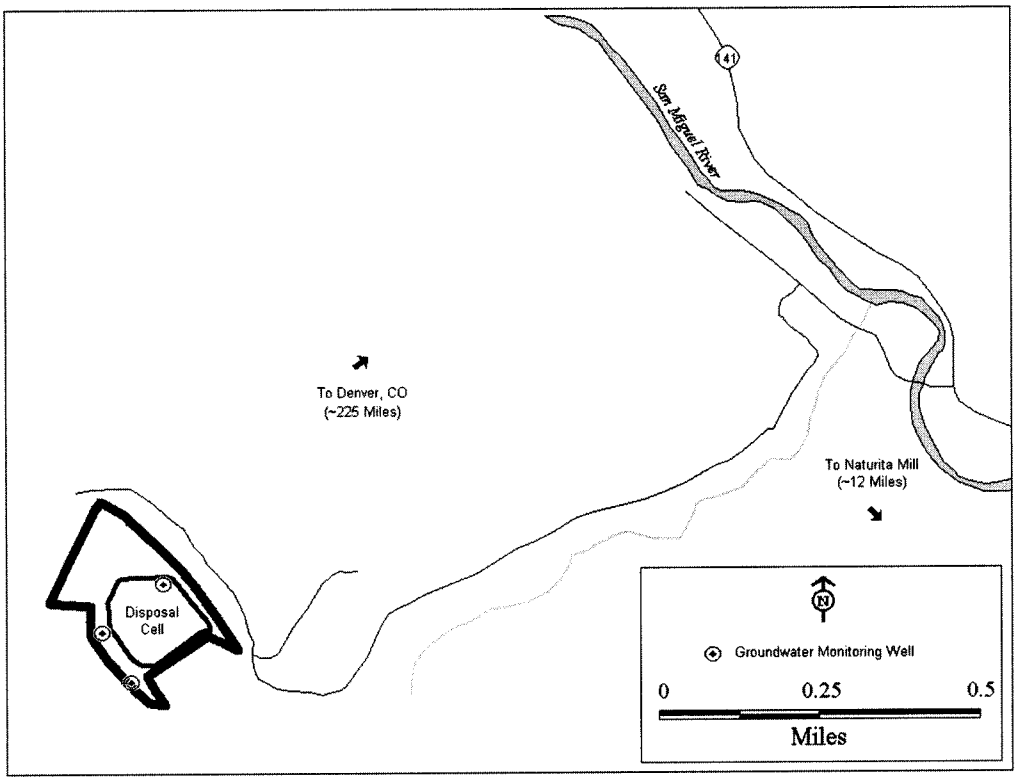
1.2 Site Cleanup and Accomplishments

As a result of past milling operations at the Naturita Mill, contamination at the processing site consisted of radium, thorium, and uranium in soils and building debris. The contaminants were relocated and disposed in the disposal cell at the Naturita Site, which is now covered with a radon barrier and a rock erosion protection layer to meet U.S. Environmental Protection Agency (EPA) standards for longevity, radon control, and groundwater protection. In accordance with EPA standards, the cover is designed to remain effective for 200 to 1,000 years. After completing surface remediation actions at the Naturita Site, DOE received concurrence in August 1999 from the U.S. Nuclear Regulatory Commission (NRC) that the site conformed to cleanup standards (Title 40 of the *Code of Federal Regulations,* Part 192). No soil or groundwater contamination exists at the site.

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

In August 1999, the long-term care of the disposal site was assigned to DOE's Grand Junction Office. Under the provisions of the site-specific long-term surveillance plan, the DOE conducts annual inspections of the site to evaluate the condition of surface features; performs site maintenance, as necessary; and monitors the disposal cell. Annual inspections of the disposal site are conducted to detect progressive change (e.g., erosion) caused by slow-acting natural processes and to identify potential problems before extensive maintenance, repairs, or corrective actions are needed. DOE does not plan to conduct significant maintenance at the Naturita Site. However, DOE will perform minor maintenance (e.g., replace signs, fix fence) and repairs as determined by site



Naturita Site

inspections. Groundwater monitoring is not required for contamination purposes, but monitoring is required to measure the disposal cell's initial performance.

A wire fence with a locked gate surrounds the Naturita Site to prevent unauthorized access. Warning signs are posted on the site perimeter at increments of about 61 meters (200 feet). Permanent surveillance features at the Naturita Site include survey and boundary monuments and site markers. In addition, DOE staffs a 24-hour phone line for reporting any site concerns. Unless authorized by DOE, no drilling or other intrusive activities are allowed on the property.

DOE maintains and updates the specific records and reports required to document long-term stewardship activities at the Naturita Site. DOE submits an annual report to the NRC that documents the results of the site's long-term surveillance plan, as required by NRC regulations in Title 10 of the *Code of Federal Regulations*, Part 27, Appendix A, Criterion 12. Site records are kept in permanent storage at the DOE Grand Junction Office in Colorado, and real property records are retained at the DOE Albuquerque Operations Office in New Mexico. Types of records maintained include site characterization data, remedial action design information, the site completion report, long-term monitoring plans, annual inspection reports, and current and historic monitoring data.

STAKEHOLDER INVOLVEMENT

Since the remedial action was completed, community interaction has been minimal. Copies of the annual inspection report for the Naturita Site are distributed to the local library and to any stakeholders that requests them. The report is also published on the DOE Grand Junction Office website at www.doegjpo.com.

2.2 Specific Long-Term Stewardship Activities

Engineered Units

The site contains one lined 4-hectare (10-acre) disposal cell, which requires long-term surveillance and maintenance to ensure continued protection of human health and the environment. The disposal cell contains 971,762 dry tons of residual radioactive material, with a total activity of 79 curies of radium-226. Consequently, long-term stewardship activities for the disposal cell include monitoring and annual inspections, vegetation control via herbicide application, and fence repairs and sign replacements, as needed. Long-term stewardship activities also include monitoring the water level in one standpipe in the disposal cell. The water level is measured periodically to verify that the water from precipitation does not infiltrate through the disposal cell cover. In addition, DOE monitors two wells for signs of water infiltration. Specifically, groundwater is monitored the first, third, and fifth year after NRC licensing (1999), after which time the need for continual monitoring is reevaluated.

2.3 Regulatory Regime

In August 1999, NRC issued a general license to the Naturita Site for custody and long-term care of residual radioactive material disposal sites (contained at Title 10 of the *Code of Federal Regulations,* Section 40.27). The purpose of the general license is to ensure that such sites will be cared for in a manner that protects human health and safety and the environment. The general license went into effect when NRC concurred that the site conformed to cleanup standards and formally accepted the site-specific long-term surveillance plan.

Several requirements in the following regulations govern long-term stewardship of the Naturita Site: the *Uranium Mill Tailings Radiation Control Act of 1978*; the *Atomic Energy Act of 1954,* as amended; Environmental Protection Agency Groundwater Protection Standards, including Subpart A of Title 40 of the *Code of Federal Regulations,* Part 192; a cooperative agreement between DOE and the State of Colorado; and the *National Environmental Policy Act of 1969,* as amended.

2.4 Assumptions and Uncertainties

Because the site has been monitored since 1999, long-term stewardship activities at the site are well known and are not expected to change dramatically. Sound scope and cost estimates for the long-term stewardship activities at the site have been developed. DOE assumes that monitoring will continue indefinitely, until data demonstrate that the disposal cell achieves infiltration control. In addition, the disposal cell cover is not expected to be replaced for a minimum of 200 years.

3.0 Estimated Long-Term Stewardship Costs

The cost estimates are based on the actual cost of long-term stewardship activities at this and other similar sites. Long-term stewardship costs for the Naturita Site are based on historic costs incurred while conducting actual surveillance and maintenance activities. Cost estimates reflect the current site agreements and monitoring frequencies. Contingency costs, such as cap replacement, have not been incorporated into the cost estimate. Costs from fiscal years (FY) 2000 through 2006 include prorated costs associated with decommissioning unnecessary monitoring wells at similar sites.

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	***Amount***	***Year(s)***	***Amount***	***Year(s)***	***Amount***
FY 2000	$23,400	**FY 2008**	$9,200	**FY 2036-2040**	$46,000
FY 2001	$33,200	**FY 2009**	$9,100	**FY 2041-2045**	$46,000
FY 2002	$35,200	**FY 2010**	$9,200	**FY 2046-2050**	$46,000
FY 2003	$31,400	**FY 2011-2015**	$46,000	**FY 2051-2055**	$46,000
FY 2004	$35,400	**FY 2016-2020**	$46,000	**FY 2056-2060**	$46,000
FY 2005	$23,300	**FY 2021-2025**	$46,000	**FY 2061-2065**	$46,000
FY 2006	$23,700	**FY 2026-2030**	$46,000	**FY 2066-2070**	$46,000
FY 2007	$9,200	**FY 2031-2035**	$46,000		

4.0 FUTURE USES

Future use of the site will be limited to monitoring and maintaining the disposal cell in perpetuity. Public access to the disposal site will be restricted indefinitely.

For more information about the Naturita Site, please contact:

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NAVAL OIL SHALE RESERVES SITE

1.0 SITE SUMMARY

1.1 Site Description and Mission

The Naval Oil Shale Reserves Site is located seven miles west of Rifle in Anvil Points, Colorado. The site covers approximately 5,700 hectares (14,100 acres) and is adjacent to the Sharrard Creek. From the early 1940s through the early 1980s, the U.S. Department of Energy (DOE) conducted oil shale retort experiments in the Green River geologic formation. These retort experiments involved heating the oil shale in the geologic formation in-situ to produce oil.

LONG-TERM STEWARDSHIP HIGHLIGHTS

Major Long-Term Stewardship Activities - groundwater monitoring
Total Site Area - 5,700 hectares (14,100 acres)
Estimated Volume of Residual Contaminants - groundwater unknown
Long-Term Stewardship Start-End Years - 2000-unknown
Average Annual Long-Term Stewardship Cost FY 2000-2006 - $3,000
Landlord - U.S. Bureau of Land Management

DOE's current mission at the site is limited to monitoring of the shale pile and groundwater. DOE and the State of Colorado have not yet finalized decisions on the need for remediation of the shale pile. DOE will be responsible for any remediation activities if they are determined to be necessary by the State of Colorado. DOE expects that its mission will be restricted to long-term stewardship activities beginning in 2000.

1.2 Site Cleanup and Accomplishments

The site contains a shale pile (that has undergone the retort process) located within six meters (20 feet) of Sharrard Creek. The shale pile contains approximately 274,000 cubic meters (300,000 cubic yards) of contaminated waste material. The shale pile, which covers approximately four hectares (ten acres), is contaminated with benzene, toluene, phenols, and heavy metals. DOE's Office of Fossil Energy has conducted extensive testing of the shale pile and the site's groundwater. Groundwater wells have shown very little contaminant movement, and what little contamination that was present historically has decreased over the past seven years.

ACCOMPLISHMENTS

- Characterized the site through sampling and submitted the results to the State of Colorado

BY 2006, DOE WILL HAVE

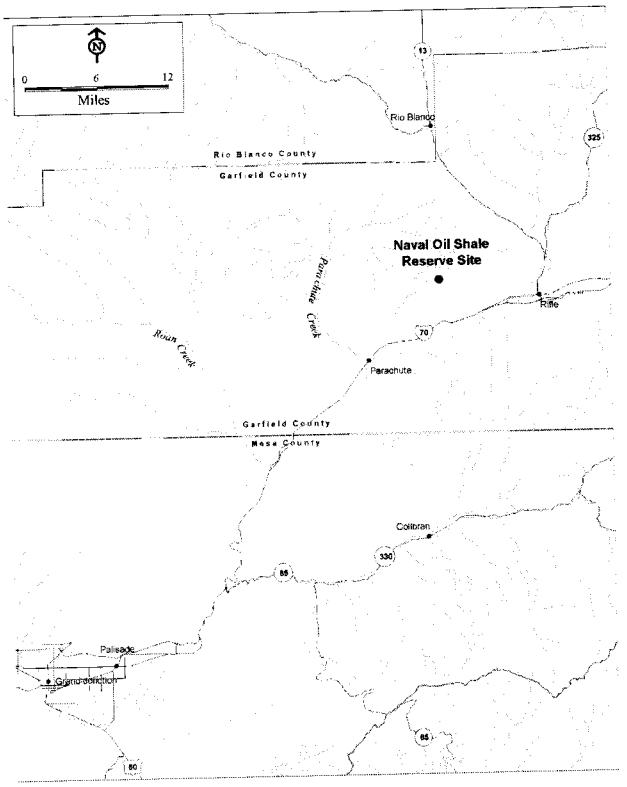
- Made a decision on whether to move the shale pile
- Moved the shale pile if its relocation is determined to be necessary

DOE is working with the State of Colorado's Department of Health to determine if the shale pile needs to be moved to a safer location. If the State of Colorado decides that relocation is necessary, the potential relocation site will be chosen as part of the *National Environmental Policy Act* (NEPA) process.

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

DOE is expecting to continue annual groundwater sampling and monitoring of the shale pile unless directed otherwise by the State of Colorado. If the shale pile is moved, DOE plans to continue monitoring the original location's groundwater and the relocated shale pile to ensure the continued stability of the contamination. The duration of long-term stewardship activities has not yet been determined. However, the State of Colorado will determine the duration of the monitoring period during the NEPA decision making process. The monitoring

period is contingent on whether or not the shale pile is relocated. The State will also determine all the other long-term stewardship activities for the site's groundwater and the shale pile during the NEPA process.



Naval Oil Shales Reserve Site

3.0 ESTIMATED LONG-TERM STEWARDSHIP COSTS

If the State of Colorado determines that the shale pile must be moved, the total estimated cost of moving the pile is approximately $7-10 million. The estimated annual cost of conducting groundwater sampling and monitoring the shale pile is approximately $3,000 (regardless of whether or not the shale pile is relocated).

4.0 FUTURE USES

Although DOE has transferred this site to the U.S. Bureau of Land Management, DOE retains responsibility for the ongoing surveillance and maintenance activities.

For additional information about the Naval Oil Shale Reserves Site, please contact:

Mr. Craig Zamuda
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1000 Independence Avenue
Washington, DC 20585
Phone: 202-586-6367
craig.zamuda@hq.doe.gov

RIFLE (NEW) MILL

1.0 SITE SUMMARY

1.1 Site Description and Mission

The Rifle (New) Mill site is the location of a former vanadium and uranium milling site that operated from 1958 through 1984. The 58-hectare (142-acre) site is located between U.S. Highway 6 and Interstate 70, approximately four kilometers (two miles) west of the city of Rifle, in Garfield County, Colorado.

LONG-TERM STEWARDSHIP HIGHLIGHTS

Major Long-Term Stewardship Activities - passive groundwater remediation and monitoring
Total Site Area - 58 hectares (142 acres)
Estimated Volume of Residual Contaminants - groundwater 2.27 million cubic meters (2.97 million cubic yards)
Long-Term Stewardship Start-End Years - 1995-2050
Average Annual Long-Term Stewardship Cost FY 2000-2006 - n/a (costs begin in FY 2008)
Landlord - U.S. Department of Energy, Grand Junction Office

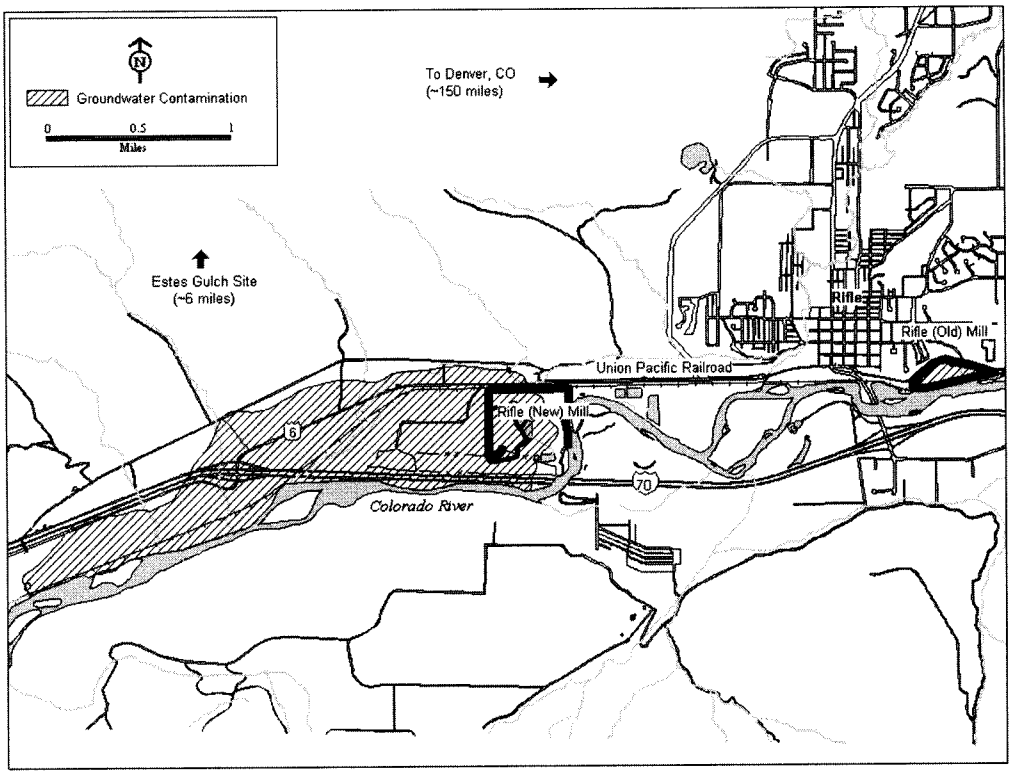
The milling operations created process-related waste and tailings. Approximately 2,656,000 cubic meters (3,474,000 cubic yards) of contaminated material were left on the site, and the west central portion of the site contained approximately 14 hectares (33 acres) of tailings in two distinct piles. Mill buildings were located north and east of the piles. Former holding ponds that held processing wastes (including vanadium and gypsum) were located east of the piles. Union Carbide (the former mill operator) stabilized the Rifle (New) Mill site by covering the tailings piles with soil and fertilizer. An irrigation system was also installed. Much of the pile did not revegetate, and wind and water eroded the tailings pile. The U.S. Department of Energy (DOE) completed surface remediation of the abandoned uranium mill tailings and other contaminated material associated with the former milling operation in 1995. DOE relocated the tailings and contaminated materials to an offsite repository. The former processing site is currently covered and regraded with clean fill material and reseeded with range grasses.

DOE's current mission at the Rifle (New) Mill site is long-term stewardship, including monitoring and remediation of the groundwater at the former mill site. The former mill site is subject to Title I of the *Uranium Mill Tailings Radiation Control Act of 1978* (UMTRCA). As such, DOE is responsible for remediation and long-term stewardship activities at the site.

The original mission at the Rifle (New) Mill was to provide uranium and vanadium for the United States national defense program. Union Carbide constructed the mill and began uranium and vanadium production in 1958. Production continued at the Rifle (New) Mill until 1984. Concentrated ore was shipped to the site from 1958 to the early 1960s by truck and railroad from upgrading plants at Green River, Utah, and Slick Rock, Colorado. From 1964 to 1967, the Rifle (New) Mill also processed lignite ash produced by Union Carbide's strip mining operations near Belfield, North Dakota. From 1973 to 1984, part of the mill was used to produce vanadium. This operation, which did not produce tailings, involved processing vanadium-bearing solutions from Union Carbide's plant at Uravan, Colorado, for various vanadium products used by the steel industry.

1.2 Site Cleanup and Accomplishments

DOE was responsible for cleaning up surface and groundwater contamination at the Rifle (New) Mill site, as directed under UMTRCA. DOE completed surface remediation in 1995. All buildings and structures were demolished, and DOE relocated all tailings and other residually contaminated materials to a disposal cell at the Estes Gulch Disposal Cell, approximately ten kilometers (six miles) north of the town of Rifle.



Rifle (New) Mill

At the Rifle (New) Mill site, groundwater contamination in the alluvial aquifer extends at least 3,281 meters (10,000 feet) downgradient of the former tailings area. Approximately 2.27 million cubic meters (2.97 million cubic yards) of groundwater beneath the site are contaminated with molybdenum, nitrate, selenium, uranium, net gross alpha, radium, antimony, fluoride, strontium, sulfide, vanadium, and zinc. The groundwater was contaminated by the former vanadium and uranium ore processing operations and potentially by additional infiltration of groundwater contaminants until surface remediation was complete in 1995. Results of groundwater quality sampling in the Rifle (New) Mill vicinity generally indicate that contaminants continue to migrate southwest toward the Colorado River. However, the Colorado River has not been affected. Groundwater at the site has been determined a nondrinking water source and will undergo natural attenuation until the site meets U.S. Environmental Protection Agency (EPA) standards (up to 100 years).

The proposed compliance strategy to cleanup the alluvial groundwater at the site is groundwater remediation of only those constituents that pose a potential risk or exceed the EPA standards. In addition, DOE will seek the establishment of alternate concentration limits for selected constituents. A pilot study for vanadium contamination will be performed to determine whether vanadium will naturally flush or whether active remediation will be required. DOE assumes that natural attenuation will remediate the groundwater or that alternate concentration limits for selected constituents will be established, and that active remediation is not required.

2.0 SITE WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

DOE is responsible for groundwater remediation, long-term stewardship, and funding for the Rifle (New) Mill. The site was acquired by the State of Colorado, as specified by UMTRCA. However, the site has since been transferred to the community. DOE will continue to conduct annual groundwater monitoring until 2050. The land can only be used for public purposes, such as parks, golf courses, or open space. No drilling or other intrusive activities are allowed on the property unless approved by DOE. The site records for the Rifle (New) Mill are kept in permanent storage at the DOE Grand Junction Office in Colorado. The types of records that are kept include the characterization data, remedial action design, completion report, groundwater compliance plan, annual inspection reports, and groundwater monitoring results.

STAKEHOLDER INTERACTION

Stakeholder meetings have been held recently to establish institutional controls. Copies of the annual sampling results and other project documentation for the Rifle (New) Mill are distributed to the local library and to any stakeholders that request copies. The report is also published on the DOE Grand Junction Office website at www.doegipo.com.

2.2 Specific Long-Term Stewardship Activities

Groundwater

Responsibility for the Rifle (New) Mill will transfer from DOE's Uranium Mill Tailings Remedial Action Groundwater Project to the Long-Term Surveillance and Maintenance Project in 2008. DOE will continue with characterization and modeling through 2010, and then will only perform routine sampling every 5 years. Institutional controls prohibit some groundwater uses during the natural attenuation period, and groundwater monitoring is conducted to observe the progress of remediation. The municipal water distribution system has been extended to area residences and businesses.

2.3 Regulatory Regime

The *Uranium Mill Tailings Radiation Control Act of 1978* (UMTRCA) authorized DOE to care for the uranium mill tailings disposal sites under a general license issued by NRC for the long-term care of residual radioactive material disposal cells. However, for the actual processing site where the residual radioactive materials were relocated off the processing site, NRC will not license the site. Compliance with EPA ground water standards will require NRC concurrence.

Long-term stewardship of the Rifle (New) Mill is governed by several requirements in the following regulations: the UMTRCA; the *Atomic Energy Act of 1954,* as amended; EPA Groundwater Protection Standards, including Subparts B and C of Title 40 of the *Code of Federal Regulations*, Part 192; a cooperative agreement between DOE and the State of Colorado; and the *National Environmental Policy Act of 1969,* as amended.

2.4 Assumptions and Uncertainties

DOE assumes that natural attenuation will remediate the groundwater or that alternate concentration limits for selected constituents will be established; and that active remediation is not required. Groundwater monitoring will continue until 2050 or until cleanup levels are achieved.

3.0 ESTIMATED LONG-TERM STEWARDSHIP COSTS

The following table shows the estimated costs of the long-term surveillance and monitoring program for DOE's

Grand Junction Office. Currently, DOE is conducting annual groundwater sampling to characterize and model the extent of contamination. After fiscal year (FY) 2010, DOE will only perform routine sampling every five years. The site is currently funded through the Uranium Mill Tailings Remedial Action Ground Water Project. In FY 2008, DOE's Long-Term Surveillance and Maintenance Program will continue, with characterization and modeling through FY 2010, and then will only perform routine sampling every five years. Cost estimates reflect the current site agreements and monitoring frequencies.

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	***Amount***	***Year(s)***	***Amount***	***Year(s)***	***Amount***
FY 2000	$0	**FY 2008**	$161,700	**FY 2036-2040**	$3,200
FY 2001	$0	**FY 2009**	$160,300	**FY 2041-2045**	$3,100
FY 2002	$0	**FY 2010**	$135,300	**FY 2046-2050**	$3,200
FY 2003	$0	**FY 2011-2015**	$2,800	**FY 2051-2055**	$3,100
FY 2004	$0	**FY 2016-2020**	$2,800	**FY 2056-2060**	$3,200
FY 2005	$0	**FY 2021-2025**	$2,800	**FY 2061-2065**	$3,100
FY 2006	$0	**FY 2026-2030**	$3,200	**FY 2066-2070**	$3,200
FY 2007	$0	**FY 2031-2035**	$3,100		

4.0 FUTURE USES

The site was acquired by the State of Colorado before remediation commenced and has since been transferred to the local government. The City of Rifle's future comprehensive growth plan zones the land within the Rifle (New) Mill boundaries "Commercial/Service Cluster." This designation would allow for a western park; county fairgrounds; year-round recreational, educational, and agricultural facilities; a park trail to the visitor center and downtown; and/or wetland/recreation/wildlife enhancement use at a future date if the City of Rifle annexes the property. The State of Colorado has imposed land use restrictions which require state notification and approval of surface penetrations; DOE will continue to have access to the site to continue the Uranium Mill Tailings Remedial Action Ground Water Project.

For more information about the Rifle (New) Mill, please contact:

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RIFLE (OLD) MILL

1.0 SITE SUMMARY

1.1 Site Description and Mission

> ***LONG-TERM STEWARDSHIP HIGHLIGHTS***
>
> *Major Long-Term Stewardship Activities* - passive groundwater remediation and monitoring
> *Total Site Area* - 10 hectares (23.6 acres)
> *Estimated Volume of Residual Contaminants* - groundwater 265,000 cubic meters (346,600 cubic yards)
> *Long-Term Stewardship Start-End Years* - 1995-2050
> *Average Annual Long-Term Stewardship Cost FY 2000-2006* - n/a (costs begin in FY 2008)
> *Landlord* - U.S. Department of Energy, Grand Junction Office

The Rifle (Old) Mill is the location of a former vanadium and uranium milling site that operated from 1924 through 1958. The site is located in western Colorado, approximately 0.5 kilometers (0.3 miles) east of the city of Rifle in Garfield County, Colorado. The ten-hectare (23.6- acre) site is accessible by U.S. Highway 6.

The milling operations created process-related waste and tailings. Initially, the tailings were left on the site in a pile that covered approximately five hectares (13 acres) of land and had steep side slopes rising to a height of about ten meters (33 feet). The U.S. Department of Energy (DOE) completed surface remediation of the abandoned uranium mill tailings and other contaminated surface radioactive material associated with the former milling operation in 1995. The former processing site is currently covered and regraded with clean fill material and reseeded with range grasses.

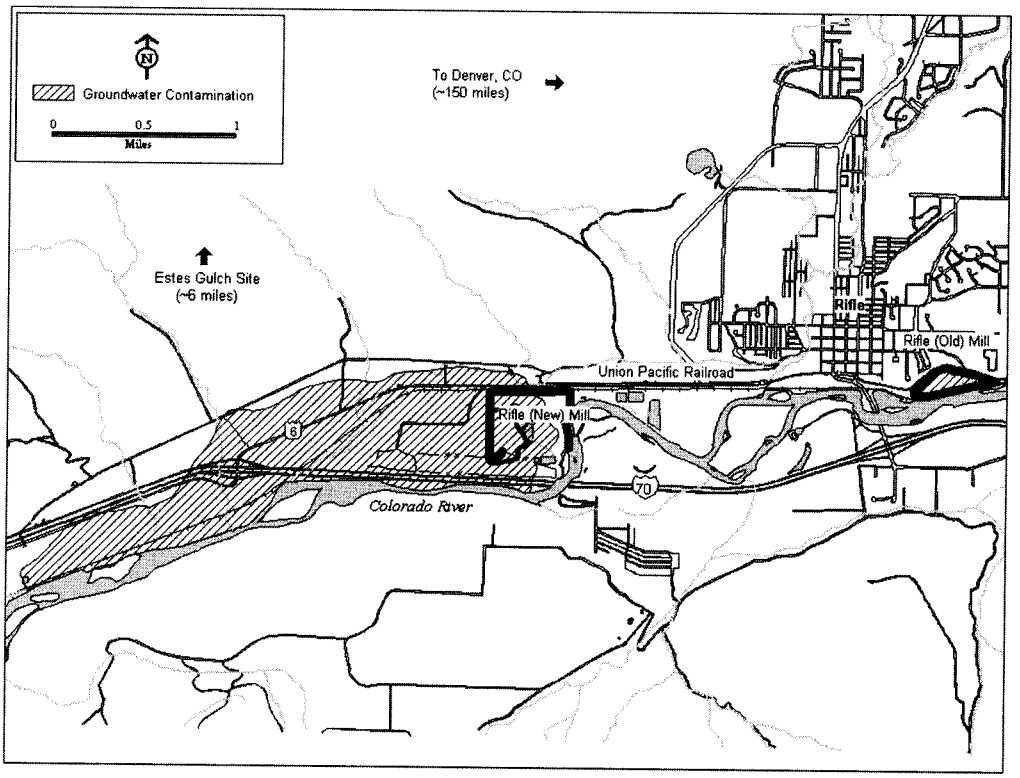
DOE's current mission at the Rifle (Old) Mill is long-term stewardship, including monitoring of passive groundwater remediation at the former mill site. The former mill site is subject to Title I of the *Uranium Mill Tailings Radiation Control Act of 1978* (UMTRCA). As such, DOE is responsible for remediation and long-term stewardship activities.

The original mission at the Rifle (Old) Mill was to provide uranium for the United States Government. The Standard Chemical Company constructed the original Old Rifle processing plant in 1924. The operation was purchased by United States Vanadium Company (a successor to Union Carbide Corporation) in 1928. The plant closed in 1932 as a result of an ore shortage. In 1942, Union Carbide reactivated the plant for vanadium production, and in 1946 the plant was modified to include the recovery of uranium by a sulfuric and hydrochloric acid leaching process. Operations continued until 1958.

1.2 Site Cleanup and Accomplishments

DOE completed remediation of surface contamination at the Rifle (Old) Mill in 1995. Prior to DOE's surface remedial action, approximately five hectares (13 acres) of tailings remained at the mill site. The relatively flat tailings pile had been partially stabilized by Union Carbide in 1967 in accordance with the State of Colorado regulations. The edge of the pile was moved away from the railroad tracks and the entire pile was covered with six inches of soil, fertilized, and seeded with native grasses. Surface water draining from an upgradient seep across Highway 6 flowed through the site. The seep water collected in a lined pond after it passed the tailings pile. Overflow from the pond was released into the Colorado River.

The tailings were removed, the pond was drained, and the sediments were removed by DOE during the surface remedial action. The contaminated surface material, excavated to U.S. Environmental Protection Agency (EPA) standards, was transported approximately 14 kilometers (9 miles) to the Estes Gulch Disposal Cell for long-term disposal.



Rifle (Old) Mill

As a result of the former vanadium and uranium ore-processing operations, groundwater beneath the Rifle (Old) Mill was also contaminated. Contaminants were most likely discharged into the Colorado River, a short distance southwest of the site. Approximately 265,000 cubic meters (346,600 cubic yards) of groundwater are contaminated. However, results of the recent *Rifle Baseline Risk Assessment* indicate that uranium processing activities have not impacted domestic wells north of United States Highway 6.

Groundwater at the Rifle (Old) Mill is not a drinking water source and will undergo natural flushing until the site meets EPA standards (within 100 years). Site-specific field investigations revealed that the alluvial aquifer and the semi-confined strata aquifer of the Wasatch Formation were affected by the former milling operations. The constituents of concern in the alluvial aquifer are arsenic, selenium, uranium, and vanadium. Uranium is the most prevalent site-related contaminant in the site's groundwater.

DOE's goal is to implement a cost-effective strategy to remediate the groundwater at the former Rifle (Old) Mill that protects human health and the environment, and complies with EPA groundwater standards. The proposed compliance strategy to clean up the alluvial groundwater at the Rifle (Old) Mill is to perform groundwater remediation only of those constituents that pose a potential risk and/or exceed EPA standards through natural attenuation (i.e., natural flushing) in combination with establishing institutional controls.

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

DOE began groundwater restoration activities at the Rifle (Old) Mill in 1998, after the remedial action of the surface contamination was complete in 1995. DOE will continue to conduct annual groundwater monitoring until 2050. No drilling or other intrusive activities are allowed within the property unless approved by DOE. The site records are kept in permanent storage at the DOE Grand Junction Office in Grand Junction, Colorado. Types of records kept include characterization data, remedial action design, the completion report, the groundwater compliance plan, annual inspection reports, and groundwater monitoring results.

2.2 Specific Stewardship Activities

Groundwater

Responsibility for groundwater remediation and maintenance of institutional controls will pass from DOE's Uranium Mill Tailings Remedial Action Groundwater Project to the Long-Term Surveillance and Maintenance Program in 2008. DOE will continue with characterization and modeling through 2010, and then will only perform routine sampling every 5 years. Institutional controls, in the form of deed restrictions, prohibit some groundwater uses during the natural flushing period, and groundwater monitoring is conducted to observe the progress of remediation. The municipal water distribution system has been extended to area residences and businesses.

STAKEHOLDER INTERACTION

Stakeholder meetings have been held recently to establish institutional controls. Copies of the annual sampling results and other project documentation for the Rifle (Old) Mill are distributed to the local library and to any stakeholders that request copies. The report is also published on the DOE Grand Junction Office website at www.doegipo.com.

2.3 Regulatory Regime

The *Uranium Mill Tailings Radiation Control Act of 1978* (UMTRCA) authorized DOE to care for the uranium mill tailings disposal sites under a general license issued by NRC for the long-term care of residual radioactive material disposal cells. However, for the actual processing site where the residual radioactive materials were relocated off the processing site, NRC will not license the site. Compliance with EPA ground water standards will require NRC concurrence.

Long-term stewardship activities at the Durango Mill are governed by several requirements in the following regulations: UMTRCA; the *Atomic Energy Act of 1954,* as amended; EPA Groundwater Protection Standards, including Subparts B and C of Title 40 of the *Code of Federal Regulations*, Part 192; a cooperative agreement between DOE and the State of Colorado; and the *National Environmental Policy Act of 1969,* as amended.

2.4 Assumptions and Uncertainties

DOE assumes that groundwater remediation can be accomplished through natural attenuation and that active remediation is not required. Groundwater monitoring will continue until 2050 or until cleanup levels are achieved.

3.0 ESTIMATED LONG-TERM STEWARDSHIP COSTS

The following table shows the estimated costs of the Long-Term Surveillance and Monitoring Program for DOE's Grand Junction Office. Currently, DOE is conducting annual groundwater sampling to characterize and model the extent of contamination. After fiscal year (FY) 2010, DOE will only perform routine sampling every

five years. The site is currently funded through the Uranium Mil Tails Remedial Action Ground Water Project. In FY 2008, the Long-Term Stewardship and Maintenance Program will continue, with characterization and modeling through FY 2010, and then will only perform routine sampling every five years. Cost estimates reflect the current site agreements and monitoring frequencies.

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	***Amount***	***Year(s)***	***Amount***	***Year(s)***	***Amount***
FY 2000	$0	**FY 2008**	$80,800	**FY 2036-2040**	$1,600
FY 2001	$0	**FY 2009**	$80,100	**FY 2041-2045**	$1,600
FY 2002	$0	**FY 2010**	$67,700	**FY 2046-2050**	$1,600
FY 2003	$0	**FY 2011-2015**	$1,400	**FY 2051-2055**	$1,600
FY 2004	$0	**FY 2016-2020**	$1,400	**FY 2056-2060**	$1,600
FY 2005	$0	**FY 2021-2025**	$1,400	**FY 2061-2065**	$1,600
FY 2006	$0	**FY 2026-2030**	$1,600	**FY 2066-2070**	$1,600
FY 2007	$0	**FY 2031-2035**	$1,600		

4.0 FUTURE USES

The site was originally deeded to the State of Colorado, as specified by UMTRCA. Since then, the State of Colorado transferred ownership of the site to the local government for public use with restrictions. The land can only be used for public purposes such as parks, golf courses or open space. Through an agreement, DOE continues to have access to the site for groundwater monitoring purposes.

For more information about the Rifle (Old) Mill, please contact:

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or visit the Internet website at http://www.doegjpo.com

RIO BLANCO

1.0 SITE SUMMARY

1.1 Site Description and Mission

The Rio Blanco site occupies approximately 10 hectares (25 acres) and is located 58 kilometer (36 miles) northwest of Rifle, Colorado. The U.S. Atomic Energy Commission (AEC), which later became the Department of Energy (DOE), conducted the Rio Blanco test under the Plowshare Program, which was a series of nuclear and conventional tests to explore peacetime uses of nuclear detonations. The test consisted of the nearly simultaneous detonation of three 33-kiloton nuclear devices in May 1973, at depths of 1,780 meters (5,838 feet), 1,899 meters (6,230 feet), and 2,039 meters (6,689 feet). The Rio Blanco test which was designed to increase natural gas production from low-permeability sandstone, was the third and final gas production experiment in the Plowshare Program.

LONG-TERM STEWARDSHIP HIGHLIGHTS

Major Long-Term Stewardship Activities - groundwater monitoring; enforcing restrictions for access to and use of the subsurface
Total Site Area - 10 hectares (25 acres)
Estimated Volume of Residual Contamination - unknown
**Surface Long-Term Stewardship Start-End Years* - 2006-in perpetuity
**Subsurface Long-Term Stewardship Start-End Years* - 2009-in perpetuity
Average Annual Long-Term Stewardship Cost FY 2000-2006 - $38,000
Landlord - U.S. Department of Interior
*For purposes of this report, long-term stewardship activities for the surface will begin when surface remediation is complete in 2006. However, DOE recognizes that subsurface investigation and modeling activities will continue beyond the surface completion date.

The Rio Blanco site is currently managed by the Department of the Interior. The only ongoing DOE mission at the site is to complete environmental restoration of surface areas and to continue long-term stewardship of residual subsurface contamination.

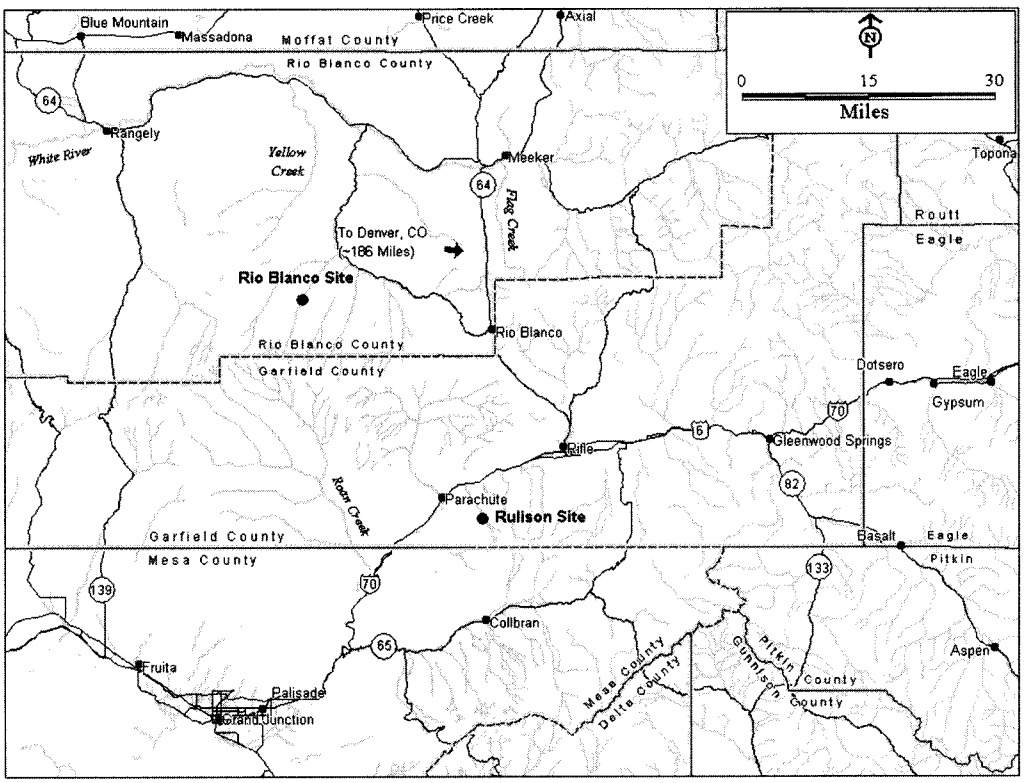
1.2 Site Cleanup and Accomplishments

As a result of testing activities, areas of the subsurface and surface were contaminated. The potential subsurface contaminants of concern are mixed fission products, plutonium, uranium, and tritium. DOE will use site assessment activities, such as modeling and characterization data, to determine the extent of subsurface contamination and to refine, if warranted, the existing subsurface intrusion restrictions. DOE will continue to impose institutional controls to restrict access to the subsurface contamination in perpetuity. DOE assumes that natural gas is the primary contaminant migration pathway at the site. A natural gas reservoir and subsurface condition analysis will be conducted to obtain data for modeling the subsurface contamination. DOE does not plan to remediate the subsurface contamination because of the lack of viable technologies for removing the site's subsurface contamination. However, DOE will complete the following activities prior to closure of the subsurface in 2009:

- Characterize the natural gas contaminant migration pathway;
- Develop a subsurface model to analyze subsurface conditions at the site;
- Assess risk associated with subsurface contamination;
- Determine contaminant fate and transport based on the data available;
- Establish a compliance boundary to refine subsurface intrusion restrictions, if warranted; and
- Negotiate the final closure actions with the regulators and stakeholders.

Four mud pits, one gas flaring facility, four shaker pad areas, two disposal trenches, three leachfields, and three underground storage tanks may have some contamination. Contaminants of concern at the surface of these areas

include petroleum hydrocarbons from diesel and drilling additives, metals, and radionuclides. DOE conducted some surface remediation at the site in 1976. At that time, some surface contamination was excavated and transported to the Nevada Test Site for disposal. DOE will continue characterization of the surface areas, and any surface contamination will either be clean-closed, closed in place and covered with an engineered cap, or left in place to naturally degrade, depending on the potential risk to human health or the environment.



Rio Blanco

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

Surface remediation will be complete and institutional controls, if necessary, will be in place by 2006 for the long-term stewardship of the surface. DOE will continue to investigate and model subsurface contamination, which is not expected to be complete until 2009. Existing subsurface intrusion restrictions will be refined, as necessary, based on the outcome of the investigation and modeling efforts.

DOE will not maintain an active presence at this site but will be responsible for monitoring and maintaining institutional controls over the residual surface and subsurface contamination. Final stewardship requirements for the site will be negotiated with the Department of Interior and the State of Colorado. Periodic monitoring will be conducted to ensure that there is no contaminant migration from the test cavity to the groundwater.

DOE maintains the project-specific records at the Nevada Operations Office in Las Vegas, Nevada. These

records include corrective action investigation work plans and reports; corrective action decision documents; health assessments; risk assessments; information submitted by the public; National Environmental Policy Act documents; and the Public Involvement Plan. The DOE Public Reading Facility and the Nevada Division of Environmental Protection Administrative Record are provided with copies of these documents. Upon the completion of the project, all DOE project files will be transferred to controlled storage at the Nevada Operations Office in Las Vegas, Nevada. Records are retained according to DOE records retention procedures.

STAKEHOLDER INVOLVEMENT

Public participation at Rio Blanco is project-specific and defined by the needs and interests associated with each project. At the initiation of project work, DOE identifies the relevant state regulators, federal agencies, tribal governments, interest groups, and stakeholders expected to have an interest in the project and the site. Issues of interest and concern and key decision points are identified with stakeholders to determine the means by which public involvement will occur. Although the construct of this process is similar for different DOE sites, the implementation can be highly variable, as each is tailored to the specific needs of each site. These opportunities for stakeholder involvement might include the following: public hearings, town halls meetings, public workshops, informational and technical briefings, site tours, and document reviews.

2.2 Specific Long-Term Stewardship Activities

Groundwater

DOE will maintain institutional controls, including a subsurface intrusion restriction, over the subsurface in perpetuity to prevent access to the test cavity, groundwater, and associated subsurface contamination. In addition, a monument has been placed at the site to mark the location of the test cavity. DOE will continue to conduct annual groundwater monitoring at the site for at least 100 years after closure of the subsurface in 2009, and will repair or replace groundwater monitoring wells every 25 years. At the end of the post-closure groundwater monitoring period in 2109, the monitoring wells will be plugged and abandoned in place in accordance with state regulations.

Soil

Contaminated surface areas that are left in place to naturally degrade will require annual monitoring of the surface conditions. Areas closed in place with engineered caps will likely require institutional controls to restrict access to the residual contamination. The specific long-term stewardship activities for the surface areas will be detailed in the site closure report, but may also include visual inspections, cap monitoring and maintenance, information management, and environmental monitoring activities.

2.3 Regulatory Regime

In accordance with applicable regulatory drivers listed below, DOE is responsible for identifying the nature and extent of contamination, determining potential risk to the public and the environment, and performing the necessary corrective actions in compliance with guidelines and requirements under federal regulatory drivers, as well as the state-specific regulatory drivers associated with the site location.

Resource Conservation and Recovery Act (RCRA): RCRA was the first comprehensive federal effort to deal with solid and hazardous waste and regulates the generation, transportation, treatment, storage, and disposal of hazardous waste. At Rio Blanco, RCRA is enforced to protect human health and the environment; conserve energy and natural resources; reduce the amount of generated waste; and ensure that wastes are managed in an environmentally sound manner.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA): CERCLA supplies a system for identifying and providing corrective action to sites where hazardous substances have been released

into any part of the air, water, groundwater, or land. Provisions of CERCLA include a National Contingency Plan, which establishes procedures for corrective action for hazardous substance releases. Rio Blanco is not regulated under CERCLA; however, the regulations are useful as developmental guidelines.

In addition to federal regulations, DOE must comply with state regulatory requirements in Colorado. In most cases, State of Colorado requirements are based on federal guidelines; however, in specific cases they may be more detailed and stringent than federal regulations.

Nuclear Regulatory Commission (NRC): NRC regulations establish "free release" criteria. Rio Blanco is not regulated under the NRC; however, the regulations are useful as developmental guidelines.

2.4 Assumptions and Uncertainties

DOE has not yet fully characterized the contamination, and long-term stewardship activities have not yet been finalized with the regulators. Therefore, long-term stewardship activities and associated costs may change, depending on final agreements.

DOE does not plant to remove subsurface contamination in and around the test cavities. However, DOE will develop subsurface models and use them to define the contaminant boundary and refine the existing subsurface intrusion restrictions, if necessary. Post-closure monitoring will be conducted, as agreed upon in the site closure reports for the subsurface. The schedule for groundwater monitoring after closure of the subsurface will be defined in the subsurface closure report. DOE assumes monitoring will be performed for 100 years (2009-2109).

DOE assumes that current land use designations and subsurface intrusion restrictions will continue into the foreseeable future. However, DOE will reevaluate and modify the subsurface restrictions, as appropriate, as part of the assessment and/or corrective action activities.

3.0 Estimated Long-Term Stewardship Costs

The cost profile in the table below applies to the entire Rio Blanco site. The major long-term stewardship costs are associated with monitoring activities, data analysis, and repair and replacement of monitoring wells. Repairing or replacing monitoring wells are estimated to require maintenance every 25 years.

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	***Amount***	***Year(s)***	***Amount***	***Year(s)***	***Amount***
FY 2000	$27,000	**FY 2008**	$40,000	**FY 2036-2040**	$272,000
FY 2001	$40,000	**FY 2009**	$40,000	**FY 2041-2045**	$272,000
FY 2002	$40,000	**FY 2010**	$40,000	**FY 2046-2050**	$272,000
FY 2003	$40,000	**FY 2011-2015**	$272,000	**FY 2051-2055**	$272,000
FY 2004	$40,000	**FY 2016-2020**	$272,000	**FY 2056-2060**	$272,000
FY 2005	$40,000	**FY 2021-2025**	$272,000	**FY 2061-2065**	$272,000
FY 2006	$40,000	**FY 2026-2030**	$272,000	**FY 2066-2070**	$272,000
FY 2007	$40,000	**FY 2031-2035**	$273,000	**Post FY 2070**	$2,000,000

The long-term stewardship costs for the Rio Blanco site remain roughly constant at $40,000 annually. The cost increase from $27,000 in FY 2000 to $40,000 in FY 2001 is the result of the costs associated with the new Real Estate Operations Permit (RE-OP) requirements. DOE projects that the total post-2070 (2071-2109) costs will be approximately $2 million dollars.

4.0 FUTURE USES

The anticipated future use for the surface area (25 acres) is open space. Deed restrictions will prevent access to the test cavities, subsurface soil, natural gas, and groundwater in perpetuity.

For additional information about the Rio Blanco site, please contact:

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ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

1.0 SITE SUMMARY

1.1 Site Description and Mission

The Rocky Flats Environmental Technology Site is a former nuclear weapons production facility located approximately 24 kilometers (15 miles) northwest of Denver, Colorado. The U.S. Department of Energy (DOE) owns and operates the site, which encompasses 2,536 hectares (6,266 acres).

> ***LONG-TERM STEWARDSHIP HIGHLIGHTS***
>
> *Major Long-Term Stewardship Activities* - maintain Buffer Zone and Industrial Area institutional controls; conduct surveillance and maintenance of engineered units, if needed, within the site; and conduct groundwater, surface water, soil, and air quality monitoring in Industrial Area and Buffer Zone.
> *Total Site Area* - 2,536 hectares (6,266 acres)
> *Estimated Volume of Residual Contaminants* - to be determined
> *Long-Term Stewardship Start-End Years* - 2007-time period to be specified under CERCLA process
> *Average Annual Long-Term Stewardship Cost Post FY 2006* - $6.1 million
> *Landlord* - U.S. Department of Energy

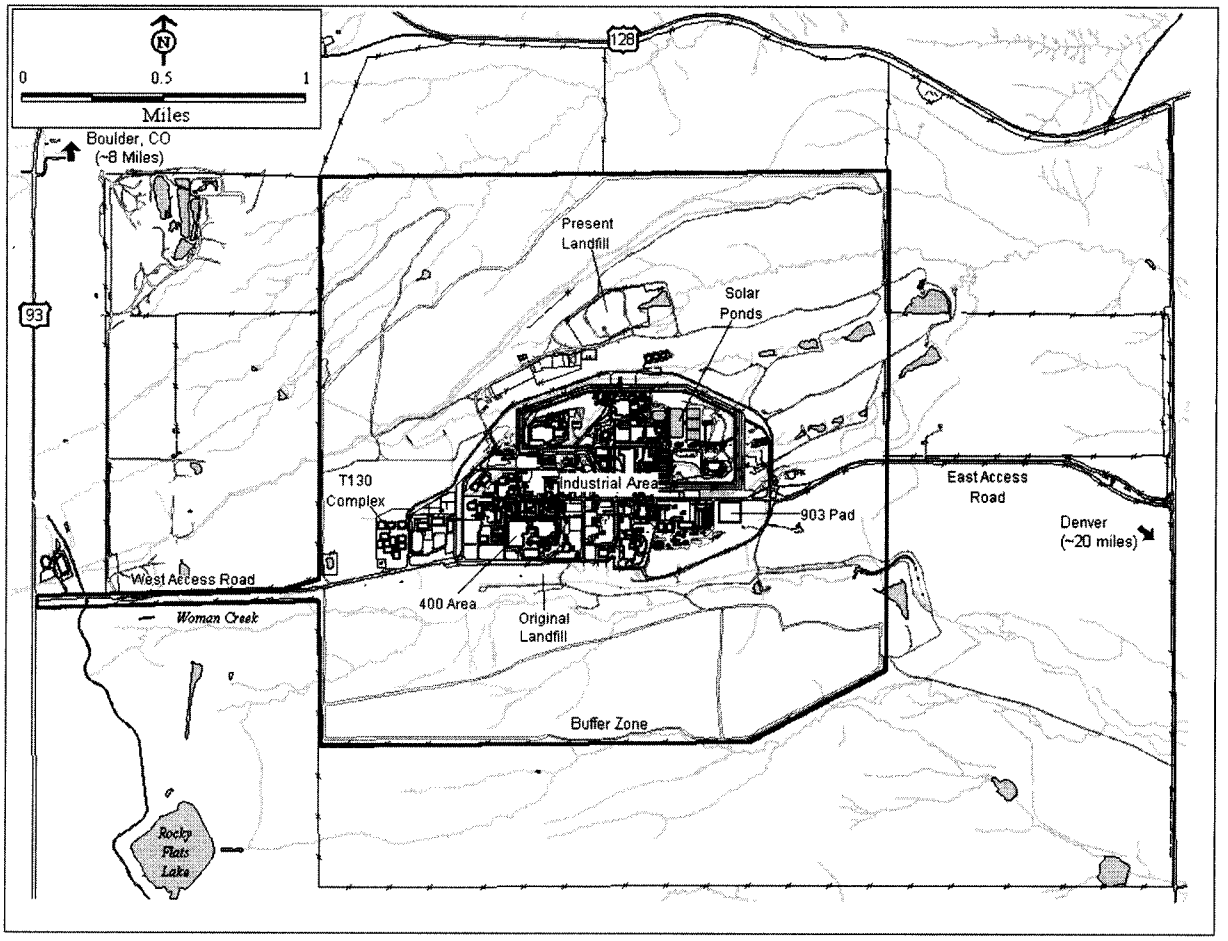
DOE expects to complete site environmental remediation and officially close the site by the end of 2006. The Rocky Flats Closure Project is based on completing the cleanup activities regulated by the Rocky Flats Cleanup Agreement (RFCA), signed by DOE, the Colorado Department of Public Health and Environment (CDPHE), and the U.S. Environmental Protection Agency (EPA) in 1996. Completion of the Closure Project will result in most surface buildings and structures being torn down by 2006, after which long-term stewardship activities will commence for the entire site. After closure, and consistent with inputs from stakeholders and community interest groups, DOE assumes that the entire site will be restricted to "open space" use, although final land use decisions have not been made. The RFCA requires a consultative process involving community interest groups, stakeholders and regulators for cleanup decisions that are dependent on land use assumptions. This process is ongoing at the present time. Currently, the Interim Soil Action Levels agreed to by the parties that were signatories to the RFCA are based on "open space" land use. Additionally, DOE intends to meet its obligations to perform any required National Environmental Policy Act (NEPA) analysis for land use decisions.

To address cleanup, DOE divided the Rocky Flats Environmental Technology Site into two zones, the Industrial Area and the Buffer Zone. Existing facilities at the site are located on approximately 160 hectares (395 acres) of the site's 2,536 hectares (6,266 acres). These 160 hectares (395 acres) are referred to as the Industrial Area. A 2,376-hectare (5,871-acre) prairie-terrain area, referred to as the Buffer Zone, surrounds the Industrial Area. The original site facilities comprised more than 700 buildings and structures that were built to support its weapons production mission. Of these, there were originally approximately 400 buildings located in the Industrial Area.

Construction of the Rocky Flats Environmental Technology Site began in 1951, and site operations commenced in 1952. From 1952 to 1989, the site's historic mission was to produce nuclear weapons components and assemblies manufactured from uranium, plutonium, beryllium, stainless steel, and other metals. Production activities included metalworking, component fabrication and assembly, and plutonium recovery and purification. To support these missions, the site also conducted research and development in the fields of chemistry, physics, metallurgy, materials technology, nuclear safety, and mechanical engineering.

Weapons production activities resulted in the contamination of buildings and environmental media with chemical and radioactive substances. In addition, large quantities of special nuclear material and plutonium residues, transuranic waste, and other radioactive and hazardous waste remain on the site. In 1989, many of the Rocky

Flats Site's nuclear production functions were suspended after a safety review, conducted under the auspices of the Federal Bureau of Investigation and the EPA, temporarily shut down plutonium operations. The entire site was listed on the *Comprehensive Environmental Response, Compensation and Liability Act* (CERCLA) National Priorities List in 1989. Following an extensive review, limited plutonium production activities resumed until January 1992, when all nuclear production terminated. All non-nuclear production activities at the site ceased in October 1994.



Rocky Flats Environmental Technology Site

The site's current mission began in October 1994, and focuses on site cleanup, remediation, and closure of the entire site by 2006, after which DOE will begin conducting long-term stewardship activities. Long-term stewardship activities will maintain an adequate level of human health and environmental protection from hazards remaining after cleanup is complete, consistent with the RFCA. Past cleanup activities, however, commenced in 1989 and some were included in regulatory agreements as early as 1985.

DOE's Rocky Flats Field Office (RFFO) has recently entered into a new (effective date, February 1, 2000) Cost Plus Incentive Fee (CPIF) contract with the site contractor (Kaiser-Hill) to accelerate and complete the cleanup and closure of the site by December 15, 2006, at a target cost of $3.96 billion. The cleanup of the site is structured as one project, the aforementioned Rocky Flats Closure Project. The plan to clean up and close the site by the end of 2006 is described in the Closure Project Baseline (CPB), a bottom-up, activity-based, life-cycle

project baseline. The Closure Project Baseline for implementing this contract has been delivered to the RFFO on June 30, 2006. Although this Closure Project Baseline does not address long-term stewardship activities that the site will enter into starting on or about calendar year 2007, this Closure Project Baseline describes a changed strategy for closure. An example of such a change, that which impacts long-term stewardship activities, is the number of "closure caps" or engineered barriers required by the Final End State envisioned in DOE's strategic planning document, *Accelerating Cleanup, Paths to Closure, Rocky Flats Environmental Technology Site, June 1998*. The new Closure Project Baseline assumes that three closure caps will be installed over the Solar Ponds, the Original Landfill and the Present Landfill, respectively.

Concurrent with the site contractor's efforts to comply with the terms of the new closure contract, the RFFO has initiated the necessary planning and dialogue with the local community for long-term stewardship. It must be pointed out, however, that long-term stewardship planning is in its embryonic stages at present. As reiterated in DOE's strategic planning document referenced above, the "Final End State for the site has yet to be determined." The final end state would necessarily dictate the type and extent of long-term stewardship activities. The RFCA envisions the site to enter into dialogue with the local stakeholder community and regulators to determine the final end state for the site. This dialogue also is ongoing. Both RFCA and the Paths to Closure document referenced above recognize that... "Additional cleanup and removal activities may be conducted as funding, technology and political opportunities allow. While recognizing that some members of the public prefer cleanup to background levels, the DOE, the EPA and the CDPHE are currently unable to commit to this goal. These Agencies will continue to explore new technologies to make further cleanup possible. The agencies have agreed to avoid taking actions that would, as a practical matter, preclude further cleanup in the long-term future. Activities beyond this document's intermediate site condition are to be determined, and are therefore not described."

It must be emphasized that, for long-term stewardship purposes, the Rocky Flats Environmental Technology Site is considered to be "one portion." This is a functional decision predicated on technical as well as economic considerations. Various groupings of cleanup and closure activities (usually referred to as sub-projects of the Closure Project) are all scheduled to be completed in a similar time frame -- that is, by the end of 2006. This will enable the entire site (including both the Industrial Area and the Buffer Zone) to enter into long-term stewardship at about the same time, supporting the concept to treat the site as one portion. Any remaining contamination (after RFCA prescribed cleanup standards are met) would have been derived from similar sources, would be closely located, and would be subject to similar types of long-term stewardship activities. DOE recognizes that the remaining contamination, if any, may indeed be spread across various media, such as groundwater, soils and facility foundations. However, the planned long-term stewardship activities (such as monitoring, maintenance, surveillance, among others) are assumed to be similar for all media types within the "one portion" site. Additionally, DOE believes that managing the site as one portion is more cost-effective than multiple portions, in due diligence to responsible stewardship of taxpayer funds. All of these arguments support the designation of the site as "one portion." However, DOE does not wish to preclude the need for additional portions in the future if additional information and/or the RFCA consultative process so indicate.

1.2 Site Cleanup and Accomplishments

ROCKY FLATS CLOSURE GOALS

- Complete cleanup and closure of the site by 2006
- Remove all wastes and special nuclear material
- Remove all buildings and surface structures

DOE expects to complete cleanup and closure of the site by the end of 2006, as evidenced by the terms of the new closure contract with Kaiser-Hill, after which the site will start long-term stewardship in 2007. Completion of the Closure Project will include removal of all wastes and special nuclear materials from the site, removal of all surface structures from the site, and implementation of all site remediation activities. It is assumed that the entire site will be designated and managed as open space for preservation of habitat, among other purposes. There are no buildings or surface structures

proposed to remain on the site, with the possible exception of those structures specifically needed for long-term environmental monitoring and stewardship activities consistent with open space uses. There is no proposed construction of new buildings or facilities on the site after closure. Access to the site will be controlled as specified by open space use decisions which, as stated earlier, have not been made at this point in time.

SITE CLEANUP ACCOMPLISHMENTS

- Transferred all plutonium pits offsite and completed shipments of enriched uranium to Oak Ridge.
- Drained and stabilized all plutonium bearing solutions in tanks.
- Commenced operating passive groundwater treatment systems for Solar Evaporation Pond Plume, East Trenches/Ryan's Pit Plume, and Mound site Plume.
- Completed removal of approximately 9,200 cubic meters (12,000 cubic yards) of pondcrete waste from the site.
- Shipped more than 11,222 cubic meters (14,500 cubic yards) of low level and mixed waste offsite.
- Packaged for shipment to WIPP about 60,000 kilograms (132,200 pounds) of plutonium residues (transuranic waste).
- Completed more than 20 shipments of transuranic waste to WIPP.
- Completed demolition of 10 buildings or 810 square meters (8,709 square feet), including Buildings 729, 779, 788, and 308A.

In July 1996, DOE, EPA Region VIII, and the CDPHE entered into the RFCA, which constitutes the Federal Facility Agreement and Consent Order under CERCLA for the site. The RFCA establishes the regulatory guidelines and framework for achieving site cleanup and closure and coordinates DOE's statutory compliance obligations under CERCLA, the *Resource Conservation and Recovery Act* (RCRA), and the Colorado Hazardous Waste Act into a single regulatory document. On September 10, 1999, Secretary Bill Richardson signed an agreement with Colorado Governor Bill Owens and three other State Governors designed to ensure the expedited cleanup and shutdown of the site and the availability of certain other DOE facilities to assist with closure. The CDPHE and the EPA approved a Standard Operating Protocol for Recycling Concrete, under the RFCA, in the last quarter of FY 1999. This protocol will be applied to each building cluster closure at the site.

The site remediation strategy is focused on closure and includes:

- Characterization and remediation of the Industrial Area.
- Comprehensive risk assessments that include the Buffer Zone and Industrial Area.
- Corrective Action Decision(s) and Record(s) of Decision (ROD) for the site, as well as for specific remediation and closure actions in accordance with the RFCA, RCRA and CERCLA.

In addition, each specific remediation and closure action requires a decision document and a closure report. Under the provisions of the Closure Project Baseline, remediation of the Industrial Area is being conducted first. Consistent with RFCA's risk-based priority, cleanup of the Buffer Zone will follow and may not be completed until about 2006. The RFCA Integrating Decision Document will be issued about the 2003 timeframe. This document will describe the entire range of cleanup activities and choice of remedial actions needed to close down the site. At the completion of all remedial actions and upon site closure, DOE will prepare a Final ROD to support the deletion of the site from the National Priorities List. The Final ROD is not expected to be published any sooner than the 2006 timeframe.

Decommissioning Activities

There were originally more than 700 buildings, facilities, and other structures at the site, more than 50 of which have already been demolished as part of site decommissioning activities. Approximately 90 percent of the potentially contaminated areas of the site that may require remediation are associated with buildings or supporting infrastructure that require decommissioning. These areas cannot be remediated until removal of the building or structure is substantially completed. Remediation activities and schedules are, therefore, integrated

with decommissioning activities in the Closure Project Baseline for the site. The Closure Project Baseline identifies and schedules decommissioning and environmental remediation activities to be conducted to achieve site closure.

Decommissioning (demolition) of surface buildings and structures completed to date include Buildings 729, 788, and 308A and 779. Of the remaining buildings on the site, 19 contain the majority of the special nuclear material, classified products, radioactive and hazardous inventories, and radioactive and chemical contamination. The remainder of the buildings and structures are uncontaminated or marginally contaminated support facilities. The final end state for the site (referenced earlier in Section 1.1) is based on removal of all surface buildings and structures, with the exception of engineered units. DOE currently assumes that onsite detention ponds could be converted to wetlands after closure.

SITE END STATE

Under the desired end state for the site, all wastes and special nuclear material currently stored at the site will be shipped offsite. All existing surface buildings and structures onsite will be demolished, except for water conveyance structures, groundwater treatment systems and engineered barriers, if installed.

Currently, there are no new buildings or structures proposed for construction on the site after closure, and the entire site is proposed to be managed as open space. Any final decisions on future land uses at the site will be subject to the public involvement process and the RFCA mandated consultative process. Foundations of certain buildings in the Industrial Area may need to be abandoned in place or capped.

Existing roads on the site will be abandoned in place or covered, and no existing roads will be maintained onsite after the site enters long-term stewardship. Only utilities and unimproved roads that are needed to support long-term stewardship monitoring activities and existing easements will remain on the site.

Environmental monitoring activities for long-term stewardship are proposed, for the most part, to be conducted using solar powered equipment or portable generators, and, therefore, the need for utility systems on the site to support long-term stewardship will be limited.

Site Remediation Strategies

There are four principal remedial strategies for the site, consistent with the RFCA. These strategies are no further action (i.e., no additional remediation); removal and offsite disposal (e.g., excavation of waste or soil and offsite shipment of nuclear material); construction of engineered units (i.e., caps and covers); and groundwater plume remediation. There are more than 60 Individual Hazardous Substance sites (IHSSs) onsite that are under consideration for classification as "No Further Action" and for which no additional remediation activities would be conducted. No Further Action IHSSs would be those for which analytical results do not exceed action levels established in the RFCA. One option for contaminated soil is removal and offsite disposal. For these IHSSs, contaminated soil is excavated and shipped in accordance with Waste Acceptance Criteria to an appropriate location for disposal offsite. In IHSSs where it is technically or economically not possible to remove contamination to less than action levels identified in the RFCA, an engineered unit will be constructed to manage the residual hazard associated with the area. Other remedial options, such as stabilization, also may be considered. These and other potential options will be evaluated with public input.

The DOE strategy for remediation of groundwater plumes is controlled by the unique geologic characteristics of the site, including shallow low-volume groundwater underlain by thick claystone with low hydraulic permeability. Groundwater moves generally from west to east across the site along the subsurface claystone layer; in the eastern area of the site, groundwater seeps appear in numerous places and generally flow near the surface of the site. Under the DOE groundwater remediation strategy for the site, the three groundwater plumes (Mound Site, East Trenches and the Solar Ponds plumes) that represent a potential imminent threat to surface water quality are being remediated with groundwater barriers and passive groundwater treatment systems. Further characterization of the other plumes may result in specification of additional barrier and treatment systems for any plumes found to pose an imminent threat to surface water. Of the three plumes mentioned above, the Solar Ponds plume may have migrated from the Industrial Area to the Buffer Zone.

A second part of the groundwater remediation strategy is to conduct removal actions to remove the source (generally buried waste) that is contributing to the plume contamination, if the source is still present and can be identified. In some cases, the source lies beneath buildings and structures and decommissioning actions must be completed prior to any removal actions. Groundwater plumes that do not pose an imminent threat to surface water may be managed by monitored natural attenuation, in which the contamination in the groundwater (e.g., volatile organic compounds) diminishes by natural processes rather than by active or passive treatment. Groundwater monitoring is conducted to monitor the progress of natural attenuation for these groundwater plumes. Surface water management on the site includes detention ponds and drainage ditches for which surface water and sediment concentration are to be monitored. One potential long-term strategy for surface water management is to convert the detention ponds to wetlands for sediment stabilization and wildlife habitat, thence to breach the dams to allow for a natural flow-through of water.

MAJOR ACTIVITY MILESTONES

Special Nuclear Materials

- All plutonium metal and highly enriched uranium metal shipped offsite by September 30, 2002.

Facility Deactivation, Decommissioning and Demolition

- All former special nuclear material buildings and supporting facilities deactivated, decontaminated and demolished by March 1, 2006; all remaining buildings and facilities by December 15, 2006.

Waste Management

- All transuranic and transuranic mixed waste; low-level waste and low-level mixed waste; sanitary waste; and RCRA-regulated hazardous waste shipped offsite by December 15, 2006.

Environmental Remediation

- All Individual Hazardous Substances Sites, Potential Areas of Concern, or under building contamination remediated by December 15, 2006.

Getting to Closure

DOE has developed a RFCA Integrating Decision Document (RIDD) strategy to integrate key project activities, regulatory decisions and key studies that will influence the actions and remedies identified in the RIDD and, subsequently, the Final ROD(s). Currently, DOE and the regulators have not achieved agreement for use of the RIDD and are in the process of discussing an acceptable term and scope for this RIDD.

DOE has already addressed or is scheduled to address most high-risk IHSSs at the site in accordance with the RFCA Environmental Remediation Ranking. Activities that have been completed or that are scheduled for completion by the end of 2006 in support of site closure include:

- construction of engineered barriers, if needed;
- dredging of a couple of site surface water detention ponds;
- construction and operation of three passive groundwater treatment well systems;
- removal of all surface buildings and structures from the site; and
- removal of all wastes and special nuclear materials from the site subject to negotiation and agreement with the regulators.

SITE RECORD OF DECISION

The new Rocky Flats Closure Project contract requires: "The contractor shall prepare a RFCA Integrating Decision Document (RIDD), submit it for DOE, EPA, and CDPHE approval, and complete all actions required by the approved RIDD to remediate soil, surface water, groundwater and other contaminated media." Present plans are for the RIDD to be developed in 2003. The RIDD will lead to a final ROD at the completion of site cleanup and remediation in 2006.

Challenges associated with closure of the site involve decommissioning of underground pipeline systems, including approximately 12,800 meters (42,000 linear feet) of underground process lines, 11,125 meters (36,500 linear feet) of sanitary sewer lines, and 239

storm drains. The key remediation strategy for underground lines is to remediate contaminated soil, process lines, and other pipelines, per RFCA provisions. The intent is to stabilize in place those segments of the lines with contamination levels below action levels identified in the RFCA. Because it is not clear where or when pipelines may have broken and leaked, characterization of the Industrial Area will focus on identifying contaminated soil and specific areas of concern, rather than on the integrity and precise location of each underground line.

Another challenge for cleanup and site closure is remediation of under-building contamination IHSS that have not been fully characterized. DOE has identified at least 31 of these IHSSs based on documented spills or releases, some of which are related to leaks from underground lines. Accurate drawings of buildings are not always available, and the location, length, and composition of the pipelines are not always known. Characterization of under-building contamination will begin during deactivation of the building. Technical challenges include developing sampling plans that identify underground lines, do not impact site utilities, and incorporate characterization needs associated with related contamination areas.

There are a total of eight contaminated groundwater plumes at the site, some within the Industrial Area and the rest within the Buffer Zone. These include the Mound Site Plume, East Trenches Plume, Solar Evaporation Ponds Plume, two Industrial Area Plumes, 881 Hillside Plume, 903 Pad/Ryan's Pit Plume, and PU&D Yard Plume. Groundwater contaminants for these plumes include volatile organic compounds, uranium, and nitrates. Passive groundwater treatment well systems are in operation for the East Trenches Plume, the Solar Evaporation Ponds Plume, and the Mound Site Plume. These systems are anticipated to remain in operation and will require periodic maintenance during the long-term stewardship period. The other groundwater plumes are being managed by monitored natural attenuation. Groundwater associated with all eight plumes is anticipated to require continued monitoring during the long-term stewardship period.

Groundwater treatment and monitoring systems will remain in operation in accordance with the RFCA until the concentration of contaminants in groundwater meets regulatory limits. DOE has not specified any time frame for achieving these goals. Cleanup levels for groundwater contamination, time frames for groundwater treatment system operation and monitored natural attenuation of groundwater will be established through processes conducted in accordance with the RFCA and documented in the ROD(s) for site closure and end state. The Final ROD(s) will not be completed until at least 2006 or later.

Detention Ponds were constructed on three surface water drainages from the Industrial Area, including North Walnut Creek, South Walnut Creek, and Woman Creek. These are referred to, respectively, as the "A-Series" ponds, "B-Series" ponds, and "C-Series" ponds. Two of the B-series ponds contain low levels of radionuclides and will likely be dredged to remove some of the sediments. Rocky Flats will rely on engineered systems to manage water over the long term. To the extent practicable, these engineered systems will take the form of passive systems that will be used to control in-stream flows and sediment loads. Such passive systems may include additional diversions incorporating features such as in-channel wetlands and lo-head dams, and the transition to passive systems may require upgrades to some of the existing ponds. Rocky Flats Environmental Technology Site has not ruled out the continued use of actively managed ponds such as those currently onsite, nor has it ruled out construction of additional ponds to protect offsite water quality, and will consider these if necessary. If practical, however, Rocky Flats Environmental Technology Site believes that well-designed passive systems will not only be protective, but will be cost-effective and consistent with our stakeholders' vision for future site use as open space. A Land Configuration Design Basis study, now underway, will help the site make informed choices in this area. In accordance with the RFCA, surface water leaving the site in Woman Creek and Walnut Creek will be of acceptable quality for all uses. Surface water onsite is required to meet standards set by the Colorado Water Quality Control Commission, except during the period of active remediation.

The site has large amounts of special nuclear material in various forms onsite. Special nuclear material consists

of plutonium metal and oxides, as well as enriched uranium metal and oxides. As of January 1996, the site's inventory consisted of 12.9 metric tons (14.2 tons) of plutonium (nearly 15,000 items) and 6.7 metric tons (7.4 tons) of highly enriched uranium in nuclear weapons parts, materials, process residues, and wastes stored onsite. Much of this material has been stored in temporary packaging since 1989, when production operations involving radioactive materials were suspended. DOE has significantly reduced the amount of special nuclear material onsite by completing the shipment of "pits" offsite, the shipment of highly enriched uranium (HEU) metal to Oak Ridge, Tennessee, and shipment of HEU solutions to Irwin, Tennessee. Numerous former production process buildings contain gloveboxes, instruments, machine tools, wells, floors, tanks, pipes, and ducts that are contaminated with radioactive and hazardous materials. Actual amounts of special nuclear material in the site's current inventory are classified data.

The site's current waste inventory includes:

- approximately 3,200 kilograms (7,100 pounds) of plutonium in transuranic waste residues;
- 3,000 cubic meters (3,900 cubic yards) of transuranic waste;
- 1,000 cubic meters (1,300 cubic yards) of transuranic mixed waste;
- 5,000 cubic meters (6,500 cubic yards) of low-level mixed waste;
- 14,000 cubic meters (18,000 cubic yards) of low-level waste; and
- 100 cubic meters (130 yards) of hazardous waste.

These inventory quantities are likely to increase as a result of decontamination and decommissioning activities and remediation activities, commensurate with progress made on the Closure Project. However, all waste (including that in the current inventory and that which is still to be generated) will be disposed offsite by the end of the Closure Project in 2006.

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

DOE assumes that the site will start long-term stewardship by the beginning of 2007. Stewardship activities related to cleanup of the site (for example, monitoring and maintenance of "caps") will be performed pursuant to the CERCLA post closure requirements. The end state for the final closure of the site and long-term stewardship activities will be documented in the CERCLA Final ROD(s) for the site, not likely any sooner than the 2006 time frame.

LONG-TERM STEWARDSHIP GOALS

Conduct long-term stewardship to maintain an adequate level of human health and environmental protection from hazards remaining on the Rocky Flats Environmental Technology Site after cleanup is complete and the site is closed, and protect and manage site lands and natural resources.

The total volume of residual contamination that may remain onsite after closure has not been determined. The final volume will depend upon the end state for the site and will be documented in the CERCLA ROD(s) discussed above for site closure. The volume of residual contamination may include contaminated groundwater in one or more of the known groundwater plumes, building foundations, and other subsurface structures that might be abandoned in place. Industrial Area characterization is by no means completed and hence no definitive judgments can be made at this time on the nature and extent of contamination at the site. At this time, all the detention ponds onsite have met and are meeting all water quality standards established by the Colorado Water Quality Control Commission, especially at RFCA points of compliance below the ponds, where routine sampling is conducted.

The Federal Government currently owns, and may continue to own, the entire site, including the Industrial Area

and the Buffer Zone. DOE assumes that it or a successor agency will be responsible for long-term surveillance and maintenance and other long-term stewardship activities at the site throughout the period of long-term stewardship, which is anticipated to continue in accordance with the specified time period under CERCLA. DOE anticipates that subcontractors may conduct certain long-term stewardship activities. Long-term stewardship activities is likely to be required with respect to engineered units, including waste disposal area caps/covers and groundwater treatment systems, groundwater monitoring systems, air quality monitoring systems, general site management activities, and recordkeeping.

Engineered Units

The cap/cover designs to be used as engineered barriers, in the event that they are needed, have not yet been finalized. The designs will eventually be finalized in consultation with the CDPHE and the EPA. All caps/covers, if needed, will be planted with native grasses and forbes for erosion protection. Surveillance and maintenance activities for the caps/covers will include management of vegetation and periodic inspection of the caps/covers. However DOE has identified no specific monitoring and maintenance actions or their respective frequencies. Activities identified in the 'basis of cost estimate' for maintenance activities, erosion control, and management of engineered unit caps/covers and hillsides include:

- operation of grading equipment,
- installation of erosion control fabric,
- reseeding of vegetated areas,
- erosion control ditch reshaping, and
- installation of rip rap.

STAKEHOLDER INVOLVEMENT

The DOE Rocky Flats Field Office provides regular briefings to the local community through various forums, principally through the Rocky Flats Citizen Advisory Board and Rocky Flats Coalition of Local Governments organizations. Several community issues or concerns have been raised through these forums. The prominent ones are: preservation of natural habitats and wildlife, treatment of noxious weeds and measures to deal with 'fuel loading' in the Buffer Zone, soil action levels, and groundwater and surface water standards. The Stewardship Dialogue Group, sponsored jointly by Rocky Flats Field Office, Rocky Flats Citizen Advisory Board, and the Rocky Flats Coalition of Local Governments, are engaged in discussion of these issues. As recommendations evolve, they will be factored into long-term stewardship plans, which are still in preparation.

Operation of the leachate collection and passive groundwater treatment system associated with the Present Landfill is anticipated to continue during long-term stewardship. Site security activities will be limited to a weekly inspection of the sensitive areas at the site, conducted by monitoring and sampling personnel.

Weekly sampling events (24-hour duration per event) and monthly analysis of particulate air filters will be conducted for the engineered units, if installed, during the long-term stewardship period, in accordance with an air quality sampling and analysis plan and procedures, which have yet to be developed. Sampling and analysis procedures for air quality monitoring will be appropriate for a long-term stewardship sampling scenario. The particulate air quality sampling strategy requires particulate filters to be collected from the sampling equipment and replaced monthly. The cost estimate for air quality monitoring is based on an assumed particulate air quality monitoring scenario for two particulate analytes, plutonium and americium, and is based on an assumed total of six sampling locations.

Groundwater Treatment Systems

Three passive groundwater collection barriers that direct groundwater plumes to treatment cells are installed at the site. These passive treatment cells are being used to control the Mound Site, East Trenches, and Solar Evaporation Ponds groundwater plumes. A fourth passive groundwater treatment system may be installed to control the Industrial Area groundwater plume, depending upon results of ongoing characterization studies for

this groundwater plume. These systems consist of groundwater barriers and underground treatment vessels filled with contaminant specific media (such as iron filings), which remove contaminants from the groundwater. The sizes of the three existing treatment systems vary. DOE assumes, for the purposes of the long-term stewardship cost estimate, that each of the three underground treatment vessels will contain an average of eight cubic meters (ten cubic yards) of iron filings, which will need to be replaced approximately every ten years. The spent iron filings will be classified and are anticipated to be disposed as low-level radioactive waste. Removal of spent iron filings will require the services of a project manager, procurement specialist, health and safety technician, and a subcontractor. Fences will not enclose the passive treatment cell systems.

Chemical Constituents Monitored in Groundwater*

Dissolved Metals	Vinyl Chloride	Strontium-89/90
Cesium	Chloroethane	Cesium-137
Lithium	Methylene Chloride	Tritium
Molybdenum	Acetone	Radium-226/228
Strontium	Carbon Disulfide	
Tin	1,1-Dichloroethane	***Total Radionuclides***
	1,1-Dichloroethene	
Target Analyte List:	trans-1,2-Dichloroethene	Americium-241
	1,2-Dichloroethene (total)	Plutonium-239/240
Aluminum	Chloroform	
Antimony	1,2-Dichloroethane	***Indicators***
Arsenic	2-Butanone	
Barium	1,1,1-Trichloroethane	Total Dissolved Solids
Beryllium	Carbon Tetrachloride	
Cadmium	Vinyl Acetate	***Field Parameters***
Calcium	Bromodichloromethane	
Chromium	1,1,2,2-Tetrachloroethane	pH
Cobalt	1,2-Dichloropropane	Specific Conductance
Copper	trans-1,3-Dichloropropene	Temperature
Iron	Trichloroethene	Alkalinity
Lead	Dibromochloromethane	
Magnesium	1,1,2-Trichloroethane	***Anions***
Manganese	Benzene	
Mercury	cis-1,3-Dichloropropene	Carbonate
Nickel	Bromoform	Bicarbonate
Potassium	2-Hexanone	Chloride
Selenium	4-Methyl-2-pentanone	Sulfate
Silver	Tetrachloroethene	Nitrate/Nitrite
Sodium	Toluene	Cyanide
Thallium	Chlorobenzene	Fluoride
Vanadium	Ethyl Benzene	
Zinc	Styrene	
	Total Xylenes	
Organics		
	Dissolved Radionuclides	
Target Compound List - Volatiles:		
	Gross Alpha	
Chloromethane	Gross Beta	
Bromomethane	Uranium-223/234, -235, and -238	

** Rocky Flats Environmental Technology Site Environmental Report for 1994.*

Groundwater Monitoring Systems

There are currently 89 groundwater wells at site, including "boundary wells" located downgradient of the site along and adjacent to the eastern boundary of the site at Indiana Street. Groundwater monitoring is anticipated to be the single greatest operating cost for long-term stewardship. All 89 wells are currently sampled semi-

annually, and this sampling schedule is anticipated to remain unchanged when long-term stewardship activities begin. DOE anticipates that current plans regarding the number of groundwater wells that will be sampled for long-term stewardship purposes may be reduced in the future. Groundwater will be sampled for volatile organic compounds; semi-volatile organic compounds; pesticides; poly-chlorinated biphenyls; nitrate/nitrite; metals; uranium-233/234, -235, and -238; strontium-89 and -90; plutonium-239 and 240; americium-241; chloride; fluoride; sulfate; carbonate; bicarbonate; and tritium. A list of contaminants for which groundwater will be sampled is included in the table above. Real-time water level measurements are also taken from groundwater wells using automated data loggers, from which data are downloaded on a quarterly basis. DOE anticipates that the water level sampling schedule and procedures will remain unchanged once long-term stewardship activities commence.

Surface Water/Sediment Management Systems

The site is located in the Big Dry Creek Watershed. There are 12 detention ponds on three surface water drainages from the Industrial Area into the Buffer Zone. These drainages include North Walnut Creek, South Walnut Creek, and Woman Creek. North Walnut Creek, which contains four ponds referred to as the "A-Series" ponds, drains the area of the Industrial Area where most of the plutonium processing took place. South Walnut Creek drains the eastern and southern areas of the Industrial Area and contains five "B-Series" ponds. The Landfill Pond is located in No Name Gulch in the Walnut Creek drainage. Two "C-Series" ponds and the South Inceptor Ditch are located in the Woman Creek drainage, which flows along the southern side of the Industrial Area. Some of the A-Series ponds sediments contain minute amounts of americium and polychlorinated biphenyls. Some of the B-Series ponds sediments contain minute amounts of americium, plutonium, polychlorinated biphenyls, and semi-volatile organic compounds. Two of the B-series ponds contain low levels of radionuclides and will likely be dredged to remove some of the sediments. DOE envisions that the ponds will be converted into wetlands to stabilize the sediments and create wildlife habitat, with the dams breached to allow a natural flow-through of water through the drainages. Surface water in the streams and wetlands will be sampled on a monthly basis, as indicated in the Integrated Monitoring Plan for the site. Surface water will be sampled from eight onsite locations, including three stream segment locations and five wetland locations, for plutonium, americium, tritium, beryllium, chromium, silver, and cadmium.

Water conveyance systems (Upper Church Ditch, McKay Ditch, and Smart Ditch) will remain. Long-term stewardship activities for these systems will remain the owner's responsibility. The water conveyance systems provide suitable Prebles' habitat, and Prebles (the Preble is a meadow jumping mouse) have been found on Smart Ditch. Two private detention ponds (D-series ponds) are located in the southeast corner of the site on Smart Ditch.

The site is taking a watershed approach to assess the function and condition of surface water and to integrate site surface waters into the Big Dry Creek Watershed. There are two ongoing studies and plans that will have a significant impact on long-term surface water management (Water Balance Study and the Water Management Closure Plan). The site has undertaken a Water Balance Study to quantify surface and ground water flow in the Industrial Area and associated drainages. This information will be used to determine the potential impact to flows from closure activities and estimate the water available that would become subject to long-term stewardship actions. The Water Management Closure Plan will examine options for closure of the site's wastewater treatment plant and the detention ponds.

Institutional Controls

The specific institutional controls that will be needed for the site during the long-term stewardship period have not yet been identified. Institutional controls for the site, for the purposes of managing residual hazardous substances requiring such controls, will be specified in the Final CERCLA ROD(s) to ensure protection of human

health and the environment.

Environmental Monitoring

DOE anticipates that ecological and surface water aquatic monitoring in the Buffer Zone, during the period of long-term stewardship, will be required to properly manage the wildlife habitat. The objective of this monitoring is to promote conservation of site ecosystems, detection and management of disturbances to Buffer Zone ecology, and protection of unique natural resources and species of concern in the Buffer Zone. Monitoring will include evaluation of habitat characteristics and plant and animal species abundance, including sampling of various species populations on a monthly to an annual basis. DOE anticipates that pesticides and biological controls will be used onsite for control of exotic plants and noxious weeds, including thistle, and that pesticide spraying will be conducted on approximately five percent of the site area each year. Erosion of former roads and disturbed areas from severe storm events can be expected and will require periodic re-contouring and re-vegetating.

Environmental sampling personnel will periodically inspect physical site features, including landfill and disposal area enclosures, groundwater wells, and passive treatment cell sites and will conduct an annual inspection of all site features, including caps/covers, boundary markers, groundwater wells, fences, wetlands and drainage ditches. Inspection reporting for the site will include a Five-Year Review Report, prepared in accordance with CERCLA.

Recordkeeping

Groundwater monitoring data for the site is provided to government agencies and local communities and is maintained in the Soil Water Database (SWD). The cost estimate for long-term stewardship is based on the assumption that record storage and maintenance activities will be conducted at the Neosho, Missouri, facility, which is a Veterans Affairs Records Depository. This facility has enough space to accommodate the Rocky Flats records. DOE has estimated that fifteen percent of the current volume of electronic information for the site will be needed and maintained for the purposes of ongoing long-term stewardship activities. Redundant copies of information and non-record information will not be retained. At present, there are approximately three terabytes (three thousand gigabytes) of electronic information stored within the site's Central Computing Facility. Therefore, it is estimated that approximately 450 gigabytes of space will be required to adequately contain those electronic records necessary for ongoing long-term stewardship activities.

2.2 Assumptions and Uncertainties

The following are key assumptions concerning long-term stewardship after site closure:

- The site will close in 2006 and begin long-term stewardship activities in 2007.
- The Federal Government may or may not maintain ownership of the entire site property.
- No buildings or surface facilities will exist onsite, with the exception of engineered units, limited facilities needed for open space and land management purposes, utility easements, and water conveyance structures, to be determined at the time of closure.
- No provision will be made to maintain all existing, improved roads. Roads will be maintained for access to long-term monitoring equipment and easements. Roads may be necessary for land or fire management, as determined by the post-closure owner.
- Other than existing utility easements, only those utilities (electricity and telephone) needed for monitoring activities will remain. These utilities are expected to be minimal since:
  a) Air and surface water monitoring stations will likely be solar powered; however, freeze protections will be required for surface water stations.
  b) Generators on the sampling truck will power sampling pumps.
- The configuration of onsite drainage ditches and ponds is expected to change: the ponds will be

converted to a passive water management system to the extent practical to allow for sediment retention and enhancement of wildlife habitat, although Rocky Flats has not ruled out the use of more active water management systems if needed to meet water quality regulatory requirements.

- Landfill and site caps/covers are expected to be planted with native grasses and forbes.
- The entire site is likely to be designated as open space. Final land use determinations may be made by pending legislation, or the future owner, based on CERCLA and/or deed restrictions.
- The assumed greatest long-term stewardship operating cost is associated with onsite groundwater monitoring. It is likely that the current number of groundwater wells (89) required for monitoring purposes may be reduced in the future.
- Vehicle access to easements, monitoring wells, air monitoring stations, and passive treatment cells will be necessary during long-term stewardship. It is assumed that unimproved roads onsite will be sufficient to provide access to monitor and make needed repairs to easements, wells, air monitoring stations, and passive treatment cells.
- Security will be limited to a weekly inspection of the perimeter fence by a subcontracted security service. Monitoring personnel will perform inspection of features within the perimeter such as fenced-off areas and wells.
- Management and oversight of site monitoring will be performed by locally based personnel.
- A Federal Real Estate Officer will spend five weeks per year onsite conducting land management activities for the site in accordance with Federal Real Property management requirements; such activities will require travel, as there will not be dedicated site staff.
- Post-closure real property appraisal and title work for the site will be completed in 2006 by contracted professional real estate services and the Federal Real Estate Officer; this appraisal and title work may not be necessary if pending legislation mandates future site ownership.
- The goals and objectives of ecological monitoring as described in the document, "Integrated Monitoring Plan: Ecological Monitoring," will not change during the stewardship period.
- Surface water sampling that will be required for the end state status of the site will only be that specified in the *Integrated Monitoring Plan,* or subsequent documents.

2.3 Estimated Site-Wide Long-Term Stewardship Costs

Estimated costs for long-term stewardship activities for the site are summarized in the table below. The cost estimates for groundwater monitoring do not include any costs for groundwater well maintenance or groundwater modeling. The cost estimates for groundwater treatment do not include the cost of a fourth passive treatment cell system that may be needed for the Industrial Area groundwater plume. Travel, vehicle, and lodging costs associated with required air quality monitoring during the long-term stewardship period are not included in the cost estimate. Specific long-term stewardship activities represent the following proportion of total long-term stewardship costs:

- project management - 3.0 percent,
- operations - 13.2 percent,
- physical controls - 0.1 percent,
- institutional controls - 12.6 percent,
- information systems - 36.2 percent, and
- contingency - 35.0 percent.

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	*Amount*	*Year(s)*	*Amount*	*Year(s)*	*Amount*
FY 2000	$0	**FY 2008**	$6,241,000	**FY 2036-2040**	$31,938,000
FY 2001	$0	**FY 2009**	$6,176,000	**FY 2041-2045**	$30,813,000
FY 2002	$0	**FY 2010**	$6,176,000	**FY 2046-2050**	$29,796,000
FY 2003	$0	**FY 2011-2015**	$30,884,000	**FY 2051-2055**	$30,133,000
FY 2004	$0	**FY 2016-2020**	$31,500,000	**FY 2056-2060**	$31,509,000
FY 2005	$0	**FY 2021-2025**	$30,387,000	**FY 2061-2065**	$30,340,000
FY 2006	$0	**FY 2026-2030**	$29,381,000	**FY 2066-2070**	$31,417,000
FY 2007	$8,416,000	**FY 2031-2035**	$28,297,000		

3.0 CONTAMINATED MEDIA

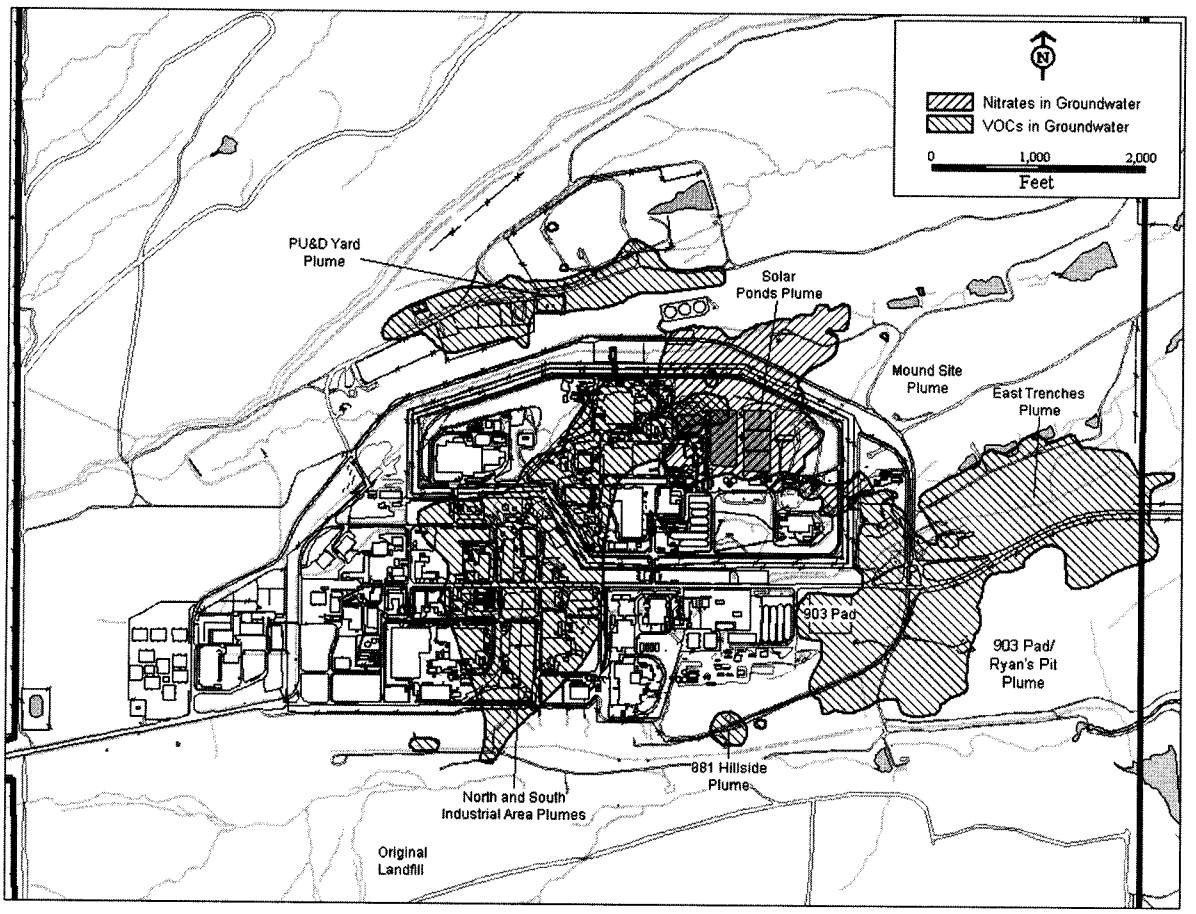
In accordance with present plans, long-term stewardship activities will begin in 2007 and continue in order to implement the remedial actions required by any Final CERCLA ROD(s). Following the designation of the site as "one portion," the site has been differentiated into various media where contamination is likely to remain after closure, for the purpose of developing a more detailed description of long-term stewardship planning activities. These media designations and their respective descriptions are as follows:

3.1 Groundwater

Contaminated groundwater media would include the Mound Site plume, the East Trenches plume, the Solar Ponds plume, the 903 Pad/Ryan's Pit plume, the 881 Hillside plume, PU&D Yard plume and possibly the Industrial Area plumes (the Industrial Area has not been adequately characterized until this point in time).

- Mound Site Plume: The Mound Site was a disposal site located within the Inner Buffer Zone east of the Protected Area and used for disposal of uranium- and beryllium-contaminated lathe oil, containing volatile organic compounds (VOCs), and also low levels of plutonium. A removal action was conducted in 1970 to remove buried drums and radioactive contaminated soil from this site. A second soil removal action was conducted in 1997, in accordance with the RFCA, to remove VOC-contaminated soil that was contributing to the Mound Site Plume. The removed soil was treated onsite using thermal treatment and then returned to the Mound site. Also, the T-1 Trench, which contained buried drums of wastes containing VOCs, was excavated in 1998. The T-1 Trench is suspected of being a possible contributor to the Mound Site Plume contamination. These removal actions are considered to be interim remedies under RFCA. The RFCA approach is to implement interim remedies until the No Further Action ROD or Final ROD is issued at the end of the remediation project. Based on modeling data, "groundwater from the source area could take up to 30 years to reach South Walnut Creek" at the Mound Site. This estimate does not take natural attenuation into account.

  The Mound Site Plume is an approximately one-hectare (two-acre) groundwater plume contaminated with VOCs, primarily trichloroethene and tetrachloroethene. The site remediation plan for the Mound Site Plume includes passive collection of groundwater using a 70-meter (230- foot) barrier treatment well constructed of high-density polyethylene, and two subsurface reactive iron treatment cells to remove volatile organic compound and radionuclide contamination from the groundwater. The groundwater



Groundwater Plumes

barrier well and passive groundwater collection and treatment system were installed in 1998. Effluent from the passive treatment system is discharged by gravity into subsurface soil.

- East Trenches Plume: The East Trenches were used to dispose of site industrial wastes and are located east of the Protected Area in the Outer Buffer Zone (east of the East Perimeter Road.) The plume originates from the East Trenches and 903 Pad sites and flows towards South Walnut Creek, where it emerges as surface water seeps. The trenches were used between 1964 and 1967 to dispose of sanitary sewage sludge contaminated with low levels of uranium and plutonium, and were also used for disposal of drummed wastes containing VOCs, primarily tetrachloroethene and trichloroethene. A removal action was conducted in 1998, in accordance with the RFCA, to remove the sources of contamination from the East Trenches that were contributing to the East Trenches Plume. The removed material was treated onsite by thermal treatment to remove VOCs and then returned to the trenches.

  The East Trenches Plume is an approximately 45-hectare (110-acre) groundwater plume contaminated with VOCs. The site remediation plan for the East Trenches Plume includes interception of the part of the groundwater plume that is migrating to the north using a passive treatment system. The passive treatment well system, installed in 1999, includes a 365-meter (1200-foot) barrier well and two subsurface reactive iron treatment cells to remove VOCs from the collected groundwater. Effluent from the passive treatment well system is discharged by gravity through an infiltration system located adjacent

to South Walnut Creek, but the system is also designed to discharge directly into South Walnut Creek. The part of the East Trenches plume that is migrating to the south is being addressed in a separate remedial action as the 903 Pad/Ryan's Pit Plume, discussed below. Based on modeling covering a 70-year period, contaminant concentrations are expected to increase only slightly initially, and then remain constant over the period modeled.

- Solar Ponds Plume: The Solar Evaporation Ponds Plume is an approximately 23-hectare (56-acre) groundwater plume contaminated with uranium and nitrates. The plume emanates from the Solar Evaporation Ponds and flows towards North Walnut Creek. The remediation plan for the Solar Evaporation Ponds Plume includes passive collection of groundwater, using a passive treatment well consisting of subsurface sawdust and iron reductive treatment cells to prevent the plume from causing North Walnut Creek to exceed water quality standards. In 1971, an interceptor trench system was installed to collect contaminated groundwater from the Solar Evaporation Ponds Plume and treat the collected groundwater in an evaporator. The interceptor system was expanded in 1981. In 1999, this system was supplanted by a passive treatment well system, in accordance with the Solar Plume Decision Document. The upgraded system employs a part of the original subsurface collection system to direct groundwater flow to a 335 meter (1,100-foot) barrier well and a two-part reactive treatment cell to remove uranium and nitrate contamination from the groundwater. The first part of the cell contains sawdust, leaf mold (a carbon source) and iron filings; the second part contains only iron filings. Based on modeling over a 100-year period, nitrate concentrations in groundwater adjacent to North Walnut Creek would continue to exceed 100 mg/liter during the modeled period.

  Effluent from the system is discharged by gravity through an infiltration system located adjacent to North Walnut Creek. The RFCA Decision Document for the Solar Evaporation Ponds Plume requires that the uranium concentration of the effluent is 10 pCi/l or less and the nitrate concentration is 100 mg/l or less. The RFCA Decision Document requires that the nitrate standard revert to 10 mg/l in 2009.

- 903 Pad/Ryan's Pit Plume: The 903 Pad/Ryan's Pit Plume is an approximately one-hectare (two-acre) groundwater plume contaminated with VOCs, and is located south of the southeast corner of the Protected Area, within the Industrial Area of the site. The plume originates in the 903 Pad area and flows towards Woman Creek. The sources of the contamination for this plume were:

  - Leaking organic solvents, primarily carbon tetrachloride, tetrachloroethene, and trichloroethene, and plutonium- and uranium-contaminated liquids from drums stored on the 903 Pad;

  - Nonradioactive liquid chemical wastes, primarily carbon tetrachloride, tetrachloroethene, and trichloroethene.

  These chemicals were disposed of in the Ryan's Pit disposal area between 1969 and 1971. Some radioactive-contaminated soils were removed from the 903 Pad site in 1968 and 1969, after which part of the area was re-graded and covered with asphalt. Contaminated soil from Ryan's Pit was removed in 1996, treated onsite by thermal treatment, and returned to the same location. The 903 Pad source removal action is scheduled for 2001. Dense non-aqueous phase liquids are suspected to exist beneath the 903 Pad.

  The site remediation plan for the 903 Pad/Ryan's Pit Plume is based on monitored natural attenuation. This itself is based on the assumption that the plume does not represent a threat to surface water. In the event that monitoring data indicate that the plume is migrating towards surface water, additional mitigation may be required for this plume. Migration pathways for this plume are to the north, east, and south. It appears that the part of the plume that is migrating to the south to the Woman Creek drainage

is limited, and that the part of the plume towards the east is nearly stable. Monitoring data for the plume indicates that there is evidence that natural attenuation of the plume contamination is occurring. The part of the 903 Pad/Ryan's Pit plume that is migrating to the north is being addressed in a separate remedial action as the East Trenches Plume, discussed above.

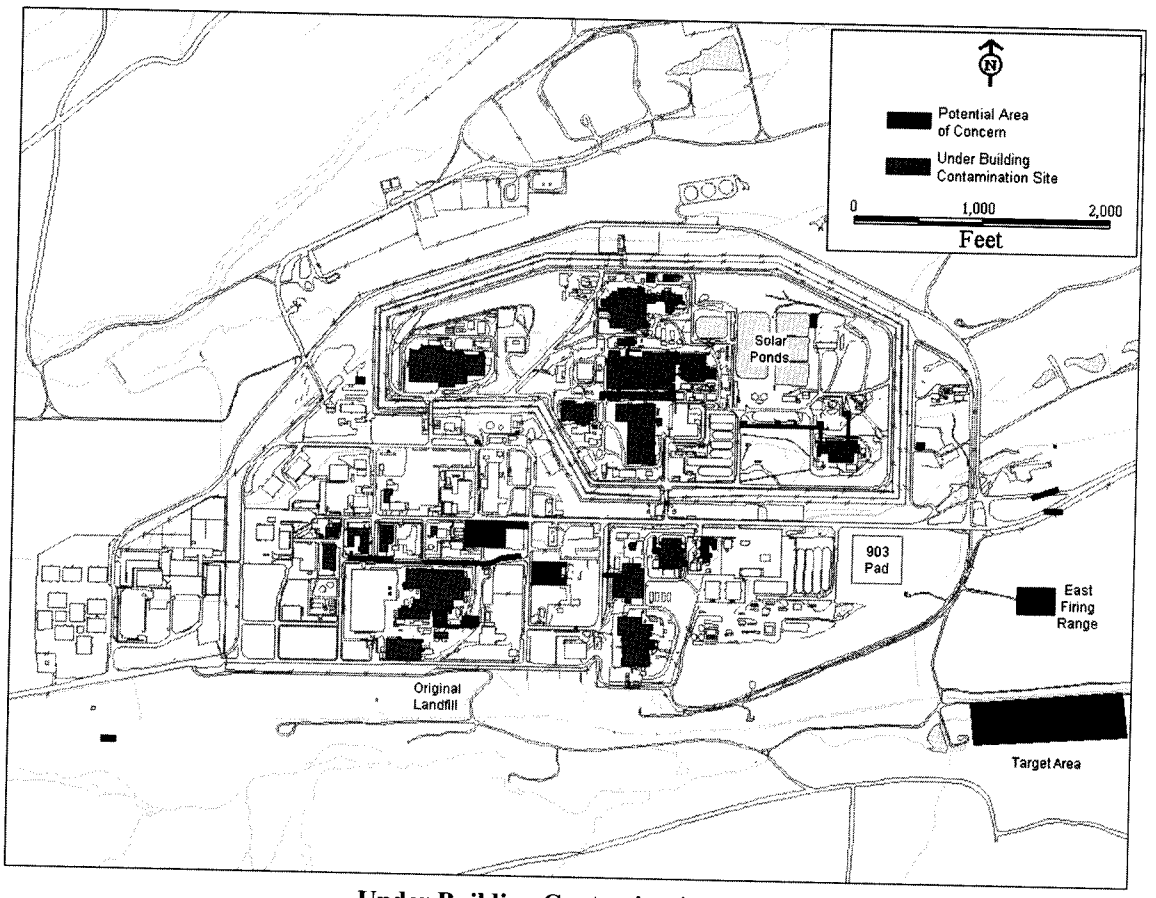
- 881 Hillside Plume: Several waste disposal sites were located on the hillside adjacent to Building 881 in the south central area of the Industrial Area. In 1992, a French drain was installed to divert contaminated groundwater from this plume to a sump and subsequent treatment in the site industrial wastewater treatment system. The 881 Hillside Plume is an approximately one-hectare (two-acre) groundwater plume contaminated with VOCs. The site remediation plan for the 881 Hillside Plume is based on monitored natural attenuation, based on the low levels of contamination found in the sump water and the assumption that, therefore, the plume does not represent a threat to surface water. In the event that ongoing groundwater monitoring indicates that the plume is migrating towards surface water, additional mitigation may be required for this plume.

- PU&D Yard Plume: The PU&D Yard is located north of the Industrial Area in the Buffer Zone. It was a staging area for the construction of the Present Landfill and was converted for use as a Property Utilization and Disposition Yard (PU&D) after construction of the Present Landfill. The PU&D Yard Plume is an approximately nine-hectare (22-acre) groundwater plume contaminated with VOCs as a result of materials storage activities in the area. The site remediation plan for the PU&D Yard Plume is based on monitored natural attenuation, based on the assumption that the plume does not represent a threat to surface water. In the event that ongoing groundwater monitoring indicates that the plume is migrating towards surface water, additional mitigation may be required for this plume.

- Industrial Area Plumes: It must be emphasized that the two plumes in the Industrial Area (the Northside and Southside plumes) have not been adequately characterized at this point. The central area of the Industrial Area may be underlain with groundwater contaminated with VOCs from numerous sources. The Industrial Area Plumes may be migrating both to the north and to the south. The total area for both plumes is approximately 45 hectares (110 acres). The plume migrating northwards appears to traverse along subsurface utility corridors and a partially buried drainage. It appears that this plume may be fed by a carbon tetrachloride source. The plume migrating southward may perhaps be contaminated with volatile organic compounds. The site remediation plan for the Industrial Area plumes is based on monitored natural attenuation, on the assumption that the plumes do not represent a threat to surface water.

3.2 Solar Evaporation Ponds

The Solar Evaporation Ponds, located in the northeast corner of the Protected Area, consist of five lined evaporation ponds and comprise a total of approximately five hectares (12 acres). The ponds are located adjacent to former plutonium processing areas. From 1953 to 1986, the ponds were used primarily for the temporary storage and evaporation of radioactive process wastes, including uranium nitrate and neutralized acidic wastes containing aluminum hydroxide with high levels of nitrate. Closure of the Solar Evaporation Ponds is being conducted jointly under the provisions of the RCRA and CERCLA, in accordance with the RFCA. The process waste contents of the ponds (e.g., wastewaters, sludges and pondcrete) have been removed via separate remediation projects so that the liners and soils beneath the ponds could be characterized. Soil beneath the ponds is contaminated with uranium, nitrates, and chromium. A single evapo-transpiration cover is planned for the five solar evaporation ponds. The proposed cover boundary for the solar evaporation ponds was revised in 1999 and includes only the five evaporation ponds and their respective berms. The remediation plans for the solar evaporation ponds assume that the berms will be pushed into the ponds before the cap is constructed. The solar evaporation ponds are managed as an interim-status unit under RCRA, which requires the final cover to meet



Under Building Contamination Sites

design concentration limits that are protective of surface water.

3.3 Original Landfill

The Original Landfill and the Filter Backwash Pond encompass approximately eight hectares (20 acres) and are adjacent to and south of the Industrial Area between the 600 Area of the site and Woman Creek. The Original Landfill, located on a steep hillside, was in operation from 1952 to 1968 and was used to dispose of general wastes generated at the site. It is estimated that 56,630 cubic meters (two million cubic feet) of miscellaneous site wastes were buried in the landfill, including solvents, paints, paint thinners, oil, pesticides, cleaners, construction-related debris, waste metal, and glass. The landfill also received beryllium and uranium wastes and used graphite. It has been reported that ash containing depleted uranium was buried in the Original Landfill. Chemicals that may have been buried include commonly used solvents, such as trichloroethene, carbon tetrachloride, benzene, paint, and paint thinners. Metals such as beryllium, uranium, lead, and chromium may also be present, and barium, manganese, and radium have been observed in groundwater below the landfill. The landfill was closed with a soil cover; however, a bottom liner was not installed. The date and year the cover was installed is not available, nor are details on the landfill construction. Closure of the Original Landfill is being conducted jointly under the provisions of RCRA and CERCLA, in accordance with the RFCA. The Remedial Investigation Report for the Original Landfill identified several surface areas with radiological contamination. An evapo-transpiration cover is planned for the Original Landfill. Because of the steep slope of the landfill area,

buttressing of the structure will be required resulting in increased landfill cap inspection and maintenance requirements.

3.4 Facility Foundations

The current decontamination and decommissioning and closure plan for the Industrial Area assumes that certain facility foundations in the Industrial Area will be abandoned in place or capped. Decommissioning will generally remove any subsurface structural material within one meter (three feet) of the ground surface. This will include facility slabs and foundations, unless otherwise required based on other remediation requirements. Removal will generally include the building foundation and at least one meter (three feet) of the building footings or pilings. Subsurface structural material below one meter (three feet) will be removed in cases where the structure prevents access to underlying soil requiring remediation (i.e., under building contamination) or in cases where the structure cannot be certified for unrestricted release. The provisions of DOE Order 5400.5, *Radiation Protection of the Public and the Environment*, govern structures certified for unrestricted release. An Industrial Area Sampling and Analysis Plan, which will address the facility foundations, is anticipated to be completed in September 2000. DOE anticipates that there will be some level of groundwater monitoring associated with the facility foundations throughout the long-term stewardship period.

3.5 Soil

The 903 Pad Characterization Report, completed in September 1999, identified areas of soil contamination in the 903 Pad area. The 903 Pad was used as a drum storage area, and soil contamination resulted from leaking drums of volatile organic and semi-volatile organic compounds and plutonium-containing liquids. High concentrations of VOCs, including carbon tetrachloride and trichloroethene, are believed to exist beneath the 903 Pad. Remediation of soil contamination in the 903 Pad area is anticipated to begin in 2003 and to be completed in 2005. There is the possibility that DOE may turn over management of the cleanup of this area to EPA Region VIII.

The remaining areas of the Industrial Zone have yet to be fully characterized for soil contamination. This will be addressed in the Industrial Area Sampling and Analysis Plan, which is anticipated for completion by September 2000.

3.6 Contamination Specific Long-Term Stewardship Activities

Long-term stewardship activities at the site may entail any one or a combination of activities (see below) within and crosscutting various media described above. These activities include:

- Monitoring of groundwater, surface water, and air; and ecological monitoring.
- Maintenance of utilities, ditches and ponds; erosion control and noxious weed control.
- Surveillance, which may include security monitoring and inspection of physical features and sensitive areas at the site and endangered species habitat.
- Institutional and engineered controls, which may include passive treatment wells for groundwater and closure caps for contaminated, below-ground facility foundations.
- Recordkeeping activities, involving both electronic records and bulk storage.
- Local community interactions, including regular briefings to citizen community groups, stakeholders and regulators.

In general, for the groundwater plumes, long-term stewardship activities will include groundwater monitoring and continued operation and maintenance of the passive groundwater treatment system, if installed. In the latter event, underground treatment vessels will contain an average of eight cubic meters (ten cubic yards) of iron

filings, which will need to be replaced approximately every ten years. The spent iron filings will be classified and are anticipated to be disposed as low-level radioactive waste. Groundwater at the site will not be permitted for drinking water use during the long-term stewardship period. Groundwater cleanup will be accomplished to protect surface water both onsite and offsite, based on site-specific standards developed by the Colorado Water Quality Control Commission in October 1999.

Long-term stewardship activities for the Solar Evaporation Ponds and the Original Landfill will include surveillance and maintenance of the cap (if installed) and its associated erosion control systems, a security fence, and air quality monitoring for particulate radionuclides.

Long-term stewardship activities for the Facilities Foundations have not been determined. Anticipated activities include restrictions on subsurface intrusion (drilling, excavation) during the long-term stewardship period in areas where foundations have been abandoned in place or capped.

Long-term stewardship activities for the 903 Pad Soils also have not been determined and will be developed based on the end state following the remedial action and in accordance with the RFCA action levels.

Specific long-term stewardship activities for each media within the site have not been determined at this point in time.

4.0 FUTURE SITE USE

Future ownership of the Rocky Flats Environmental Technology Site has not been determined. DOE currently owns the entire acreage comprising both the Industrial Area and the Buffer Zone. No long-term decision has been made to keep the site in DOE (or Federal) ownership, and there is no legal requirement to do so. An easement will be retained for future cleanup activities, and transfer of fee ownership is possible whenever it is in the government's best interest to do so. The proposed final end state envisions that all surface buildings and structures, except the limited number of structures needed for long-term stewardship activities, will be removed from the site prior to entering into long-term stewardship. Generally speaking, no new construction of buildings or structures will be permitted. However, a decision precluding all future construction of buildings and improvements has not been made. Future use as open space, wildlife refuge, or dispersed recreation may require improvements such as parking areas, roads, trails, restrooms, fences or other improvements to protect the resources and manage public access. Public access will depend on the Final Record(s) of Decision and any administrative or institutional controls, deed restrictions, and other factors. Public entry may be allowed to the entire site or only to limited areas of the site.

Similarly, future land use decisions have not been made at this time. Future use planning anticipates open space use for the entire site, including both the Industrial Area and the Buffer Zone. However, pending legislation may change that proposal to include limited industrial development or other uses. At present, the U.S. Fish and Wildlife Service manages the 283-hectare (700-acre) Rock Creek Fish and Wildlife Management Area, located in the Buffer Zone, in accordance with an Interagency Agreement dated May 17, 1999. In 1995, a 243 hectare (600-acre) portion of the Buffer Zone was transferred to the National Renewable Energy Laboratory in Golden, Colorado, for research purposes.

For additional information about the Rocky Flats Environmental Technology Site, please contact.

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RULISON

1.0 SITE SUMMARY

1.1 Site Description and Mission

The Rulison site encompasses approximately 20 hectares (50 acres) and is located 12 miles southwest of Rifle, Colorado. The U.S. Atomic Energy Commission (AEC), which later became the Department of Energy (DOE), conducted the Rulison test under the Plowshare Program, which was a series of nuclear and conventional tests to explore peacetime uses of nuclear explosives. For the Rulison test, a 40 kiloton nuclear device was detonated at a depth of 2,568 meters (8,426 feet) below ground surface in a sandstone formation in September 1969. The Rulison test, which was designed to increase natural gas production from low-permeability sandstone, was the second gas production experiment in the Plowshare Program.

The Rulison site is privately owned. DOE's current mission at the site is the characterization and corrective action of the subsurface area, and continuing institutional controls to prevent access to the subsurface and other long-term stewardship activities.

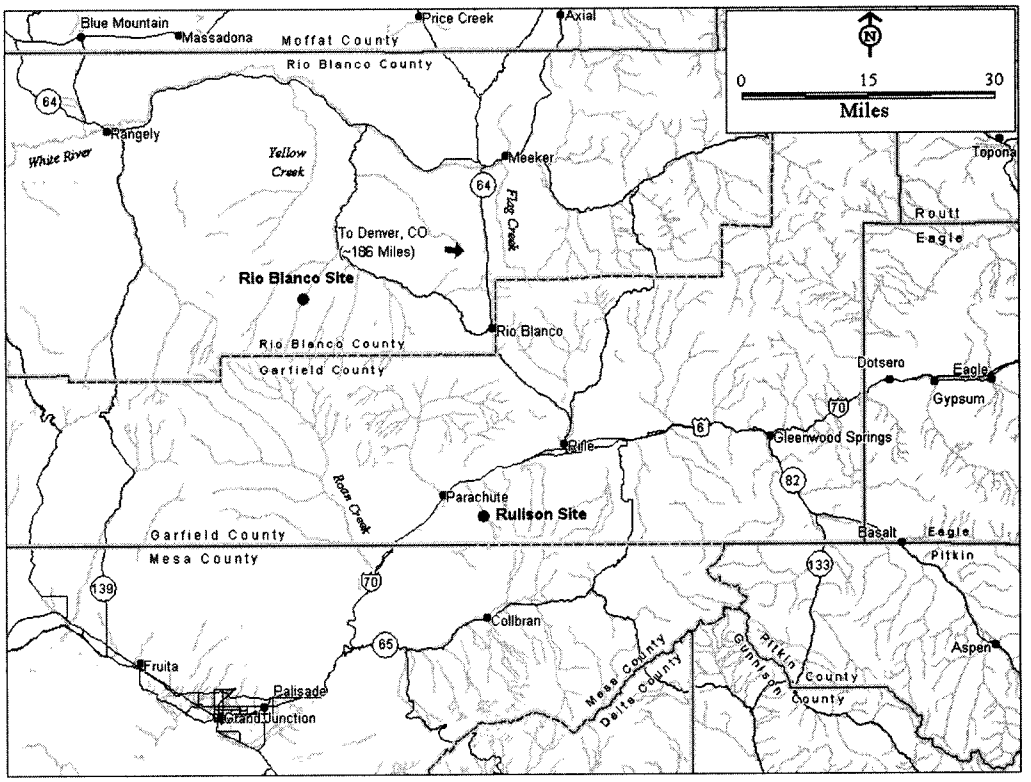
LONG-TERM STEWARDSHIP HIGHLIGHTS

Major Long-Term Stewardship Activities - groundwater monitoring; enforcing restrictions for access to and use of the subsurface
Total Site Area - 20 hectares (50 acres)
Estimated Volume of Residual Contamination - unknown
**Surface Long-Term Stewardship Start-End Years* - 1998-in perpetuity
**Subsurface Long-Term Stewardship Start-End Years* - 2010-in perpetuity
Average Annual Long-Term Stewardship Cost FY 2000-2006 - $38,000
Landlord - Private Ownership
*For purposes of this report, long-term stewardship activities for the surface began when surface remediation was completed in 1998. However, DOE recognizes that subsurface investigation and modeling activities are on-going and are not anticipated to be complete until 2010.

1.2 Site Cleanup and Accomplishments

As a result of testing activities (underground nuclear detonation and gas flaring), areas of the subsurface and surface were contaminated. The potential subsurface contaminants of concern are mixed fission products, plutonium, uranium, and tritium. DOE assumes that natural gas is the primary contaminant migration pathway at the site. DOE will use modeling and characterization data to determine the extent of subsurface contamination and to refine, if warranted, the existing subsurface intrusion restrictions in areas that will require institutional controls. A natural gas reservoir and subsurface condition analysis will be conducted to obtain data for modeling the subsurface contamination. Subsurface modeling efforts are scheduled to begin in 2006 and be concluded by 2010. DOE does not plan to remediate the subsurface contamination because of the lack of feasible technologies for removing the site's subsurface contamination. However, at the end of the subsurface modeling period, DOE will have assessed risk, determined the contaminant fate and transport, and established a compliance boundary for refinement of subsurface intrusion restrictions, if necessary. DOE will continue to impose existing subsurface intrusion restrictions in perpetuity.

Surface contamination at Rulison consisted of petroleum hydrocarbons and metals in mud pits from well drilling at the site. Remediation of the mud pit at Rulison began in 1995. DOE exhumed approximately 16,000 cubic meters (21,000 cubic yards) of contaminated sediments and transported them offsite for disposal at a commercial disposal facility. Other mudpits were closed in place. After remediation and final sampling was completed, and the Site Closure Report was submitted in 1998, the Colorado Department of Public Health and Environment reviewed all of the data and approved the closure without any further activity, other than periodic monitoring of the subsurface and institutional controls to prevent access.



Rulison

DOE does not conduct any post-closure monitoring of the surface, as there are no caps or residual contaminants of concern. However, in coordination with DOE, the Environmental Protection Agency (EPA) does conduct monitoring at the site, and DOE will maintain institutional controls restricting access to the subsurface contamination.

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

Surface remediation was completed in 1998. DOE will continue to investigate and model subsurface contamination, which is not expected to be complete until 2010. Existing subsurface intrusion restrictions will be refined, as necessary, based on the outcome of the investigation and modeling efforts. Final long-term stewardship requirements for the subsurface areas of contamination at the site will be negotiated with the private land owners and the State of Colorado. Periodic monitoring will be conducted to analyze contaminant migration from the test cavity to the groundwater. Since all contamination was removed from the surface, DOE does not plan to conduct any long-term stewardship associated with the former surface-level soil contamination.

DOE maintains the project-specific records at the Nevada Operations Office in Las Vegas. These records include corrective action investigation work plans and reports; corrective action decision documents; health assessments; risk assessments; information submitted by the public; National Environmental Policy Act documents; and the Public Involvement Plan. The DOE Public Reading Facility and the Nevada Division of Environmental Protection Administrative Record are provided with copies of these documents. Upon the completion of the

project, all DOE project files will be transferred to controlled storage at the Nevada Operations Office. Records are retained according to DOE records retention procedures.

2.2 Specific Long-Term Stewardship Activities

Groundwater

DOE will maintain institutional controls, including a all subsurface intrusion restriction, in perpetuity over the subsurface to prevent access to the test cavity, groundwater, and associated subsurface contamination. In addition, a monument has been placed at the site to mark the location of the test. DOE will continue to conduct annual visual inspections and groundwater monitoring at the site for at least 100 years after closure of the subsurface in 2010, during which time DOE estimates repair or replacement of groundwater monitoring wells will be necessary every 25 years. At the end of the post-closure groundwater monitoring period in 2110, and after State agreement is secured, the monitoring wells will be plugged and abandoned in place in accordance with state regulations.

STAKEHOLDER INVOLVEMENT

Public participation at Rulison is project-specific and defined by the needs and interests associated with each project. At the initiation of project work, DOE identifies the relevant state regulators, federal agencies, tribal governments, interest groups, and stakeholders expected to have an interest in the project and the site. Issues of interest and concern and key decision points are identified with stakeholders to determine the means by which public involvement will occur. Although the construct of this process is similar for different DOE sites, the implementation can be highly variable, as each is tailored to the specific needs of each site. Opportunities for stakeholder involvement might include the following: public hearings, town halls meetings, public workshops, informational and technical briefings, site tours, and document reviews.

DOE held a meeting with the Colorado Department of Public Health and Environment in October of 1999. Discussions with the regulators addressed the site regulatory framework, exit strategy, and the preliminary data quality objectives for the subsurface remedial actions at the site. Additional meetings with the site regulators and stakeholders will be held on a periodic basis. All surface work conducted at the site has been accepted by the private landowner as well as the State regulator.

2.3 Regulatory Regime

In accordance with applicable regulatory drivers listed below, DOE is responsible for identifying the nature and extent of contamination, determining potential risk to the public and the environment, and performing the necessary corrective actions in compliance with guidelines and requirements under federal regulatory drivers, as well as the state-specific regulatory drivers associated with the site location.

Resource Conservation and Recovery Act (RCRA):
RCRA was the first comprehensive federal effort to deal with solid and hazardous waste and regulates the generation, transportation, treatment, storage, and disposal of hazardous waste. At Rulison, RCRA is enforced to protect human health and the environment; conserve energy and natural resources; reduce the amount of generated waste; and ensure that wastes are managed in an environmentally sound manner.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA): CERCLA supplies a system for identifying and providing corrective action to sites where hazardous substances have been released into any part of the air, water, groundwater, or land. Provisions of CERCLA include a National Contingency Plan, which establishes procedures for corrective action for hazardous substance releases. Rulison is not regulated under CERCLA; however, the regulations are useful as developmental guidelines.

In addition to federal regulations, DOE must comply with state regulatory requirements in Colorado. In most cases, State of Colorado requirements are based on federal guidelines; however, in specific cases they may be more detailed and stringent than federal regulations.

Nuclear Regulatory Commission (NRC): NRC regulations establish "free release" criteria. Rulison is not regulated under the NRC; however, the regulations are useful as developmental guidelines.

2.4 Assumptions and Uncertainties

DOE has not yet fully characterized the contamination, and long-term stewardship activities have not yet been finalized with the regulators. Therefore, long-term stewardship activities and associated costs may change, depending on final agreements.

DOE does not plan to remove subsurface contamination in and around the test cavities. However, DOE will develop subsurface models and use them to define the contaminant boundary and refine the existing subsurface intrusion restrictions, if necessary. Post-closure monitoring will be conducted, as agreed upon in the site closure reports for the subsurface. The schedule for groundwater monitoring after closure of the subsurface will be defined in the subsurface closure report. DOE assumes monitoring will be performed for 100 years (2010-2110).

DOE assumes that current land use designations and subsurface intrusion restrictions will continue into the foreseeable future. However, DOE will reevaluate and modify the subsurface restrictions, as appropriate, as part of the assessment and/or corrective action activities.

3.0 Estimated Long-Term Stewardship Costs

The cost profile in the table below applies to the entire Rulison site. The major long-term stewardship costs are for monitoring activities, data analysis, and repair and replacement of monitoring wells. The spikes in cost are a result of costs associated with repairing or replacing monitoring wells, which are assumed to require maintenance every 25 years.

The long-term stewardship costs for the Rulison site remain roughly constant at $40,000 annually through 2010. The cost increase from $27,000 in FY 2000 to $40,000 in 2001 is the result of the costs associated with the new Real Estate Operations Permit (RE-OP) requirements. The cost increase in 2008 is the result of a periodic review and analysis of the data to evaluate and possibly refine the monitoring strategy. This review and analysis will occur every five years throughout the post-closure monitoring period (2010-2110). DOE projects that the total post-2070 costs will be approximately $2.6 million dollars, which includes plugging and abandoning groundwater monitoring wells at the end of the monitoring period.

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	***Amount***	***Year(s)***	***Amount***	***Year(s)***	***Amount***
FY 2000	$27,000	**FY 2008**	$113,000	**FY 2036-2040**	$272,000
FY 2001	$40,000	**FY 2009**	$40,000	**FY 2041-2045**	$272,000
FY 2002	$40,000	**FY 2010**	$40,000	**FY 2046-2050**	$272,000
FY 2003	$40,000	**FY 2011-2015**	$200,000	**FY 2051-2055**	$272,000
FY 2004	$40,000	**FY 2016-2020**	$272,000	**FY 2056-2060**	$572,000
FY 2005	$40,000	**FY 2021-2025**	$272,000	**FY 2061-2065**	$272,000
FY 2006	$40,000	**FY 2026-2030**	$272,000	**FY 2066-2070**	$272,000
FY 2007	$40,000	**FY 2031-2035**	$573,000	**Post FY 2070**	$2,600,000

4.0 FUTURE USES

The anticipated future use for the surface area (50 acres) is open space; however, future use decisions at this site will be determined by the site owner. DOE has imposed deed restrictions to prevent access to the test cavities, subsurface areas, natural gas, and groundwater in perpetuity.

For additional information about the Rulison site, please contact:

Monica Sanchez
U.S. Department of Energy, Nevada Operations Office
Environmental Restoration Division
232 Energy Way
North Las Vegas, NV 89030-4199
Phone: 702-295-0160
sanchezm@nv.doe.gov

SLICK ROCK (NORTH CONTINENT) MILL 1

1.0 SITE SUMMARY

1.1 Site Description and Mission

The Slick Rock (North Continent) Mill 1 is the location of a former vanadium and uranium milling site that operated from 1931 to the early 1960s. The site lies on the banks of the Dolores River, 4.8 kilometers (3 miles) northwest of Slick Rock in southwestern Colorado. The site is seven hectares (17 acres) in size and approximately two kilometers (one mile) from the Slick Rock (Union Carbide) Mill 2.

LONG-TERM STEWARDSHIP HIGHLIGHTS

Major Long-Term Stewardship Activities - groundwater monitoring; maintaining institutional controls
Total Site Area - 7 hectares (17 acres)
Estimated Volume of Residual Contaminants - groundwater 45,000 cubic meters (59,000 cubic yards)
Long-Term Stewardship Start-End Years - 1996-2109
Average Annual Long-Term Stewardship Cost FY 2000-2006 - n/a (costs begin in FY 2009)
Landlord - U.S. Department of Energy, Grand Junction Office

As a result of past milling operations, contamination at the site consisted of vanadium and uranium mill tailings. Initially, the tailings and milling waste were disposed of on the floodplain below the mill. In 1995, approximately 99,000 cubic meters (129,000 cubic yards) of the contaminated materials were relocated offsite to the nearby Burro Canyon Disposal Cell. The U.S. Department of Energy (DOE) completed surface remediation activities at the site in 1996, and contaminated areas of the site are now reseeded with grass. Groundwater in the alluvial aquifer beneath the site remains contaminated.

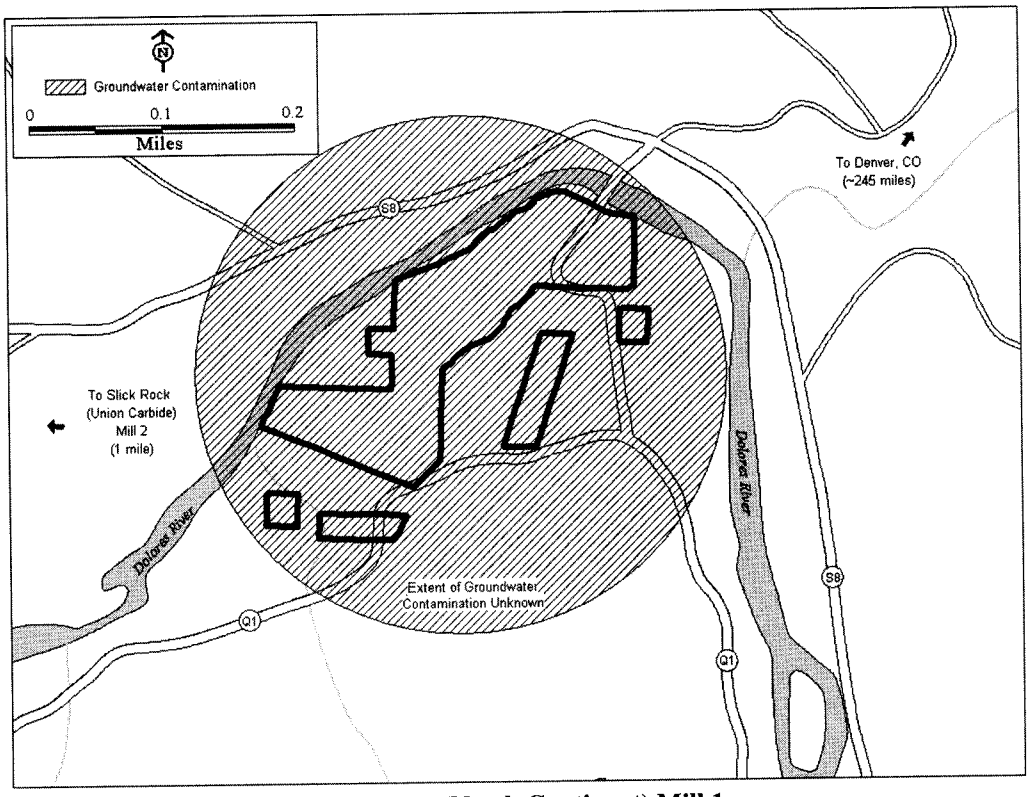
The current mission of the Slick Rock (North Continent) Mill 1 is the remediation of contaminated groundwater that still exists following completion of surface remediation. The former mill site is subject to Title I of the *Uranium Mill Tailings Radiation Control Act of 1978* (UMTRCA). As such, DOE's Grand Junction Office is responsible for remediation and long-term stewardship activities at the site. Long-term stewardship activities include monitoring of the groundwater at the former mill site. The land is privately owned by the UMETCO Minerals Corporation, but funding for long-term stewardship and groundwater remediation is provided by DOE.

The historic mission of the site was to process vanadium and uranium for the U.S. national defense program. The mill was designed to extract vanadium and radium salts from locally mined ores. From 1931 until 1942, vanadium was extracted from ore by a sulfuric acid leaching process. In 1942, the extraction techniques included an initial salt-roast circuit with an acid-leach process to recover vanadium, uranium, and radium concentrates. The mill operations were discontinued in the early 1960s. No other activities were conducted at the site until 1995, when DOE began remedial action.

1.2 Site Cleanup and Accomplishments

The milling operations at the Slick Rock (North Continent) Mill 1 site site caused both surface and groundwater contamination. Residual uranium mill tailings, which typically contain toxic heavy metals and radioactive thorium and radium, were the source of the contamination.

Approximately 99,000 cubic meters (129,000 cubic yards) of contaminated materials were relocated to the Burro Canyon Disposal Cell, approximately three kilometers (two miles) away. In accordance with U.S. Environmental Protection Agency (EPA) standards, the soil at the Slick Rock (North Continent) Mill 1 was remediated and the disturbed areas were graded and revegetated. The statutory wetlands and riparian areas were re-established. DOE completed surface remedial actions at the site in 1996.



Slick Rock (North Continent) Mill 1

Approximately 45,000 cubic meters (59,000 cubic yards) of groundwater are contaminated with materials from processing ores to recover vanadium and uranium. Specifically, the identified constituents of concern include molybdenum, uranium, nitrate, selenium, net gross alpha, and radium. The groundwater plume is 19 hectares (47 acres) and extends into the shallow alluvial and bedrock aquifers beneath the former mill site and offsite. Site contaminants have not degraded water in the adjacent Dolores River. Groundwater characterization activities have not been completed; however, groundwater from the contaminated portion of the aquifers is not used. Therefore, local populations are not threatened by the contamination. Active groundwater remediation is not anticipated to be required. DOE is proposing to use natural flushing to meet the water quality standards. Monitoring will be necessary until the site groundwater complies with water quality standards.

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

DOE's Grand Junction Office is responsible for long-term stewardship activities at the Slick Rock (North Continent) Mill 1. These activities consist of maintaining any institutional controls that may be established and monitoring the progress of passive groundwater restriction at the site. DOE will continue to conduct long-term stewardship activities for the groundwater in accordance with a U.S. Nuclear Regulatory Commission (NRC)-approved plan until the groundwater complies with EPA standards. Surface access is not restricted; however, this region is sparsely populated. There are no other permanent surveillance features at the Slick Rock site, and institutional controls have not been established. However, DOE staffs a 24-hour phone line for reporting any site concerns.

DOE maintains and updates the specific records and reports required to document long-term stewardship activities at the Slick Rock (North Continent) Mill 1. The site records are kept in permanent storage at the DOE Grand Junction Office in Colorado. Types of records maintained include site characterization data, remedial action design information, the site completion report, the groundwater compliance plan, annual inspection reports, and groundwater monitoring results.

2.2 Specific Long-Term Stewardship Activities

Groundwater

Long-term stewardship activities for groundwater are expected to begin in 2008 to ensure that natural flushing is removing contamination in accordance with the EPA's time limit for remediation of 100 years. DOE will conduct groundwater monitoring once every three years. Once the U.S. Nuclear Regulatory Commission (NRC) certifies compliance with Subpart B of EPA's groundwater protection standards (Title 40 of the *Code of Federal Regulations*, Part 192), the site will be released for unrestricted use to its owner, UMETCO.

STAKEHOLDER INTERACTION

Since the surface remedial action was completed, community interaction has been minimal. Copies of the monitoring results for the Slick Rock (North Continent) Mill 1 and other sites are distributed to the local library and to any stakeholders that request them. The monitoring results are also published on the DOE Grand Junction Office website at www.doegjpo.com.

2.3 Regulatory Regime

The *Uranium Mill Tailings Radiation Control Act of 1978* (UMTRCA) authorized DOE to care for the uranium mill tailings sites under a general license issued by NRC for the long-term care of residual radioactive material disposal cells. However, for the actual processing site where the residual radioactive materials were originally located, NRC will not license the site. Compliance with EPA groundwater standards will require NRC concurrence.

Several requirements in the following regulations govern the long-term stewardship of the Slick Rock (North Continent) Mill 1: UMTRCA; the *Atomic Energy Act of 1954,* as amended; EPA Groundwater Protection Standards, including Subparts B and C of Title 40 of the *Code of Federal Regulations*, Part 192; a cooperative agreement between DOE and the State of Colorado; and the *National Environmental Policy Act of 1969,* as amended.

2.4 Assumptions and Uncertainties

DOE assumes that groundwater compliance will be achieved through natural flushing and that active remediation will not be required. Because the site has not completed subsurface remediation, the anticipated long-term stewardship activities at the site are based on requirements at similar sites. However, long-term stewardship activities associated with groundwater monitoring may change slightly because remediation has not yet been completed. DOE assumes that groundwater monitoring will continue indefinitely or until cleanup levels are achieved.

3.0 Estimated Long-Term Stewardship Costs

Estimated costs for the Slick Rock (North Continent) Mill 1 are identified in the table below. The cost estimates are based on the costs of other sites undergoing similar long-term stewardship activities. Cost estimates reflect the current site agreements and monitoring frequencies. DOE will continue groundwater characterization and finalization of a groundwater remediation strategy (natural flushing) in coordination with NRC during fiscal years

(FY) 2000 through 2007. Beginning in FY 2009, long-term stewardship costs are related to groundwater monitoring conducted by DOE. Thereafter, long-stewardship costs for the site are relatively constant, with slight spikes every three years due to the costs associated with groundwater monitoring. For purposes of this report, long-term stewardship costs are shown until FY 2070; however, it is anticipated that the costs will continue until 2109.

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	***Amount***	***Year(s)***	***Amount***	***Year(s)***	***Amount***
FY 2000	$0	**FY 2008**	$0	**FY 2036-2040**	$12,200
FY 2001	$0	**FY 2009**	$11,100	**FY 2041-2045**	$24,000
FY 2002	$0	**FY 2010**	$0	**FY 2046-2050**	$12,200
FY 2003	$0	**FY 2011-2015**	$21,500	**FY 2051-2055**	$24,000
FY 2004	$0	**FY 2016-2020**	$10,800	**FY 2056-2060**	$12,200
FY 2005	$0	**FY 2021-2025**	$21,600	**FY 2061-2065**	$24,000
FY 2006	$0	**FY 2026-2030**	$12,200	**FY 2066-2070**	$12,200
FY 2007	$0	**FY 2031-2035**	$24,000		

4.0 FUTURE USES

UMETCO owns the site; however, NRC continues to regulate the site while it is still in a state of remedial action (i.e., groundwater remediation). Once the groundwater standards are met, the site will be released for unrestricted use to UMETCO.

For more information about the Slick Rock (North Continent) Mill 1, please contact:

Art Kleinrath, Long-Term Surveillance and Maintenance Program Manager
U.S. Department of Energy, Grand Junction Office
2597 B3/4 Road, Grand Junction, CO 81503
Phone: 970-248-6037
or visit the Internet website at http://www.doegjpo.com

SLICK ROCK (UNION CARBIDE) MILL 2

1.0 SITE SUMMARY

1.1 Site Description and Mission

The Slick Rock (Union Carbide) Mill 2 is the location of a former vanadium and uranium milling site that operated from 1957 to 1961. The site is in a rural area of southwestern Colorado, on the banks of the Dolores River, approximately five kilometers (three miles) northwest of Slick Rock, Colorado, and approximately two kilometers (one mile) downriver from the Slick Rock (North Continent) Mill 1. The site occupies 37 hectares (93 acres) in size.

LONG-TERM STEWARDSHIP HIGHLIGHTS

Major Long-Term Stewardship Activities - groundwater monitoring; maintaining institutional controls
Total Site Area - 37 hectares (93 acres)
Estimated Volume of Residual Contaminants - groundwater 98,000 cubic meters (129,000 cubic yards)
Long-Term Stewardship Start-End Years - 1996-2108
Average Annual Long-Term Stewardship Cost FY 2000-2006 - n/a (costs begin in FY 2009)
Landlord - U.S. Department of Energy, Grand Junction Office

As a result of past milling operations, contamination at the site consisted of vanadium and uranium mill tailings and groundwater contaminated by milling activities. In 1995, approximately 513,000 cubic meters (671,000 cubic yards) of the contaminated materials were relocated offsite to the nearby Burro Canyon Disposal Cell. The U.S. Department of Energy (DOE) completed surface remediation activities at the site in 1996, and contaminated areas at the site are now reseeded with grass.

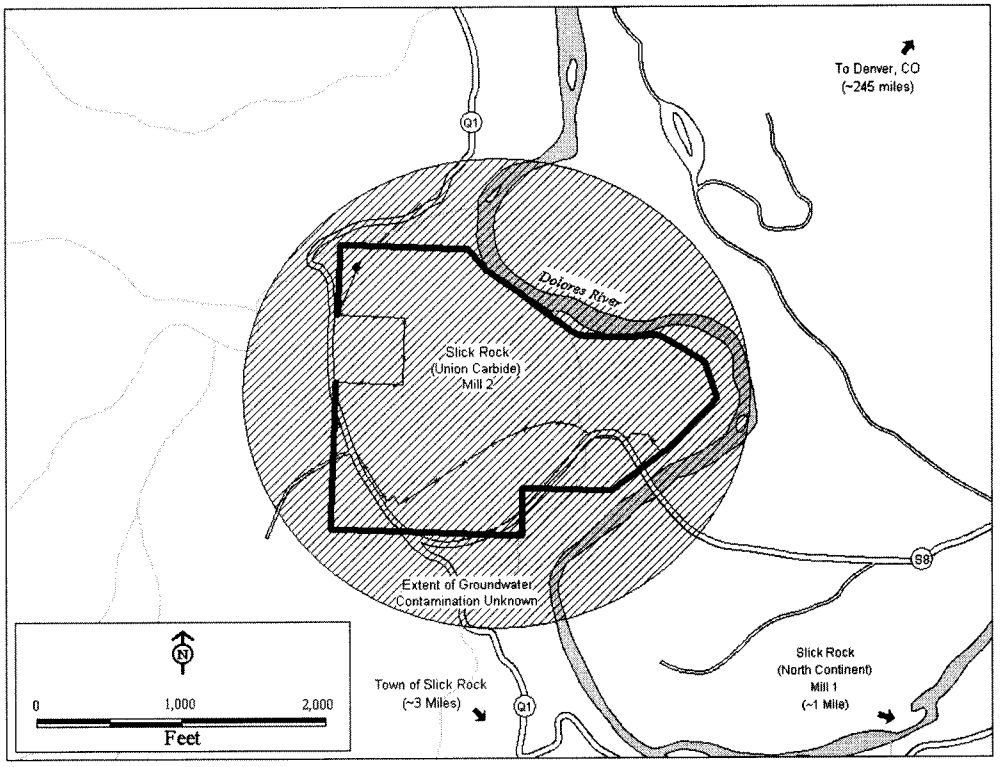
DOE's current mission at the Slick Rock (Union Carbide) Mill 2 is the remediation of contaminated groundwater that still exists following completion of surface remediation. The former mill site is subject to Title I of the *Uranium Mill Tailings Radiation Control Act of 1978* (UMTRCA). As such, DOE is responsible for remediation and long-term stewardship activities at the site. Long-term stewardship activities include monitoring of the groundwater at the former mill site. The land is privately owned by the UMETCO Minerals Corporation, but funding for long-term stewardship and groundwater remediation is provided by DOE.

The historic mission of the site was to process vanadium and uranium for the U.S. national defense program. The Slick Rock (Union Carbide) Mill 2 began operation in 1957, using a uranium-vanadium upgrading technique to process ore mined from the surrounding area. The milling process at the site included an initial step to dry-grind the coarse-grain sandstone, separating the fines from the coarser ore. The upgraded material was shipped to the Union Carbide mill at Rifle, Colorado, for further processing. The Union Carbide mill was closed in December 1961. No other activities were conducted at the site until 1995, when DOE began remedial action.

1.2 Site Cleanup and Accomplishments

The milling operations at the site caused both surface and groundwater contamination. Residual uranium mill tailings, which typically contain toxic heavy metals and radioactive thorium and radium, were the source of the contamination. The tailings pile at the site was composed of fine-grained sand with virtually no slimes because of the process used to separate the finer fraction for shipment offsite.

Approximately 513,000 cubic meters (671,000 cubic yards) of contaminated materials were relocated to the Burro Canyon Disposal Cell, approximately three kilometers (two miles) away. The disturbed areas at the Slick Rock (Union Carbide) Mill 2 were graded and the soil was remediated to U.S. Environmental Protection Agency (EPA) standards. The statutory wetlands and riparian areas were re-established. DOE completed surface remedial actions at the site in 1996.



Slick Rock (Union Carbide) Mill 2

Approximately 98,000 cubic meters (129,000 cubic yards) of groundwater are contaminated with materials from processing ores to recover vanadium and uranium. Specifically, the identified constituents of concern include molybdenum, uranium, nitrate, selenium, net gross alpha, and radium. The groundwater plume is 37 hectares (92 acres) and extends into the shallow alluvial and bedrock aquifers beneath the former mill site. Site contaminants have not degraded the water in the adjacent Dolores River. Groundwater characterization activities have not been completed; however, groundwater from the contaminated portion of the aquifers is not used. Therefore, local populations are not threatened by the contamination. Active groundwater remediation is not anticipated to be required. DOE is proposing to use natural flushing to meet the water quality standards. Monitoring will be necessary until the site groundwater complies with water quality standards.

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

DOE's Grand Junction Office is responsible for long-term stewardship activities at the Slick Rock (Union Carbide) Mill 2. These activities consist of maintaining any institutional controls that may be established and monitoring the progress of passive groundwater restriction at the site. DOE will continue to conduct groundwater-related, postclosure long-term stewardship activities in accordance with a U.S. Nuclear Regulatory Commission (NRC)-approved plan until the groundwater complies with EPA standards. Surface access is not restricted; however, this region is sparsely populated. There are no other permanent surveillance features at the Slick Rock (Union Carbide) Mill 2 site, and institutional controls have not been established. However, DOE staffs a 24-hour phone line for reporting any site concerns.

DOE maintains and updates the specific records and reports required to document long-term stewardship activities at the Slick Rock (Union Carbide) Mill 2 site. The site records are kept in permanent storage at the DOE Grand Junction Office in Colorado. Types of records maintained include site characterization data, remedial action design information, the site completion report, the groundwater compliance plan, annual inspection reports, and groundwater monitoring results.

2.2 Specific Long-Term Stewardship Activities

Groundwater

Long-term stewardship activities for groundwater are expected to begin in 2008 to ensure that natural flushing is removing contamination in accordance with EPA's standard of remediation within 100 years. DOE will conduct groundwater monitoring once every three years. Once NRC certifies compliance with EPA's groundwater protection standards (Title 40 of the *Code of Federal Regulations*, Part 192), the site will be released for unrestricted use to its owner, UMETCO.

STAKEHOLDER INTERACTION

Community interaction has been minimal since the surface remedial action was completed. Copies of the monitoring results for the Slick Rock (Union Carbide) Mill 2 and other sites are distributed to the local library and to any stakeholders that request them. The monitoring results are also published on the DOE Grand Junction Office website at www.doegjpo.com.

2.3 Regulatory Regime

The *Uranium Mill Tailings Radiation Control Act of 1978* (UMTRCA) authorized DOE to care for the uranium mill tailings sites under a general license issued by NRC for the long-term care of residual radioactive material disposal cells. However, for the actual processing site where the residual radioactive materials were originally located, NRC will not license the site. Compliance with EPA groundwater standards will require NRC concurrence.

Several requirements in the following regulations govern the long-term stewardship of the Slick Rock (Union Carbide) Mill 2: the *Uranium Mill Tailings Radiation Control Act of 1978*; the *Atomic Energy Act of 1954,* as amended; EPA Groundwater Protection Standards, including Subparts B and C of Title 40 of the *Code of Federal Regulations*, Part 192; a cooperative agreement between DOE and the State of Colorado; and the *National Environmental Policy Act of 1969,* as amended.

2.4 Assumptions and Uncertainties

DOE assumes that groundwater compliance will be achieved through natural flushing and that active remediation will not be required. Because the site has not completed subsurface remediation, the anticipated long-term stewardship activities at the site are based on requirements at similar sites. However, long-term stewardship activities associated with groundwater monitoring may change slightly because remediation has not yet been completed. DOE assumes that groundwater monitoring will continue indefinitely or until cleanup levels are achieved.

3.0 ESTIMATED LONG-TERM STEWARDSHIP COSTS

Estimated costs for the Slick Rock (Union Carbide) Mill 2 are identified in the table below. The cost estimates are based on the costs of other sites undergoing similar long-term stewardship activities. Cost estimates reflect the current site agreements and monitoring frequencies. DOE will continue groundwater characterization and finalization of a groundwater remediation strategy (natural flushing) in coordination with NRC during fiscal years (FY) 2000 through 2007. Beginning in FY 2009, long-term stewardship costs are related to groundwater monitoring conducted by DOE. Thereafter, long-stewardship costs for the site are relatively constant, with slight

spikes every three years due to the costs associated with groundwater monitoring. For purposes of this report, long-term stewardship costs are shown until FY 2070; however, it is anticipated that the costs will continue until 2108.

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	***Amount***	***Year(s)***	***Amount***	***Year(s)***	***Amount***
FY 2000	$0	**FY 2008**	$0	**FY 2036-2040**	$6,100
FY 2001	$0	**FY 2009**	$5,600	**FY 2041-2045**	$12,000
FY 2002	$0	**FY 2010**	$0	**FY 2046-2050**	$6,100
FY 2003	$0	**FY 2011-2015**	$10,800	**FY 2051-2055**	$12,000
FY 2004	$0	**FY 2016-2020**	$5,400	**FY 2056-2060**	$6,100
FY 2005	$0	**FY 2021-2025**	$10,800	**FY 2061-2065**	$12,000
FY 2006	$0	**FY 2026-2030**	$6,100	**FY 2066-2070**	$6,100
FY 2007	$0	**FY 2031-2035**	$12,000		

4.0 FUTURE USES

UMETCO owns the site; however, NRC continues to regulate the site while it is still in a state of remedial action (i.e., groundwater remediation). Once the groundwater standards are met, the site will be released for unrestricted use to UMETCO.

For more information about the Slick Rock (Union Carbide) Mill 2, please contact:

Art Kleinrath, Long-Term Surveillance and Maintenance Program Manager
U.S. Department of Energy, Grand Junction Office
2597 B3/4 Road, Grand Junction, CO 81503
Phone: 970-248-6037
or visit the Internet website at http://www.doegjpo.com

(UMETCO) MAYBELL SITE 2

1.0 Site Summary

1.1 Site Description and Mission

The (UMETCO) Maybell Site 2 is the location of a former mill built by Union Carbide, used for the recovery of uranium and vanadium. The mill operated between 1975 and 1982. The site occupies 81 hectares (200 acres) and is located in Moffat County, Colorado, about 3.2 kilometers (2 miles) north of U.S. Highway 40 and 6.4 kilometers (4 miles) northeast of the town of Maybell. The area is sparsely populated; residences are limited to a few isolated ranches. Lay Creek, which passes about 1.6 kilometers (1 mile) southeast of the site, has seasonal flow into the Yampa River to the south, and subsequently flows into the Green River and then the Colorado River. At least a dozen open pit uranium mines dot the landscape east of the site, including the neighboring Maybell Mill Site. The UMETCO Maybell Site 2 has 11- to 17-meter (35- to 55-foot) high piles of low-grade uranium ore from nearby open pit mines stored on top of a compacted clay liner.

LONG-TERM STEWARDSHIP HIGHLIGHTS

Major Long-Term Stewardship Activities - disposal cell and groundwater monitoring
Total Site Area - 81 hectares (200 acres)
Estimated Volume of Residual Contaminants - engineered units unknown; groundwater unknown
Long-Term Stewardship Start-End Years - 2001-in perpetuity
Average Annual Long-Term Stewardship Cost FY 2000-2006 - $24,000
Landlord - U.S. Department of Energy, Grand Junction Office (beginning in 2001)

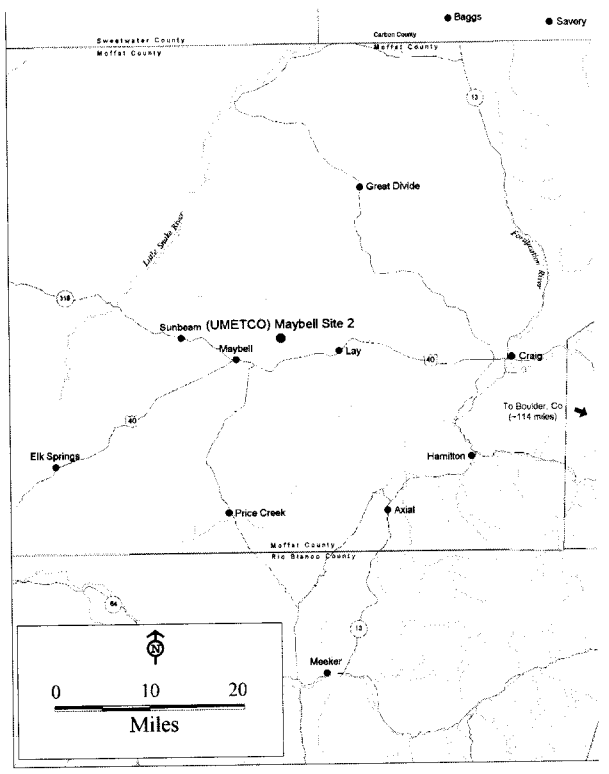
The site is subject to Title II of the *Uranium Mill Tailings Radiation Control Act of 1978* (UMTRCA). UMTRCA Title II sites are privately owned and operated sites that were active when UMTRCA was passed, or thereafter. The mining and milling conducted at these sites was for the private sale of uranium. The (UMETCO) Maybell Site 2 is expected to be transferred to the U.S. Department of Energy (DOE) for long-term-stewardship in 2001. DOE is not responsible for site remediation. UMETCO Minerals Corporation, previously a wholly-owned subsidiary of Union Carbide, but recently purchased by Dow Chemical, is the current owner of the site and is conducting the site cleanup. UMETCO is currently finishing reclamation of the site, including the encapsulation of the contaminated materials onsite in a 26-hectare (64-acre) engineered disposal cell. DOE expects the state license for the site to be terminated by the Colorado Department of Public Health and Environment, which is responsible for overseeing the cleanup, in 2001. Upon termination of the state license, the site will be licensed by the U.S. Nuclear Regulatory Commission (NRC) and transferred to DOE for long-term stewardship. The DOE Grand Junction Office will be the custodian of the site and will be responsible for long-term surveillance and maintenance of the disposal cell.

The historic mission of the (UMETCO) Maybell Site 2 was the recovery of uranium and vanadium originally processed at other mills. During operation, dilute acid was applied on top of the material heaps and allowed to percolate by gravity through the low-grade ore to dissolve the residual uranium. A collection system constructed on top of the clay at the bottom of the heap drained the uranium-laden solution produced by this heap leach process to an adjacent plant for further processing.

1.2 Site Cleanup and Accomplishments

UMETCO submitted a final reclamation plan to the Colorado Department of Public Health and Environment in 1995. After the plan was approved, reclamation began with placement of the process plant demolition debris and contaminated soils into heaps and reshaping of the heaps into one cell to improve long-term stability. Soils were remediated to U.S. Environmental Protection Agency (EPA) standards (as required in Title 40 of the *Code of Federal Regulations*, Part 192), and all identified contaminated materials were encapsulated in an engineered

disposal cell onsite that complies with EPA standards. A new heap drainage system and evaporation pond were constructed to optimize collection of waste liquids from the disposal cell. The drains will be plugged and the evaporation pond will be eliminated once flow from the disposal cell has ceased. The heap has been covered with an earthen radon barrier cap to keep moisture from entering the cell and to control radon emission from the cell. A frost-protection layer was placed over the barrier to guard against frost damage. Finally, a rock erosion-protection layer was placed over the entire cell to keep the cover intact. A rock-lined channel directs surface water from the top of the cell into a diversion channel. Work scheduled for 2000 includes elimination of the evaporation pond and winter storage pond, continued surface recontouring, and site revegetation.



(UMETCO) Maybell Site 2

Groundwater in the vicinity of the site is contaminated with uranium, radium, and other constituents from the processing of uranium ores, natural mineralization and adjacent mining activities. However, no active groundwater remediation will be necessary for the site. Remediation of the groundwater will be completed through natural flushing.

UMETCO plans to transfer title of the reclaimed site to the DOE Grand Junction Office in 2001 after the state license is terminated. The site transfer will be conducted in accordance with NRC regulations on license transfers.

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

Because of the nature of the contaminants present on the site, residual contamination will remain after remediation is complete. DOE currently does not know the volume of residual contamination that will remain in the disposal cell. Upon transfer to DOE, the Grand Junction Office will be responsible for providing long-term stewardship activities for the groundwater and disposal cell at the site and for controlling land use within site boundaries. DOE will provide long-term stewardship services, as required under the NRC license to maintain protectiveness and regulatory compliance. Access will be restricted through the use of fencing and warning signs posted as necessary along the site boundary. DOE will maintain a 24-hour phone line for reporting site concerns. Drilling and other intrusive activities will be prevented within site boundaries through management controls. DOE will conduct annual inspections to ensure the integrity of cell covers and other engineered features and to ensure that institutional controls are effective and the site complies with applicable requirements. Prior to transfer, the Grand Junction Office will prepare a long-term surveillance plan for the site. An inspection report will be submitted annually to the NRC to summarize, describe, and evaluate all surveillance and maintenance actions, as required under Title 10 of the *Code of Federal Regulations*, Part 40, and specified in the site's long-

term surveillance plan.

Site records for the site will be maintained in permanent storage at the DOE Grand Junction Office in Colorado. The types of records maintained will include characterization data, remedial action design information, the site completion report, long-term monitoring plans, annual inspection reports, and historic data.

2.2 Specific Long-Term Stewardship Activities

Groundwater

The site's groundwater monitoring program, which has been in effect since 1991, has identified no increase in radionuclide concentrations in the groundwater. DOE Grand Junction Office groundwater monitoring requirements will be specified in the site's long-term surveillance plan, to be approved by the NRC at the time of site transfer and license of the site to DOE. Assuming that the compliance strategy for remediating the contaminated groundwater below the site will be natural flushing, long-term stewardship activities for groundwater will be limited to routine sampling.

STAKEHOLDER INVOLVEMENT

When the site is licensed and transferred to DOE, copies of the annual inspection report for the UMETCO Maybell Site 2 will be distributed to the local library and to any stakeholders that request copies. The report is also published on the DOE Grand Junction Office website at www.doegjpo.com.

Engineered Units

Radioactive materials onsite have been consolidated and covered with an engineered radon barrier cover that has been tested and meets the EPA's radon release rate requirements. The disposal cell will have a low permeability radon barrier cover and rock surface layer for erosion control. Erosion control will be provided for all potentially vulnerable features, and the site will be graded to provide positive drainage. Annual inspections will be conducted to verify the integrity of the visible features of the engineered units (i.e., check for subsidence, bioinstrusion, and the condition of riprap).

2.3 Assumptions and Uncertainties

The actual site transfer date is currently uncertain. The transfer date depends on when remediation activities will be completed. Cleanup levels will be achieved before the site is transferred to DOE for long-term stewardship. It is assumed that no active groundwater remediation will be required and that natural flushing will remediate the groundwater. Groundwater monitoring may or may not continue indefinitely, based on site-specific circumstances and hydrology, or until data demonstrate that the cell achieves infiltration control.

2.4 Regulatory Regime

The site is currently licensed by the Colorado Department of Public Health and Environment under the Colorado Agreement State program with NRC. Once the (UMETCO) Maybell Site 2 remediation is complete, Colorado will forfeit its licensing authority for this site to the NRC so that the site can be licensed for long-term stewardship. Following NRC concurrence that cleanup has been achieved, the NRC, in accordance with regulations (Title 10 of the *Code of Federal Regulations,* Part 40.28), will accept the site under it's a general license for the long-term care of the residual radioactive disposal cell. The purpose of the license is to ensure the site will be cared for in a manner that protects human health and safety and the environment. The license also means the NRC formally accepts the site's long-term surveillance plan.

The long-term stewardship activities of the site will be governed by several requirements in the following regulations: the *Uranium Mill Tailings Radiation Control Act of 1978* (UMTRCA); the *Atomic Energy Act of 1954,* as amended; a cooperative agreements between DOE and the State of Colorado; and the *National Environmental Policy Act of 1969*, as amended.

3.0 Estimated Long-Term Stewardship Costs

DOE currently is not conducting long-term stewardship activities at the (UMETCO) Maybell Site 2. The site will be transferred to DOE in 2001. Cost estimates are based on the projected costs of long-term stewardship activities at this site and the other sites currently managed by the DOE Grand Junction Program.

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	***Amount***	***Year(s)***	***Amount***	***Year(s)***	***Amount***
FY 2000	$4,200	**FY 2008**	$26,300	**FY 2036-2040**	$127,900
FY 2001	$31,200	**FY 2009**	$26,300	**FY 2041-2045**	$127,800
FY 2002	$27,100	**FY 2010**	$25,700	**FY 2046-2050**	$127,900
FY 2003	$26,100	**FY 2011-2015**	$122,700	**FY 2051-2055**	$127,800
FY 2004	$26,400	**FY 2016-2020**	$119,400	**FY 2056-2060**	$127,900
FY 2005	$26,600	**FY 2021-2025**	$119,800	**FY 2061-2065**	$127,800
FY 2006	$26,100	**FY 2026-2030**	$126,600	**FY 2066-2070**	$127,900
FY 2007	$26,500	**FY 2031-2035**	$127,800		

4.0 Future Uses

The site will be a permanent uranium mill tailings repository. Public access to the site will be restricted in perpetuity. The site will be fenced and marked as appropriate.

For more information about the (UMETCO) Maybell Site 2, please contact:

Art Kleinrath, Long-Term Surveillance and Maintenance Program Manager
U.S. Department of Energy, Grand Junction Office
2597 B3/4 Road, Grand Junction, CO 81503
Phone: 970-248-6037
or visit the Internet website at http://www.doegjpo.com

(UMETCO) URAVAN SITE[1]

1.0 SITE SUMMARY

1.1 Site Description and Mission

> ***LONG-TERM STEWARDSHIP HIGHLIGHTS***
>
> *Total Site Area* - 182 hectares (450 acres) (acreage to be transferred to DOE for long-term stewardship is unknown)
> *Estimated Volume of Residual Contaminants* - unknown
> *Current Landlord* - UMETCO Minerals Corporation
> *Expected Long-Term Stewardship Start-End Years* - 2010-in perpetuity
> *Expected Future Landlord* - U.S. Department of Energy, Grand Junction Office (beginning in 2010)
> *Reason Not Subject to NDAA Requirements* - This site is not expected to be transferred to DOE until 2010

The (UMETCO) Uravan Site is the location of a former uranium and vanadium recovery facility that operated between 1912 and 1985. The site is located in Montrose County, Colorado, approximately 21 kilometers (13 miles) northwest of the town of Nucla, and 145 kilometers (90 miles) southwest of the city of Grand Junction. The site is located on the bank of the San Miguel River, which flows into the Dolores River and is a tributary of the Colorado River. The site boundary currently comprises 182 hectares (450 acres) and is owned by a private company, UMETCO. The (UMETCO) Uravan Site is subject to Title II of the *Uranium Mill Tailings Radiation Control Act of 1978* (UMTRCA). UMTRCA Title II sites are privately owned and operated sites that were active when UMTRCA was passed, or thereafter. The majority of the mining and milling conducted at these sites was for the private sale of uranium, but a portion of the uranium was sold to the U.S. Government.

Contamination of the site resulted from previous uranium milling operations. The milling operations created process-related wastes and tailings. Approximately 10.5 million tons of tailings and low-level radioactive waste (uranium, radium, and thorium in soils and construction debris) remain to be disposed of in on-site engineered disposal cells. Thus, remediation of the site has not been completed.

The (UMETCO) Uravan Site is expected to be transferred to the U.S. Department of Energy (DOE) for long-term-stewardship in 2010. As an UMTRCA Title II site, DOE will not be responsible for site remediation. The number of acres that will be transferred to DOE has not yet been determined. Once the site is transferred to DOE, the only site mission will be the long-term surveillance and maintenance of the disposal cell.

The site's historic mission was to supply uranium concentrate to the Federal Government. The site first began as a radium recovery plant in 1912 and was expanded to include vanadium recovery in 1935. The site operated from the 1940s to 1985 as a uranium recovery facility. The town of Uravan, Colorado, was constructed and owned by Union Carbide (then U.S. Vanadium Corporation) in 1935 to house mine and mill workers. In 1984, Union Carbide formed a wholly-owned subsidiary, UMETCO, which operated the facility until it closed. At one time, more than 800 people lived along the tree-lined streets, which included housing, schools, medical facilities,

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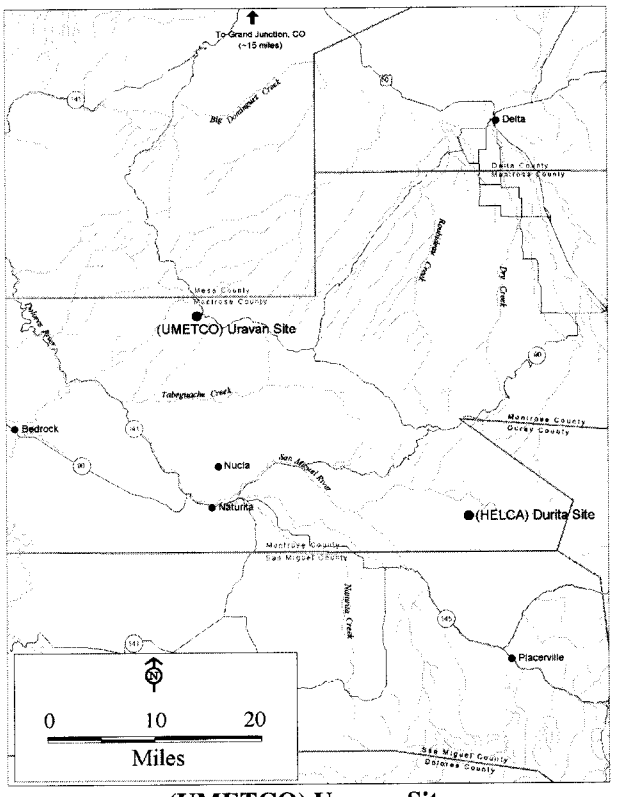
[1]This report is developed in response to a Congressional request in the Fiscal Year (FY) 2000 National Defense Authorization Act (NDAA). As requested by the Act, this report addresses current and anticipated long-term stewardship activities at each site or portion of a site by the end of calendar year 2006 ("Conference Report on S.1059, National Defense Authorization Act for Fiscal Year 2000," *Congressional Record,* August 5, 1999).

Based on current planning, the (UMETCO) Uravan Site is not expected to be transferred to the U.S. Department of Energy (DOE) for long-term stewardship until 2010, and for this reason the site is not the primary focus of this report. This brief summary of the site cleanup activities is provided for background information and potential future long-term stewardship activities. (See Section 3.2 of Volume I).

tennis courts, a recreation center, and pool provided by the company. The town has since been evacuated and demolished.



(UMETCO) Uravan Site

1.2 Site Cleanup and Accomplishments

Past operations at the (UMETCO) Uravan Site left a complex mixture of contaminants, including radioactive liquid wastes from uranium processing operations, radioactive ammonium sulfate crystals, and mill tailings containing uranium and radium. Other constituents of the tailings, soil, and groundwater included lead, arsenic, cadmium, vanadium, thorium, and residual salts. The (UMETCO) Uravan Site was placed on the U.S. Environmental Protection Agency's (EPA) National Priorities List on June 6, 1986. The Colorado Department of Public Health became the lead agency for the remediation activities. The State of Colorado developed a remediation plan for the site in 1986 that was designed to control radon production and the migration of metals, thorium, and residual salts from the site. Remedial activities include:

- Disposing of 7.6 million cubic meters (9.9 million cubic yards) of tailings in an on-site disposal cell;
- Capping and revegetating the tailings disposal cell area;
- Dismantling two mills and removing process ponds;
- Constructing a clay-lined disposal system for 405,000 cubic meters (530,000 cubic yards) of radioactive crystals;
- Extracting and treating contaminated groundwater;
- Constructing two lined evaporation ponds for groundwater treatment;
- Moving 1.1 cubic meters (1.5 million cubic yards) of waste away from the San Miguel River to a disposal site;
- Excavating and disposing of contaminated soil in an on-site disposal cell;
- Reclaiming and revegetating the former mill site and other site areas; and
- Dismantling and remediating the town of Uravan.

The liquids from the unlined ponds were pumped by UMETCO into the newly constructed lined ponds. Process pond water and seep water were collected and evaporated in the ponds. Crystals from the old ponds were dewatered prior to disposal in the lined disposal cell. Construction and remediation activities at the site are 90 percent completed, and remediation is anticipated to be completed in 2000, except for groundwater remediation and monitoring. Two existing mine buildings that have historic resource value are anticipated to remain onsite after remediation is completed. The (UMETCO) Uravan Site is expected to be transferred to DOE in 2010; however, the State of Colorado has not yet declined its option to be the long-term custodian for this site.

2.0 POTENTIAL LONG-TERM STEWARDSHIP

The extent of long-term stewardship that will be required is not known. However, it is expected that groundwater monitoring and monitoring and maintenance of the disposal cells will be required.

3.0 EXPECTED FUTURE USE AND SITE RESPONSIBILITY

UMETCO is responsible for all activities that take place at the (UMETCO) Uravan Site. Once the site license is transferred to DOE (anticipated in 2010), access to the disposal site is expected to be restricted and the site will become a permanent uranium mill tailings repository. DOE's Grand Junction Office will be responsible for funding and providing long-term stewardship activities, including groundwater monitoring and disposal cell surveillance and maintenance. Site records will be maintained in permanent storage at the DOE Grand Junction Office. Types of records to be maintained include characterization data, remedial action design information, the site completion report, long-term monitoring plans, annual inspection reports, and monitoring data.

Groundwater in the vicinity of the former mill is contaminated with materials (radionuclides including radium, thorium, and uranium; and metals, including vanadium, lead, arsenic, cadmium) from processing ores to recover radium, uranium, and vanadium. The groundwater will require monitoring for an unspecified time to ensure effectiveness of the remedy.

The (UMETCO) Uravan site will contain multiple disposal cells. The area for those disposal cells has not yet been determined. The level of contamination that will remain after remediation and the extent of required stewardship will be determined prior to transfer. The disposal cells will be surrounded by a fence to control access and will require annual monitoring to ensure the integrity of the caps. The disposal cells will have radon barriers and surface layers to control erosion. The covers must be designed to remain effective 200 to 1,000 years, in accordance with EPA requirements. About 5.9 million cubic meters (7.8 million cubic yards) of low-level radioactive waste (uranium, radium and thorium in soils and construction debris) and uranium mill tailings are expected to be disposed of in engineered, lined disposal cells.

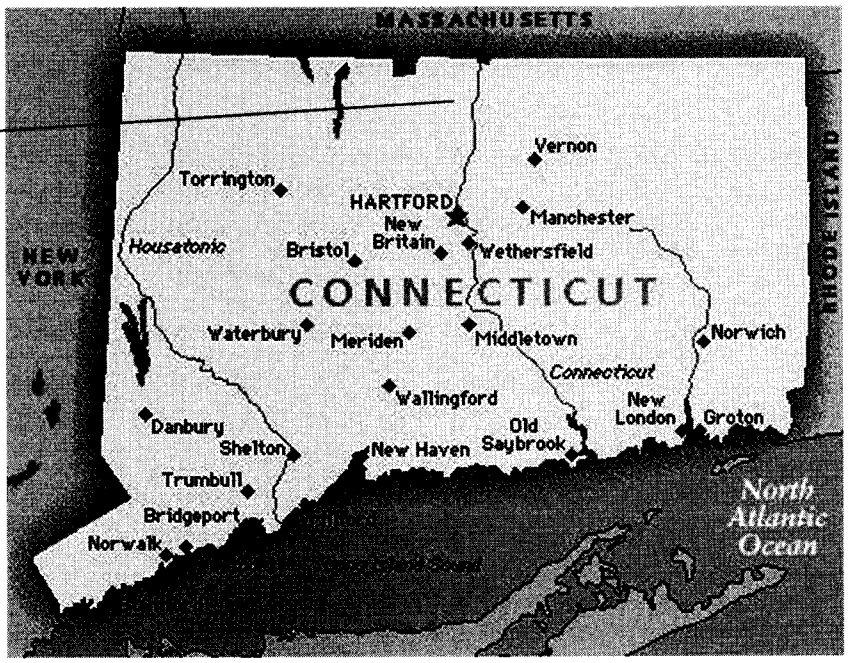
Upon coming under a general license by the U.S. Nuclear Regulatory Commission (NRC) and transfer to DOE, the disposal site will be owned by the Federal Government, which will control land use within the site boundaries. DOE will provide long-term stewardship services, as required under the NRC license to maintain protectiveness and regulatory compliance. Access will be restricted through the use of fencing and warning signs posted, as necessary, along the site boundary. DOE will maintain a 24-hour phone line for reporting site concerns. Drilling and other intrusive activities will be prevented within site boundaries through management control. DOE will conduct annual inspections to ensure the integrity of the cell covers and other engineered features, and to ensure that institutional controls are effective and the site complies with applicable requirements.

For additional information about the (UMETCO) Uravan Site, please contact:

Art Kleinrath, Long-Term Surveillance and
Maintenance Program Manager
U.S. Department of Energy, Grand Junction Office
2597 B3/4 Road
Grand Junction, CO 81503
Phone: 970-248-6037
or visit the Internet website at http://www.doegjpo.com

Richard W. Weller, Project Manager
Uranium Recovery and Low-Level Waste Branch
U.S. Nuclear Regulatory Commission
Mail Stop 7J8
Washington, DC 20555-001
Phone: 301-415-7287
or visit the Internet website at http://www.nrc.gov

Connecticut



Long-Term Stewardship Site Highlights

CE (page 3)
Unknown

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CE 3

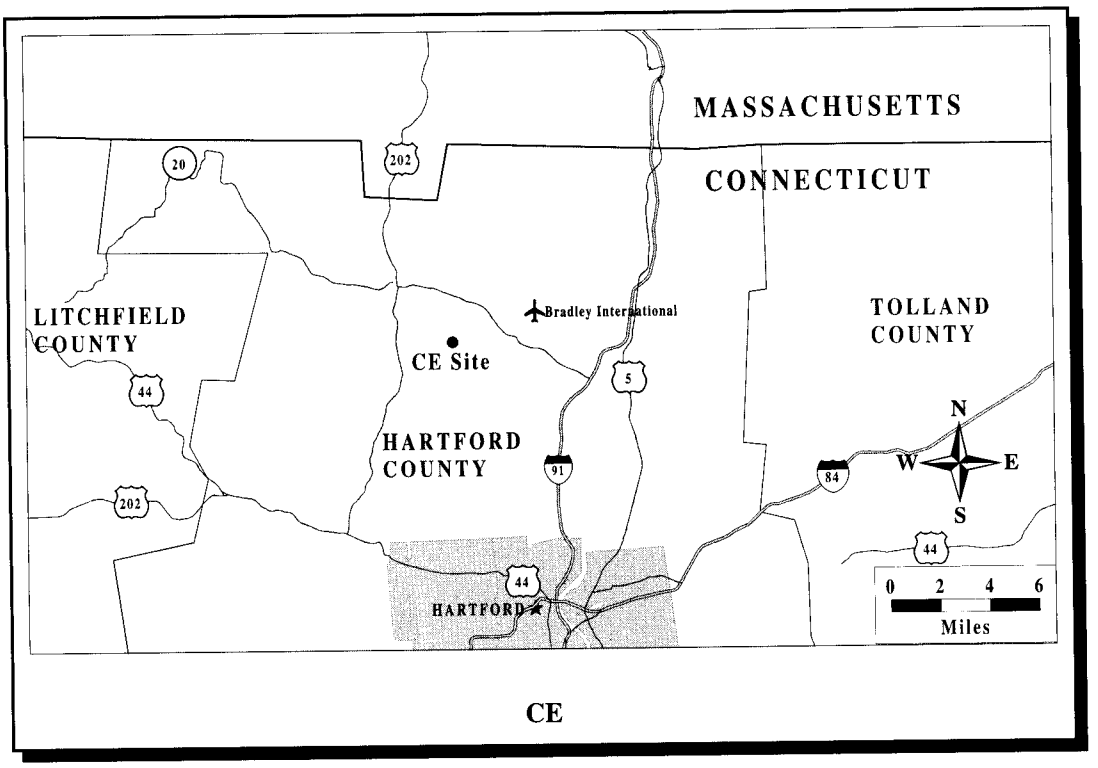
CE[1]

SITE SUMMARY

The CE site is located 13 kilometers (8 miles) north of Hartford, Connecticut in Hartford County. The CE site was used during the 1950s and 1960s for nuclear research, development and production of nuclear fuel. In Buildings 3 and 5 of the CE site, Combustion Engineering conducted contractual work for the Atomic Energy Commission (AEC), a predecessor agency to the U.S. Department of Energy, and commercial work for other customers.

The AEC-contracted work in Building 3 began in the 1950s and included research and development and fuel fabrication of high-enriched uranium and other fuels. The date when AEC-supported activities ceased is unknown. A wide range of commercial activities, which began in the early 1960s, were conducted in Building 5 and elsewhere on the CE Site. One of the major commercial products was commercial nuclear power plant fuel that was fabricated with uranium oxide.

A survey of CE's Burn and Drum Storage Area was conducted in the late 1980s by the Oak Ridge Institute for Science and Education (ORISE) for the U.S. Nuclear Regulatory Commission (NRC). The survey results found the area to be within the NRC's guidelines for thorium and uranium in soil. ORISE also took several samples nearby at the (dry) Waste Storage Pond. ORISE found that the soil and debris samples were radioactively



CE

[1] The CE site is one of the 21 Formerly Utilized Sites Remedial Action Program (FUSRAP) sites where cleanup responsibility was transferred to the U.S. Army Corps of Engineers (Corps) in accordance with the Energy and Water Development Appropriations Act for FY 1998. At these 21 sites, the Corps is responsible for remediation and DOE is responsible for long-term stewardship activities, if any are deemed necessary. The cleanup decisions for these sites are not yet final and, therefore, the extent of long-term stewardship required for these sites, if any, is not yet known.

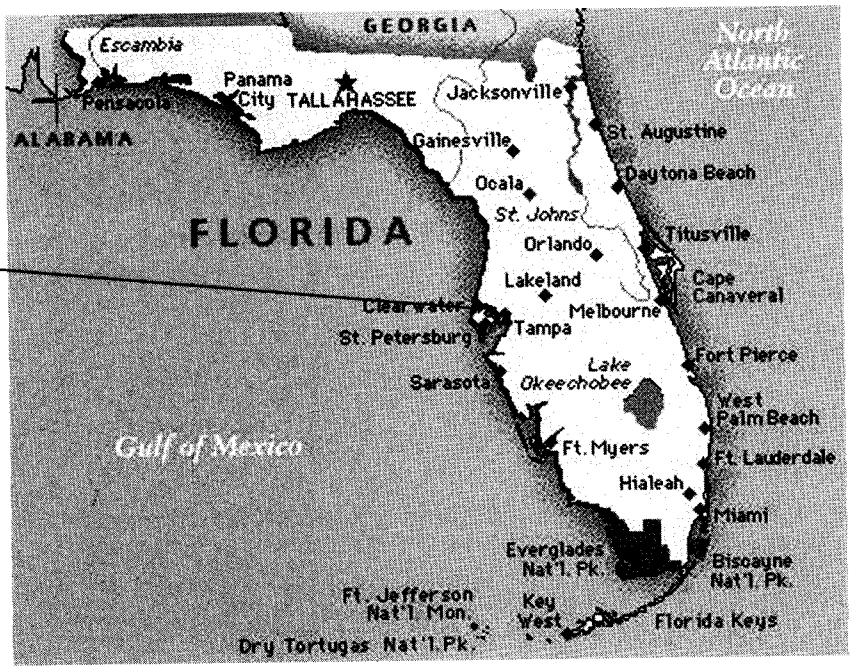
contaminated. In the 1990s, another ORISE survey of portions of the site used for AEC activities, or portions of the site affected by these activities, revealed additional uranium contamination in various areas of the site.

In 1994, the CE Site was included in the Formerly Utilized Sites Remedial Action Program (FUSRAP). The designation of this site did not include areas affected by the commercial activities that were conducted at the site. Instead, the designation (cleanup under FUSRAP) is restricted to those areas that were affected by AEC contractual activities involving high-enriched uranium (Building 3, the waste storage pad area, some sewer lines, and the drum burial area and surrounding soil) and for which the Department has authority to conduct remedial action under FUSRAP. In 1997, CE was transferred to the U.S. Army Corps of Engineers (Corps) for remediation under FUSRAP. The remedial action for this site is not yet complete and, therefore, the extent of long-term stewardship required, if any, is not yet known.

For additional information about the CE Site, please contact:

Public Affairs Office
New England District
U.S. Army Corps of Engineers
696 Virginia Road
Concord, MA 01742-2751
Phone: 978-318-8264
or visit the Internet website at: http://www.nae.usace.army.mil/

Florida



Pinellas STAR Center

Long-Term Stewardship Site Highlights

Pinellas STAR Center (page 3)

Major Activities - groundwater monitoring and sampling
Site Size - 40 hectares (100 acres)
Estimated Average Annual Cost FY 2000-2006 - n/a (costs begin in FY 2015)

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Pinellas STAR Center 3

PINELLAS STAR CENTER[1]

1.0 SITE SUMMARY

1.1 Site Description and Mission

> ***LONG-TERM STEWARDSHIP HIGHLIGHTS***
>
> *Major Long-Term Stewardship Activities* - groundwater monitoring and sampling
> *Total Site Area* - 40 hectares (100 acres)
> *Estimated Volume of Residual Contaminants* - unknown
> *Portions Requiring Long-Term Stewardship as of 2006* - 0
> *Average Annual Long-Term Stewardship Cost FY 2000-2006* - n/a (costs begin in FY 2015)
> *Landlord* - Pinellas County, Florida

The Pinellas Science, Technology, and Research (STAR) Center, formerly known as the Pinellas Plant, occupies a 40-hectare (100-acre) site in western Florida on a peninsula bordered by the Gulf of Mexico and Tampa Bay, approximately ten kilometers (six miles) north of St. Petersburg. The Plant was part of the U.S. Department of Energy (DOE) and predecessor agency nuclear weapons complex from 1957 until 1995, when it was sold to the Pinellas County Industrial Council. DOE completed transfer of facility control to the Pinellas County Industrial Council for commercial/community use in 1997. Although the facility is no longer owned by DOE, DOE is still responsible for conducting the remaining environmental restoration activities at the site, primarily groundwater remediation and subsequent long-term surveillance and monitoring of the groundwater.

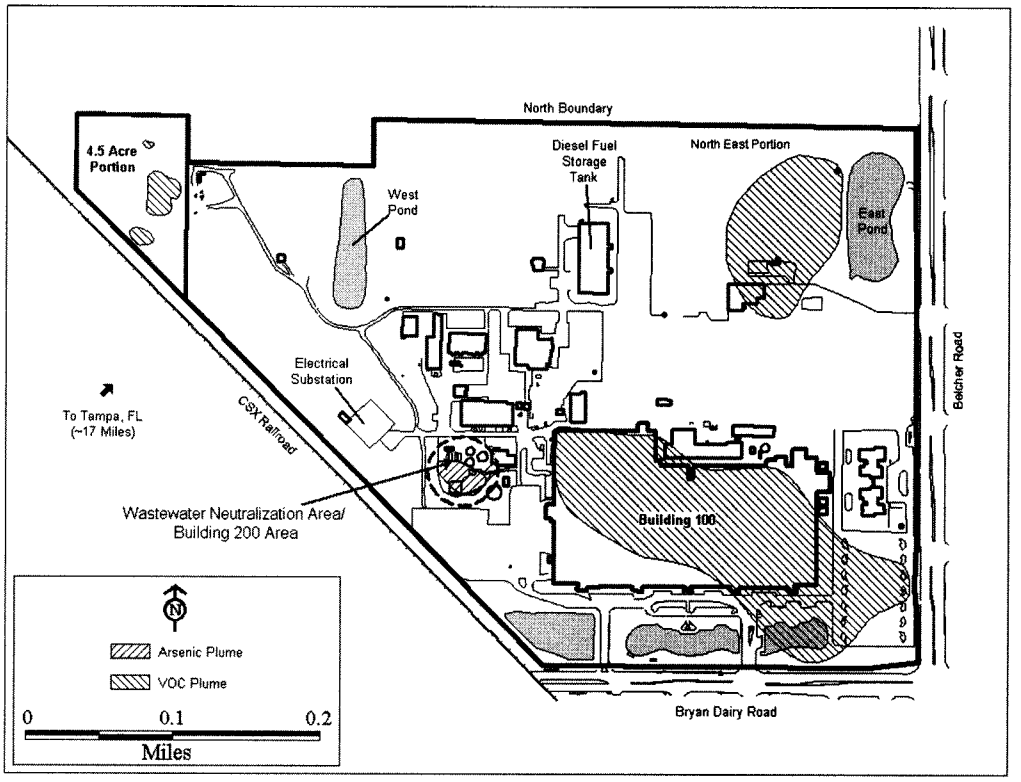
The facility was built in 1956, as part of DOE nuclear weapons research and development program in response to the need for a facility to manufacture neutron generators for use in nuclear weapons. While neutron generators were the principal products of the facility, other products were added over the years, such as thermal batteries, specialty capacitors, crystal resonators, neutron detectors, lightning arrestor connectors, vacuum switch tubes, and other special mechanical and electronic components.

In September 1994, the facility stopped producing weapons-related components and began the transition from a defense mission to an environmental management mission. DOE transferred production capability from the facility to two other DOE sites, the Kansas City Plant and the Sandia National Laboratories, New Mexico. In March 1995, when DOE sold the facility to the Pinellas County Industry Council, DOE leased back a large area of the plant site to facilitate the completion of cleanup activities and to prepare the site for alternative uses as a community resource for economic development. These activities were completed by the end of 1997. The facility is now known as the Pinellas STAR Center and houses more than 20 businesses that range from administrative to light manufacturing.

1.2 Site Cleanup and Accomplishments

As part of the sale to the Pinellas County Industry Council, DOE agreed to clean up all areas contaminated during past performance of government-funded work and to restore them to levels consistent with regulations and planned future use. The resulting contamination consisted of minor surface contamination of previous plant production areas and external groundwater contamination. DOE cleaned up the production areas, and these areas

[1]Surface cleanup at the site was completed in 1999 to an unrestricted use level. Groundwater cleanup is ongoing and expected to continue until 2014. Although the surface was cleaned up to unrestricted use, certain areas of the site are access controlled as part of ongoing groundwater remediation activities and will continue until it is deemed unnecessary.



Pinellas Star Center

were then released to the new owner for unrestricted use in 1997. There are no more surface contaminants at the site.

Under the terms of DOE's Hazardous and Solid Waste Amendments Permit, issued by the U.S Environmental Protection Agency (EPA) in 1990, DOE has completed remediation of the groundwater at one Solid Waste Management Unit (SWMU), the West Fenceline Site. Twelve other SWMUs required no further action. Groundwater remediation, utilizing groundwater extraction and treatment, continue at four SWMUs -- the Northeast Site, the Wastewater Neutralization (WWNA)/Building 200 Area, the Old Drum Storage Site and the Building 100 Area. Once the groundwater meets the federally mandated maximum contaminant levels (MCLs), DOE will be responsible for any long-term surveillance and maintenance requirements that may be required. DOE expects to complete subsurface remediation in 2014.

Remediation of contaminated groundwater is also ongoing at a privately owned parcel of land adjacent to the STAR Center that was previously owned by DOE. Currently, DOE leases the 1.8-hectare site (known as the "4.5-Acre Site") from the landowner and is actively pursuing groundwater remediation by utilizing in-situ biosparging. The Florida Department of Environmental Protection has oversight responsibility for the 4.5 Acre Site.

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

Once the groundwater remediation project is complete, the long-term surveillance and monitoring at the

STAKEHOLDER INVOLVEMENT

Community interaction has been and will continue to be extensive. A federal employee is cost-shared with the county to facilitate communication with the local government.

Pinellas STAR Center may consist of periodic sampling of the site groundwater to monitor for volatile organic compounds.

Site records for environmental remediation at the Pinellas STAR Center are kept in permanent storage at DOE's Grand Junction Office in Grand Junction, Colorado. Types of records include characterization data, remedial action design, completion reports, long-term monitoring plan, annual inspection reports, and any monitoring data.

Final land-use restrictions, if any, will be determined by the appropriate state or federal regulatory agency, in consultation with DOE and Pinellas County, upon completion of cleanup activities. Future land-use restrictions, such as deed restrictions, memoranda of understanding, restrictive easements, and other legal instruments, may be used to minimize the potential exposure to residual levels of contaminated groundwater.

2.2 Assumptions and Uncertainties

DOE assumes that the designated groundwater cleanup levels will be met. If they cannot be met, it may be necessary to apply for alternative cleanup levels because of "technical impracticality," but this will have to be demonstrated to the satisfaction of the appropriate regulatory authority.

The projected schedule and costs for long-term stewardship activities are based upon the assumption that the regulators will require some level of sampling and analysis to be performed following completion of cleanup activities.

2.3 Estimated Site-Wide Long-Term Stewardship Costs

Estimated long-term stewardship costs for the Pinellas STAR Center, identified in the table below, are based on potential monitoring and sampling of groundwater, which is expected to begin in 2015. Until then, the site is expected to continue performing remediation activities, which are funded through the groundwater project.

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	***Amount***	***Year(s)***	***Amount***	***Year(s)***	***Amount***
FY 2000	$0	**FY 2008**	$0	**FY 2036-2040**	$0
FY 2001	$0	**FY 2009**	$0	**FY 2041-2045**	$0
FY 2002	$0	**FY 2010**	$0	**FY 2046-2050**	$0
FY 2003	$0	**FY 2011-2015**	$76,800	**FY 2051-2055**	$0
FY 2004	$0	**FY 2016-2020**	$384,000	**FY 2056-2060**	$0
FY 2005	$0	**FY 2021-2025**	$384,000	**FY 2061-2065**	$0
FY 2006	$0	**FY 2026-2030**	$384,000	**FY 2066-2070**	$0
FY 2007	$0	**FY 2031-2035**	$384,000		

3.0 PORTION OVERVIEW

Remediation activities at the DOE Pinellas STAR Center comprise four areas that may require long-term stewardship: the Building 100/Old Drum Storage Area (combined due to their adjacent location), the Northeast Site, the Wastewater Neutralization/Building 200 Area, and the 4.5 Acre Site. These sites, with the exception

of the 4.5 Acre Site, are designated as SWMUs and have groundwater contamination at levels in excess of protective standards. Contaminants in the groundwater consist of common solvents, such as methylene chloride and trichloroethylene (TCE), used in previous DOE production activities.

The 4.5 Acre Site is under a voluntary cleanup by the State of Florida's Department of Environmental Protection. The three other areas are currently undergoing remediation and are under the purview of the U.S. Environment Protection Agency (EPA), Region IV, Atlanta. Cleanup, for these sites, is being conducted under EPA's *Resource Conservation and Recovery Act* (RCRA) Corrective Action Program and the Hazardous and Solid Waste Amendments of 1984. This legislation requires DOE to investigate and perform remediation activities in areas that are contaminated with hazardous materials resulting from DOE operations. Groundwater quality is routinely monitored to ensure regulatory compliance.

Long-Term Stewardship Information		
Portion	***Long-Term Stewardship Start Year***	***Long-Term Stewardship End Year***
Building 100/Old Drum Storage Area	2015	2035
Northeast	2015	2035
4.5 Acre Site	2015	2035
Wastewater Neutralization Area/Building 200 Area	2015	2035

3.1 Building 100/Old Drum Storage Area

The Building 100/Old Drum Storage Area is located in the southeast area of the STAR Center. The remediation alternative currently being implemented for the Building 100 Area consists of pumping the contaminated groundwater and treating it with an above-ground air-stripper system. Two groundwater recovery wells near the northwest corner of the building extract the contaminated groundwater that is then pumped to an air-stripper system at the Northeast Site. Remediation is ongoing and is expected to be completed by 2014.

BUILDING 100/OLD DRUM STORAGE AREA PORTION HIGHLIGHTS

Major Long-Term Stewardship Activities - groundwater sampling and monitoring
Portion Size - 4 hectares (10 acres)
Estimated Volume of Residual Contaminants - groundwater to be determined
Long-Term Stewardship Start -End Years - 2015-2035

Long-Term Stewardship Activities

At present the site expects to meet the regulatory imposed clean-up standards by 2014. After remediation, it is expected that the regulators may require that the groundwater be routinely monitored to ensure regulatory compliance. Subsequent sampling and analysis, under the long-term surveillance and maintenance program, will most likely be required by the regulator for an as yet undetermined period of time to ensure that site contamination levels do not reoccur.

3.1.1 Estimated Long-Term Stewardship Costs for the Building 100/Old Drum Storage Area

Cost estimates are based on the projected costs for groundwater sampling and monitoring.

Long-Term Stewardship Costs (Constant Year 2000 Dollars)							
FY 2000 - FY 2010	*FY 2011 - FY 2020*	*FY 2021 - FY 2030*	*FY 2031 - FY 2040*	*FY 2041 - FY 2050*	*FY 2051 - FY 2060*	*FY 2061 - FY 2070*	*Estimated Total*
$0	$115,200	$192,000	$96,000	$0	$0	$0	$403,200

3.2 Northeast Site

The Northeast Site is located in the northeastern area of the Pinellas STAR Center. The site has been covered with landscaping grass and contains no permanent buildings. The site encompasses approximately 4.8 hectares (12 acres) and is generally flat, with slight elevation changes near the pond. Access to the Northeast Site is restricted and protected by fencing. The Northeast Site was the location of a former waste solvent staging and storage area. From the late 1950s to the late 1960s, before construction of the East Pond, an existing swampy area at the site was used to dispose of drums of waste and construction debris. The East Pond was excavated in 1968 as a borrow pit. In 1986, expansion of the East Pond was initiated to create additional storm water retention capacity. Excavation activities ceased when contamination was detected directly west of the East Pond.

NORTHEAST SITE PORTION HIGHLIGHTS

Major Long-Term Stewardship Activities - groundwater sampling and monitoring
Portion Size - 4 hectares (12 acres)
Estimated Volume of Residual Contaminants - groundwater to be determined
Long-Term Stewardship Start-End Years - 2015-2035

The Northeast Site consists of a shallow groundwater aquifer contaminated with a variety of volatile organic contaminants, including chlorinated solvents such as TCE, methylene chloride, dichloroethene (DCE), and vinyl chloride. The primary management practice that contributed to contamination was the disposal of construction debris and drums/containers of resin. Contamination at the Northeast Site is believed to be the result of leakage of solvents or resins from those drums. As a result of the contamination, an Interim Corrective Measures Study was conducted and approved by EPA. In January 1992, an interim groundwater recovery system for the Northeast Site was installed and began operation. The system consisted of groundwater recovery wells that extracted the groundwater for temporary storage in a holding tank before being pumped to the existing 4.5 Acre Site groundwater treatment system for treatment.

In 1996, DOE submitted a Corrective Measures Implementation Plan to EPA and the Florida Department of Environmental Protection for the Northeast Site. This plan, which recommended a stand-alone pump-and-treat groundwater recovery system for the site, was approved by the regulators in 1997. Installation and initial operation of the system was completed in 1997.

Long-Term Stewardship Activities

At present, DOE expects that the site will meet the regulatory imposed cleanup standards by 2014. After remediation, it is expected that groundwater will be routinely monitored to ensure regulatory compliance. Subsequent sampling and analysis, under the long-term surveillance and maintenance program, will most likely be required by the regulator for an as yet undetermined period of time to ensure that site contamination levels do not reoccur.

3.2.1 Estimated Long-Term Stewardship Costs for the Northeast Site

Cost estimates are based on the projected costs for groundwater sampling and monitoring.

Long-Term Stewardship Costs (Constant Year 2000 Dollars)							
FY 2000 - FY 2010	*FY 2011 - FY 2020*	*FY 2021 - FY 2030*	*FY 2031 - FY 2040*	*FY 2041 - FY 2050*	*FY 2051 - FY 2060*	*FY 2061 - FY 2070*	*Estimated Total*
$0	$115,200	$192,000	$96,000	$0	$0	$0	$403,200

3.3 4.5 Acre Site

The 4.5-Acre Site, originally part of the Pinellas Plant, was sold to a private individual in 1972. During the 1960s, the site was used for subsurface disposal of drummed waste solvent and waste resinous materials. Buried drums were uncovered during a geophysical survey of the area in 1984. Subsequently, 83 drums and 275 metric tons (303 tons) of soil were removed and disposed of at an EPA-approved disposal facility.

4.5 ACRE SITE PORTION HIGHLIGHTS

Major Long-Term Stewardship Activities - groundwater sampling and monitoring
Portion Size - 1.8 hectares (4.5 acres)
Estimated Volume of Residual Contaminants - groundwater to be determined
Long-Term Stewardship Start-End Years - 2015-2035

All phases of the site assessment, including identification of groundwater contamination, were reported in a Contaminant Assessment Report published in May 1986. The surficial aquifer was contaminated with volatile organic compounds (VOC), primarily vinyl chloride, toluene, TCE, and DCE. The results presented in that report prompted DOE to complete a Feasibility Study. Several remedial alternatives were provided in the Feasibility Study report and its associated Work Plan. The Feasibility Study report recommended hydraulic containment and recovery of the contaminated groundwater and onsite treatment. An Interim Remedial Action consisting of groundwater extraction and treatment, via air stripping, and a routine groundwater monitoring program were initiated in May 1990. In July 1997, a modification involving installation of dual-phase extraction (DPE) wells provided a more aggressive system to remove groundwater contamination. In 1999, DOE replaced the DPE/air stripping system with an in situ biosparging system. Biosparging introduces oxygen into the subsurface for biodegradation purposes and has the potential for significantly reducing clean up time. All activities associated with this site are voluntarily conducted consistent with the Florida Department of Environmental Protection Corrective Actions for Contamination Sites.

Long-Term Stewardship Activities

At present, DOE expects that the site will meet the regulatory imposed cleanup standards by 2014. Subsequent sampling and analysis, under the long-term surveillance and maintenance program, will most likely be required by the regulator for an as yet undetermined period of time to ensure that site contamination levels do not reoccur.

3.3.1 Estimated Long-Term Stewardship Costs for the 4.5 Acre Portion

Cost estimates are based on the projected costs for groundwater sampling and monitoring.

Long-Term Stewardship Costs (Constant Year 2000 Dollars)							
FY 2000 - FY 2010	*FY 2011 - FY 2020*	*FY 2021 - FY 2030*	*FY 2031 - FY 2040*	*FY 2041 - FY 2050*	*FY 2051 - FY 2060*	*FY 2061 - FY 2070*	*Estimated Total*
$0	$115,200	$192,000	$96,000	$0	$0	$0	$403,200

3.4 Wastewater Neutralization Area/Building 200 Area

The Wastewater Neutralization Area/Building 200 Area consists of the active Wastewater Neutralization Facility, the area around Building 200, and the area south of the Wastewater Neutralization Facility. The Wastewater Neutralization Facility, a physical treatment plant that currently receives sanitary and industrial wastewater, has been in operation since 1957.

WASTEWATER NEUTRALIZATION AREA/BUILDING 200 AREA PORTION HIGHLIGHTS

Major Long-Term Stewardship Activities - groundwater sampling and monitoring
Portion Size - 0.14 hectare (0.35 acre)
Estimated Volume of Residual Contaminants - groundwater to be determined
Long-Term Stewardship Start-End Years - 2015-2035

A Corrective Measures Study Report and Corrective Measure Implementation Plan were completed in 1997 for this SWMU because contaminant concentrations above Federal and State maximum contaminant levels were detected in groundwater samples from the surficial aquifer. The recommended cleanup alternative for this SWMU is a recovery well located in the Wastewater Neutralization Facility and limited soil removal. Contaminated soil was removed in 1999. Groundwater recovered from this recovery well will be discharged directly to the Pinellas County publicly-owned treatment works.

Long-Term Stewardship Activities

At present, DOE expects that the site will meet the regulatory imposed cleanup standards by 2014. Subsequent sampling and analysis, under the long-term surveillance and maintenance program, will most likely be required by the regulator for an as yet undetermined period of time to ensure that site contamination levels do not reoccur.

3.4.1 Estimated Long-Term Stewardship Costs for the Waste Neutralization Area/Building 200 Area

Cost estimates are based on the projected costs for groundwater sampling and monitoring.

Long-Term Stewardship Costs (Constant Year 2000 Dollars)							
FY 2000 - FY 2010	***FY 2011 - FY 2020***	***FY 2021 - FY 2030***	***FY 2031 - FY 2040***	***FY 2041 - FY 2050***	***FY 2051 - FY 2060***	***FY 2061 - FY 2070***	***Estimated Total***
$0	$115,200	$192,000	$96,000	$0	$0	$0	$403,200

4.0 FUTURE USES

In March 1995, DOE sold the facility to the Pinellas County Industry Council. In 1999, Pinellas County assumed ownership of the facility. The future uses of the facility will primarily be industrial. Over 20 businesses now occupy the facility, with approximately 1500 employees. DOE remains responsible for completion of current groundwater remediation and remediation of other contamination discovered in the future if it can be linked to former DOE operations on the site.

For more information about the Pinellas STAR Center, please contact:

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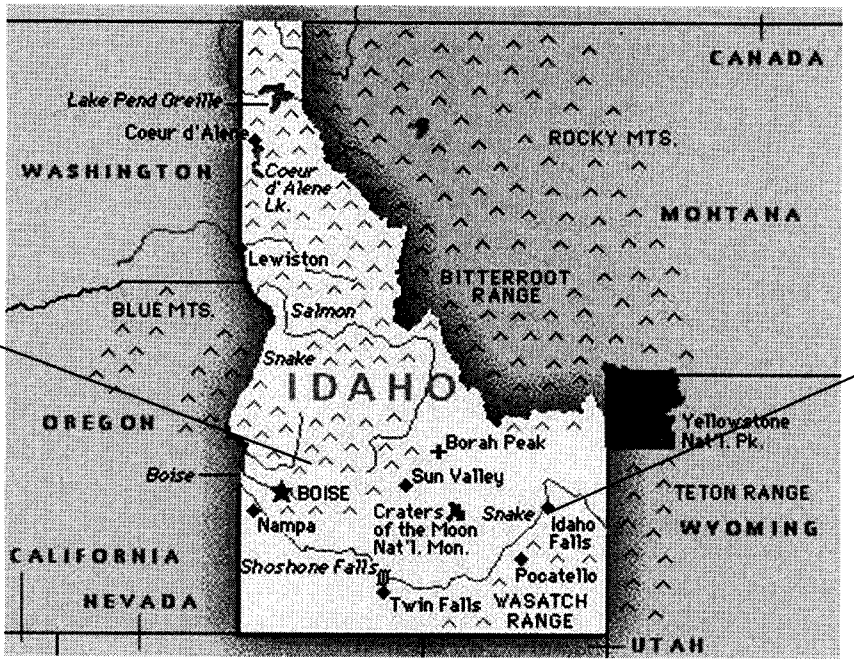
Idaho



Lowman Site

Idaho National Engineering and Environmental Laboratory

Long-Term Stewardship Site Highlights

Idaho National Engineering and Environmental Laboratory (page 3)
Major Activities -monitoring and maintaining engineered units; enforcing institutional controls; restricting access
Site Size - 230,321 hectares (569,135 acres)
Estimated Average Annual Cost FY 2000-2006 - $3,700,000

Lowman Site (page 57)
Major Activities -disposal cell monitoring; institutional control enforcement; access restrictions
Site Size - 7.3 hectares (18 acres)
Start/End Years - 1994/in perpetuity
Estimated Average Annual Cost FY 2000-2006 $71,000

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IDAHO NATIONAL ENGINEERING AND ENVIRONMENTAL LABORATORY

1.0 SITE SUMMARY

1.1 Site Description and Mission

The Idaho National Engineering and Environmental Laboratory (INEEL) has been a center of nuclear technology for over half a century supporting Naval nuclear propulsion and civilian and military nuclear applications. The site occupies 230,321 hectares (569,135 acres) in southeast Idaho, approximately 40 kilometers (25 miles) west of Idaho Falls. The site consists of nine primary facility areas situated on an expanse of otherwise undeveloped, high-desert terrain. Buildings and structures at the INEEL are clustered within these primary facility areas, which are typically less than a few square miles in size and separated from each other by miles of primarily undeveloped land. These facility areas are:

- Test Area North,
- Test Reactor Area,
- Idaho Nuclear Technology & Engineering Center (formerly Idaho Chemical Processing Plant),
- Central Facilities Area,
- Power Burst Facility/Auxiliary Reactor Area,
- Experimental Breeder Reactor-I/Boiling Water Reactor Experiment,
- Radioactive Waste Management Complex,
- Argonne National Laboratory-West, and
- Naval Reactors Facility.

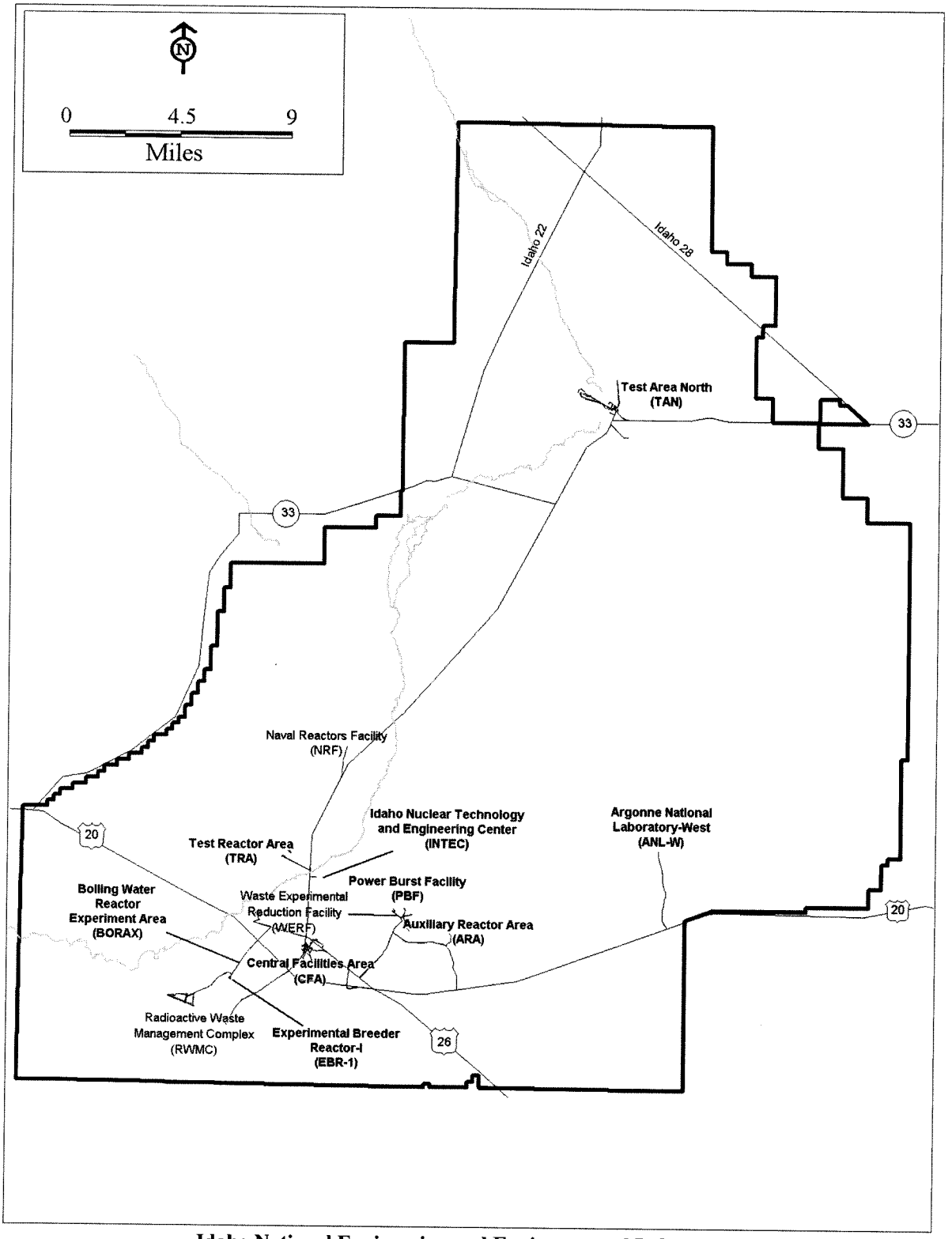
LONG-TERM STEWARDSHIP HIGHLIGHTS

Major Long-Term Stewardship Activities -monitoring and maintaining engineered units; enforcing institutional controls; restricting access
Total Site Area - 230,321 hectares (569,135 acres)
**Estimated Volume of Residual Contaminants* - soil 8.2 million cubic meters (11 million cubic yards); groundwater 18 billion cubic meters (23 billion cubic yards); engineered units 53,600 cubic meters (70,100 cubic yards); facilities 8,000-69,000 cubic meters (10,000-90,000 cubic yards)
Portions Requiring Long-Term Stewardship as of 2006 - 16
Average Annual Long-Term Stewardship Cost FY 2000-2006 - $3,700,000
Landlord - U.S. Department of Energy
*The estimated volume indicates only the known amounts of residual contaminants. For certain portions discussed for this site, exact volume is not known at this point. For specific discussions, please see Section 3.0.

The remainder of INEEL site land is sometimes referred to as the Sitewide Area, which is composed of all INEEL land outside the boundaries of the primary facility areas listed above. Several INEEL laboratories and administrative offices are also located in the city of Idaho Falls.

In 1949, the Atomic Energy Commission [a predecessor agency to the U.S. Department of Energy (DOE)] established the National Reactor Testing Station on the site of a 1940s United States Navy bombing and artillery range. This site was the primary nuclear reactor development laboratory in the United States. Over 100 reactor concepts were conceived and tested here. Between 1953 and 1992, the Idaho Chemical Processing Plant at INEEL reprocessed spent nuclear fuel from United States government reactors to recover enriched uranium for reuse in nuclear weapons production. Other facilities at INEEL also conducted various nuclear reactor research and development activities. From the mid-1970s to the 1990s, INEEL's mission expanded to include waste management and minimization, environmental engineering and restoration, energy efficiency, renewable energy, national security and defense, nuclear technologies, biotechnology, and advanced and emerging technology.

INEEL currently conducts a variety of ongoing research activities and numerous environmental management activities.



Idaho National Engineering and Environmental Laboratory

1.2 Site Cleanup and Accomplishments

Past activities at the INEEL site have resulted in the generation of radioactive waste, hazardous waste, and mixed waste. This includes radioactive high-level waste, transuranic (TRU) waste, spent nuclear fuel (SNF), low-level waste, acids, solvents, asbestos, polychlorinated biphenyls (PCBs), other organic and inorganic chemicals, and heavy metals. Past generation, treatment, storage, and disposal of this waste has resulted in contamination of structures, surrounding soils, and groundwater at several locations. INEEL was placed on the National Priorities List, because of groundwater contamination in three areas (Radioactive Waste Management Complex, Idaho Nuclear Technology & Engineering Center (INTEC) and Test Area North). The table on the following page (*Summary of Original Contamination Release Profile*) provides a summary of the contamination left from past operations and practices at INEEL. At the Radioactive Waste Management Complex and INTEC, other significant remediaton activities will be ongoing in 2006 and are not included in this report. Contamination at these locations is present in the soil, the vadose zone and the groundwater.

ACCOMPLISHMENTS

- Finalized 20 CERCLA Record of Decisions.
- Identified 426 release sites and 308 release sites (72 percent) are considered "complete".
- 118 release sites are undergoing assessment or are in active cleanup.
- Of 45 surplus contaminated facilities, 27 have been decommissioned.
- Dismantled over 100 buildings and structures.
- Awaiting disposition of over 200 facilities.

DOE will remediate all release sites identified under the INEEL Federal Facility Agreement and Consent Order, jointly developed by DOE, U.S. Environmental Protection Agency (EPA), and the State of Idaho, in accordance with *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA) requirements and the National Contingency Plan. Remediation strategies will be finalized when Records of Decision for the site are completed no sooner than 2005. All remediation will be complete by 2050, although several less complicated areas will complete remediation by 2006. By 2044, all facilities will be demolished and disposed of or decontaminated and released for reuse. Facilities will be deactivated to reduce surveillance and maintenance costs pending final decontamination and decommissioning. The Snake River Plain Aquifer underlies the entire site and is a sole source aquifer. Even after remediation activities are complete, organic contaminants will remain in the Snake River Plain Aquifer, and residual chromium, tritium, mercury, cesium, and cobalt will remain in the perched water table. Because of these residual contaminants and the possible presence of unexploded ordnance, future use restrictions will be required. While general public access restrictions will remain in place for the entire site, including the ordnance areas, less than five percent of the surface of the site is expected to require physical access controls, such as fencing. The level(s) of cleanup and remediation will be influenced by using projected future land uses. In general, some areas may be remediated to risk levels associated with potential future residential or commercial uses, while other areas may be considered permanent industrial or restricted areas. In accordance with the *INEEL Comprehensive Facilities and Land Use Plan*, the site will remain under government management and control and no residential use will be permitted for the next 100 years.

Summary of Original Contamination Release Profile	
Area of Contamination	***Original Release Profile***
Test Area North	• Contaminants are primarily radionuclides and organic chemicals • Aquifer below contaminated by past discharges to injection well • Releases in surface ponds/ditches and subsurface soils • Windblown releases • Release from fuel/oil line

Summary of Original Contamination Release Profile	
Area of Contamination	***Original Release Profile***
Test Reactor Area	• Contaminants are primarily metals, radionuclides, and organic chemicals (e.g., PCBs) • Contamination was in waste disposal ponds, storage tanks, and sewage lagoons • Groundwater below contaminated from seepage from waste disposal ponds
Idaho Nuclear Technology & Engineering Center	• Contaminants are primarily metals, radionuclides, organic chemicals, and nitrates • About 95% of soils contamination originated from transfer lines to the underground tank farm • Contamination in waste disposal ponds and soils beneath buildings • Groundwater below contaminated from injection well
Central Facilities Area	• Contaminants are primarily metals, radionuclides, and nitrates • Contamination was in landfills, underground storage tanks, waste disposal pond, and a septic system drainfield • Groundwater nitrate contamination has exceeded drinking water standards
Power Burst Facility/Auxiliary Reactor Area	• Contaminants are primarily heavy metals, radionuclides, and organic chemicals (e.g., PCBs) • Contamination in underground tanks, hot cells, waste disposal ponds, a sewage system, and buried reactor debris
Experimental Breeder Reactor-I/Boiling Water Reactor Experiment	• Contaminants are primarily metals and radionuclides • Contamination was in chemical disposal area, leach ponds, and in portions of the Experimental Breeder Reactor-I building
Radioactive Waste Management Complex	• Contaminants are primarily organic chemicals, nitrate salts, metals, and radionuclides • Contamination is in subsurface disposal areas • Groundwater below contaminated with organic compounds
Argonne National Laboratory-West	• Contaminants are primarily metals and radionuclides • Contamination was in industrial waste pond and industrial waste ditches, sanitary sewage lagoons, and a storm water canal
Navel Reactors Facility	• Contaminants are primarily metals and radionuclides • Main contamination in tile drainfields and waste disposal basins

Remediation has begun at all nine facility areas (Test Area North, Test Reactor Area, the Idaho Nuclear Technology & Engineering Center, the Central Facilities Area, the Power Burst Facility/Auxiliary Reactor Area, the Breeder Reactor, the Radioactive Waste Management Complex, Argonne National Laboratory-West, and the Naval Reactors Facility), as well as at the Sitewide Area. Once remediation is achieved in accordance with CERCLA remediation plans, the ongoing site mission will be primarily a national multi-program engineering and environmental laboratory.

SITE LONG-TERM STEWARDSHIP GOALS

The long-term stewardship activities implemented at the INEEL are intended to ensure the protectiveness of remediation, maintain the information about the contamination to support the understanding of the risk by future generations, and prevent inadvertent intrusion into areas containing residual contamination, or where limited use of residually-contaminated areas is permitted, maintain acceptable exposure levels that are protective of human health and the environment.

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

DOE will be responsible for long-term stewardship once environmental remediation is completed. The site will continue to restrict access to residually contaminated areas for as long as necessary to ensure protection. Fences and signs will be maintained to ensure continued access control. Contaminated soil sites will be maintained by managing vegetation. Routine surveys and monitoring will be conducted to ensure that areas remain properly vegetated.

Additional long-term stewardship activities include groundwater monitoring, maintenance of remediation structures (caps, etc.), maintenance of flood control diversion structures, and records management. In accordance with CERCLA, contained and capped areas will require regular (i.e., at least annually or as otherwise specified in the individual Records of Decision) inspections, monitoring, and maintenance. Long-term stewardship activities for facilities that have been deactivated, pending final decontamination and decommissioning, will include: maintaining facility-filtered off-gas systems, preventing and cleaning up contaminant releases, and maintaining surveillance and maintenance equipment. In addition, meteorological and seismic monitoring, emergency preparedness, and environmental monitoring are ongoing activities that will continue as long as necessary to support site missions.

The *INEEL Comprehensive Facility and Land Use Plan* will serve as the tracking mechanism to identify, at a minimum, all CERCLA land areas at INEEL under restriction or control. This planning document may itself become a part of an INEEL Long-Term Stewardship Plan or equivalent.

The site will determine appropriate institutional controls and surveillance and maintenance requirements for specific areas as remediation is completed and waste sites are certified as complete under either CERCLA or RCRA. All institutional controls, with some exceptions, will be in effect until 2095 or until a CERCLA five-year review determines they are no longer necessary. Institutional control plans specific to each of the remediation sites are being developed as part of the CERCLA process and will be implemented as part of those regulated actions.

INEEL maintains and updates the specific records and reports required to document long-term stewardship activities at the site. Types of records maintained include site characterization data, descriptions of the contaminants of concern, remedial action design information, the site completion report, long-term monitoring plans, annual inspection reports, current and historic monitoring data, and land use/deed restrictions. Additionally, DOE will prepare CERCLA five-year reviews for submittal to the EPA and the Idaho Department of Health and Welfare (IDHW).

Specifically, the records are managed to ensure that they are generated, identified, authenticated, retained, and preserved in accordance with DOE Order 200.1, "Information Management Program." A system of procedures and processes are used by the Environmental Restoration Program that focuses on protecting the records from loss, damage, destruction, or unauthorized revision, as well as rapid retrieval and easy accessibility by Program participants and supporting organizations. The system serves as the central records retention facility for all Environmental Restoration records; however, records are maintained in paper format (for two years at the Technical Support Building in Idaho Falls), as well to meet dual storage requirements. Public files are available electronically via the Internet (ar.inel.gov) and in paper format at five repositories throughout the State of Idaho

STAKEHOLDER INVOLVEMENT

Public participation is an open and ongoing process of both formal and informal communication between DOE-Idaho, stakeholders, regulators, and Shoshone-Bannock Tribal government. The participation processes include formal public hearings, informational workshops, open houses, media notices, and presentations at meetings of the INEEL Citizens Advisory Board. Comments from the Shoshone-Bannock Tribes, public comments, and Citizens Advisory Board recommendations on remediation strategies, including nature and extent of institutional controls, are incorporated into restoration documents.

Specifically, public involvement regarding the INEEL site includes: seeking and considering public input; informing the public in an understandable and timely manner of key decisions, progress of activities, emerging technologies, and opportunities for economic diversity; clearly defining access points for public involvement; and consistently incorporating public participation processes into program operations, planning activities, and decision-making processes. INEEL sponsored a public forum on preferred future land uses, to discuss and review development of the long-term land use scenarios and to identify regional planning issues that could affect the scenarios. The forum membership included representatives from local counties and cities, the Shoshone-Bannock Tribes, the U.S. Bureau of Land Management, the U.S. Department of Energy, the U.S. Forest Service, the U.S. Park Service, the Idaho Department of Transportation and Fish and Game, and eight businesses, education, and citizens' organizations. The U.S. Environmental Protection Agency and the Idaho Department of Health and Welfare participated in an ex-officio capacity. The resulting report, *INEEL Comprehensive Facilities and Land Use Plan*, was also subject to a 30-day public comment period.

The public participation process meets requirements applicable to RCRA permits under 40 *Code of Federal Regulations* Part 124 and RCRA Sec. 7004; CERCLA Sections 117 and 113(k); the National Contingency Plan; the INEEL Federal Facility Agreement and Consent Order; and EPA guidance on public participation and administrative records.

(at the INEEL Technical Library in Idaho Falls, the Boise State University Library in Boise, the University of Idaho in Moscow, IDHW offices in Boise, and the Environmental Protection Agency Region 10 offices in Boise). A new records storage facility is planned to be built in Idaho Falls in 2002, as well. Administrative record and information repository records are maintained in accordance with EPA's Office of Solid Waste and Emergency Response Directives 9833.3A-1 and 9230.2B.

2.2 Long-Term Stewardship Technology Development and Deployment

Due to the long-lived nature of some of the contaminants present at various cleanup sites, it may be necessary in some cases to monitor and control exposure risks associated with residual contamination for hundreds to thousands of years. Consequently, advances in science and technology that allow for reducing technical uncertainties, improving reliability of engineered solutions, and, ultimately, reducing total long-term stewardship costs are of great interest and importance.

The long-term stewardship related needs identified at the INEEL include:

- Ability to detect interactions between spent nuclear fuel and storage containers;
- Integrated suite of in-situ instruments to determine flux in the vadose zone;
- Real-time field instrumentation for characterization and monitoring of soils and groundwater;
- Better characterization of scale and spacial heterogeneity and preferential flow;
- Understanding of behavior of waste forms and their near-field transport;
- Understanding of the physics of flow in the vadose zone;

- Ability to quantify uncertainty in risk calculations;
- Development of indirect sensing instrumentation for spatial variability analyses of state variables;
- In-situ biologic activity sensor for vadose zone and groundwater monitoring, characterization and remediation;
- Instrumentation to reliably measure solid gas flux accounting for barometric and temporal variations;
- Improved passive vapor extraction technology;
- Understanding of geochemistry of contaminants in the vadose zone;
- Ability to better model flow and transport in the vadose zone;
- Understanding of transport of contaminants in the vapor phase;
- Development of sensors for large scale measurements in the vadose zone to define spacial variability; and
- Understanding of microbial alteration of heavy metal and radionuclide partitioning at mineral surfaces.

2.3 Assumptions and Uncertainties

The public forum on preferred future land uses resulted in the development of a set of relevant issues and resultant planning assumptions for the INEEL site. Over time, these planning assumptions and resulting long-term scenarios may need to be revised due to unforeseen developments. Accordingly, the constraints, assumptions, and scenarios will be revisited and revised as necessary. Some of the key planning assumptions are listed below. A complete list of assumptions is provided in the *INEEL Comprehensive Facility Land Use Plan.*

- The current assumption is the federal government will maintain ownership of the site until at least 2095, based on INEEL's 100-year planning scenario. The implementation of this management and control becomes increasingly uncertain over this time period. Regardless of the future use of the land now occupied by the INEEL, the federal government has an obligation to provide adequate institutional controls (i.e., limit access) to areas that pose a significant health and/or safety risk to the public and workers until that risk diminishes to an acceptable level for the intended purpose.

- As contaminated facilities become obsolete, decontamination and decommissioning will be required. Similarly, contaminated areas will require remediation. The decontamination and decommissioning process will commence following closure of a facility once it has been determined that the facility is no longer needed.

- Environmental restoration and waste management activities will continue. Cleanup of hazardous, mixed, and low-level waste sites is expected to be completed within ten years following completion of Records of Decision for the cleanup mandated by CERCLA. The possibility exists that contaminated environmental media not yet identified will be discovered in the future as a result of routine operations, maintenance activities, or decontamination and dismantlement activities at the INEEL. Upon discovery of a new contaminant source by DOE, IDHW, Department of Environmental Quality, or the EPA, that contaminant source will be evaluated and appropriate response actions taken in accordance with the Federal Facility Agreement and Consent Order, CERCLA, or other applicable regulation.

- No residential development (i.e., housing) will occur within INEEL boundaries. Grazing will be allowed to continue in the buffer area.

- No new major, private developments (residential or nonresidential) on public lands are expected in areas adjacent to the site. There is uncertainty about the applicability of this assumption to privately held land. Beyond 25 to 50 years, there is less certainty about this assumption.

- New locations for low-level waste disposal may need to be sited. If new locations are needed, they will be subject to regulatory approval processes.

- In accordance with DOE Order 1230.2, DOE recognizes that a trust relationship exists between federally recognized Tribes and the DOE. DOE will consult with Tribal governments to ensure that Tribal rights and concerns are considered prior to DOE taking actions, making decisions, or implementing programs that may affect the Tribes.

2.4 Estimated Site-Wide Long-Term Stewardship Costs

One of the primary assumptions involved in land use planning for the INEEL is that DOE will retain control over the INEEL, as currently configured, for the next 100 years. This assumption is reflected in the integrated INEEL long-term stewardship cost estimates presented below.

Future cost estimates for conducting long-term stewardship activities, such as surveillance and monitoring, are integrated within INEEL programmatic planning, similar in principle to that of capturing safety, waste minimization, and pollution prevention activities within each program. These estimates are consistent with the life-cycle data that support the INEEL's environmental liability. Due to the cost estimating procedures at INEEL, the site-wide long-term stewardship costs are provided below; however, the costs for each portion are not provided (except for Argonne National Laboratory-West, see note below).

Generally, the estimates for long-term stewardship costs focus on those activities that occur after remediation projects reach completion. INEEL estimates also include other surveillance and maintenance support activities conducted under the auspices of remediation project management. These costs will increase as more post-remediation activities are rolled into ongoing sitewide surveillance and maintenance. As more remediation projects are completed, more of these costs are captured in the sitewide surveillance and maintenance. It is anticipated that after 2070 overall long-term stewardship cost estimates should continue to decrease. For purposes of this report, long-term stewardship costs are shown until 2070; however, it is anticipated that long-term stewardship activities will be required in some areas until 2396.

Site Long-Term Stewardship Costs (Constant Year 2000 dollars)					
Year(s)	***Amount***	***Year(s)***	***Amount***	***Year(s)***	***Amount***
FY 2000	$0	**FY 2008**	$5,350,000	**FY 2036-2040**	$15,000,000
FY 2001	$0	**FY 2009**	$5,350,000	**FY 2041-2045**	$15,000,000
FY 2002	$0	**FY 2010**	$5,350,000	**FY 2046-2050**	$12,000,000
FY 2003	$0	**FY 2011-2015**	$22,500,000	**FY 2051-2055**	$16,400,000
FY 2004	$3,450,000	**FY 2016-2020**	$17,900,000	**FY 2056-2060**	$18,400,000
FY 2005	$3,450,000	**FY 2021-2025**	$11,750,000	**FY 2061-2065**	$18,000,000
FY 2006	$4,200,000	**FY 2026-2030**	$12,250,000	**FY 2066-2070**	$18,000,000
FY 2007	$4,200,000	**FY 2031-2035**	$15,000,000		

** The estimated costs above do not include costs for Argonne National Laboratory-West because Argonne National Laboratory-West is funded through DOE's Chicago Operations Office. Please refer to Section 3.15 for Argonne National Laboratory-West cost information.*

3.0 PORTION OVERVIEW

The INEEL site contains 16 portions that will require some long-term stewardship activities as of 2006. For purposes of this report, a "portion" is defined as a geographically contiguous and distinct area (which may involve residually contaminated facilities, engineered units, soil, groundwater, and/or surface water/sediment) for which cleanup, disposal, or stabilization will have been completed and long-term stewardship will be required as of 2006. Each portion is listed in the table below, with accompanying discussion of cleanup and long-term stewardship activities in Sections 3.1 through 3.16.

The INEEL site is generally managed as nine primary facility areas, which are listed below. For purposes of this report, these historic groupings have been subdivided into portions to allow for a more precise discussion on the geographic location of long-term stewardship activities at the site as of 2006. Some of these geographic areas are not represented as portions since long-term stewardship will not be required for those areas or because remediation activities will not be complete, or stabilization will not occur within the 2006 time frame specified by the *National Defense Authorization Act for Fiscal Year 2000* (FY 2000 NDAA) language.

- **Test Area North** occupies approximately 50 hectares (125 acres) in the north-central portion of the INEEL and consists of three active operations areas: the Contained Test Facility/ Specific Manufacturing Capability, the Technical Support Facility, and the Water Reactor Research Test Facility. A fourth area, the Initial Engine Test area, is inactive. The primary missions of Test Area North were to support the Aircraft Nuclear Propulsion Program (1954-1961); conduct loss-of-coolant experiments designed to simulate reactor accidents (1967-1979); and study materials from the Three Mile Island accident. Currently, the largest project in Test Area North is the Specific Manufacturing Capability Project, which develops and produces armor for the United States Army tanks. A variety of research programs also remain active. In 1999, DOE also designated a large portion of the undeveloped land west of the Test Area North as a Sagebrush Steepe Reserve and is partnering with the Bureau of Land Management and the Shoshone-Bannock Tribes to manage that reserve. This area includes the following portions: *Test Area North-Building 616, Test Area North Tanks, Test Area North Soils*, and *Other Test Area North Soils*.

- **Test Reactor Area** encompasses about six hectares (14 acres) and consists of 88 buildings located in the southwest portion of the INEEL. The major mission of the Test Reactor Area is to conduct scientific and engineering experiments for DOE (to study the effects of radiation on materials, fuels, and equipment) and to support various nuclear and nonnuclear programs. The secondary mission is to produce various isotopes and perform broad-based research and development, analysis, and testing. The Advanced Test Reactor is still considered the "cutting edge" of nuclear test reactors, even after some 30 years of operation. The Advanced Test Reactor is projected to remain a major program for research and radiation testing for the foreseeable future. This area includes the following portions: *Test Reactor Area Ponds* and *Test Reactor Area Subsurface Soils*.

- **Idaho Nuclear Technology & Engineering Center** (formerly Idaho Chemical Processing Plant) is situated on about 80 hectares (210 acres) that lie within its perimeter fence. An additional 22 hectares (55 acres) of the plant area lie outside the fence. Facilities at the Idaho Nuclear Technology & Engineering Center (INTEC) are used to store spent nuclear fuel and radioactive waste, treat radioactive waste, and develop waste management technologies. From 1952 to 1992, the primary mission was nuclear fuel reprocessing. However, reprocessing was phased out and, consequently, part of the mission changed. Facilities once dedicated to reprocessing will be converted to a safe and stable shutdown condition, while awaiting reuse or decontamination and decommissioning. This area includes the *Idaho Nuclear Technology & Engineering Center Sites Portion*.

- **Central Facilities Area** comprises six hectares (15 acres) and is the main service and support center for programs located at INEEL's other primary facility areas. Eighty percent of the activity at the Central Facilities Area consists of INEEL-wide programmatic support, such as transportation, maintenance, capital construction, environmental and radiological monitoring, security, fire protection, warehouses, calibration laboratories, and a cafeteria. A small amount of research and development work is also conducted. Work on radioactive and hazardous materials is restricted in and around the Central Facilities Area. This area includes the *Center Facilities Area Portion.*

- **Power Burst Facility/Auxiliary Reactor Area** is located in the southern portion of the INEEL. The Power Burst Facility and Auxiliary Reactor Area were used for various research activities, including reactor materials testing. They were also used to determine safety standards for reactor operation. All reactor-related research activities have ceased and part of the area is currently used for explosives research. This area includes the following portions: *Power Burst Facility Soils, Auxiliary Reactor Area Soils*, and *Stationary Low Power Reactor-I Burial Ground.*

- **Experimental Breeder Reactor-I/Boiling Water Reactor Experiment** is located in the southwestern quadrant of the INEEL. This area includes the Experimental Breeder Reactor-I and the Boiling Water Reactor Experiment Facility. Both of these were test reactors that have since been decommissioned. Experimental Breeder Reactor-I is now a National Historic Landmark because it was the first nuclear reactor in the world to generate usable amounts of electricity. The landmark is open to the public and the INEEL staff conduct free public tours of the facility. The area of the Boiling Water Reactor Experiment housed five reactors which operated between 1953 and 1964. No operations other than monitoring are conducted at the Boiling Water Reactor Experiment area. This area includes the following portions: *Boiling Water Reactor Experiment Area* and *Experimental Breeder Reactor-I.*

- **Radioactive Waste Management Complex** is a restricted-access area located 11 kilometers (seven miles) southwest of the Central Facilities Area at the INEEL. The mission of the facility is to manage, in a safe and environmentally sound manner, the disposal of low-level radioactive waste and the storage of transuranic (activity greater than 100 nanocuries/gram) radioactive waste. In addition, the recent award of the contract for the Advanced Mixed Waste Treatment Project will expand the complex's waste management operations to include treating and preparing these wastes for shipment out of Idaho, along with the development of technologies that will serve the waste management needs of current and planned facilities at the INEEL. About 1,100 cubic meters (1,500 cubic yards) of low-level radioactive waste are disposed at the facility each year. This area includes the *Pad A Portion.*

- **Argonne National Laboratory-West** is located in the southeastern portion of the INEEL site. For the past 50 years, Argonne National Laboratory-West has been the prime center in the United States for research on advanced reactor systems and their associated technologies. The mission of the laboratory is to conduct basic and applied research that supports these systems, with a current emphasis on development of new ways to deal with spent nuclear fuel. It is operated by the University of Chicago under contract to the DOE. This area includes the *Argonne West Portion.*

- **Naval Reactors Facility** is the birthplace of the U.S. Nuclear Navy and is located in the west-central sector of the INEEL. Beginning in the early 1950s, prototype reactors for both submarines and surface ships were developed and operated here. Until May 1995, when the last prototype was shut down, the Naval Reactors Facility served as a training school for officers and enlisted personnel destined for service aboard nuclear-powered ships. As it has for nearly 40 years, the Naval Reactors Facility continues to receive and examine Naval spent fuel. The facility is operated by Westinghouse Electric Corporation under the direct supervision of the DOE's Office of Naval Reactors. The facility supports

the Naval Nuclear Propulsion Program by carrying out assigned testing, examination, and fuel management activities.

Long-Term Stewardship Information		
Portion	***Long-Term Stewardship Start Year****	***Long-Term Stewardship End Year***
Test Area North-Building 616	2006	2095
Test Area North Tanks	2003	2099
Test Area North Soils	2004	2099
Other Test Area North Soils	2004	2095
Test Reactor Area Ponds	2000	2099
Test Reactor Area Subsurface Soils	2000	2099
Idaho Nuclear Technology & Engineering Center Sites	2008	2095
Central Facilities Area	1996	2099
Auxiliary Reactor Area Soils	1996	2095
Power Burst Facility Soils	1996	2095
Stationary Low Power Reactor-I Burial Ground	1997	2396
Boiling Water Reactor Experiment Area	1997	2316
Experimental Breeder Reactor-I	1964	2095
Pad A	1995	2095
Argonne West	2006**	2098
Ordnance Area	1993***	2095

* For the purpose of this report, long-term stewardship is assumed to begin in the year remediaton activities are complete.
** Estimated date of completion of phytoremediation activities.
*** Although the nature of contamination for the Ordnance Area is such that it is not possible to determine when remediaton will be complete, for all intents and purposes, the long-term stewardship strategy became effective at this time.

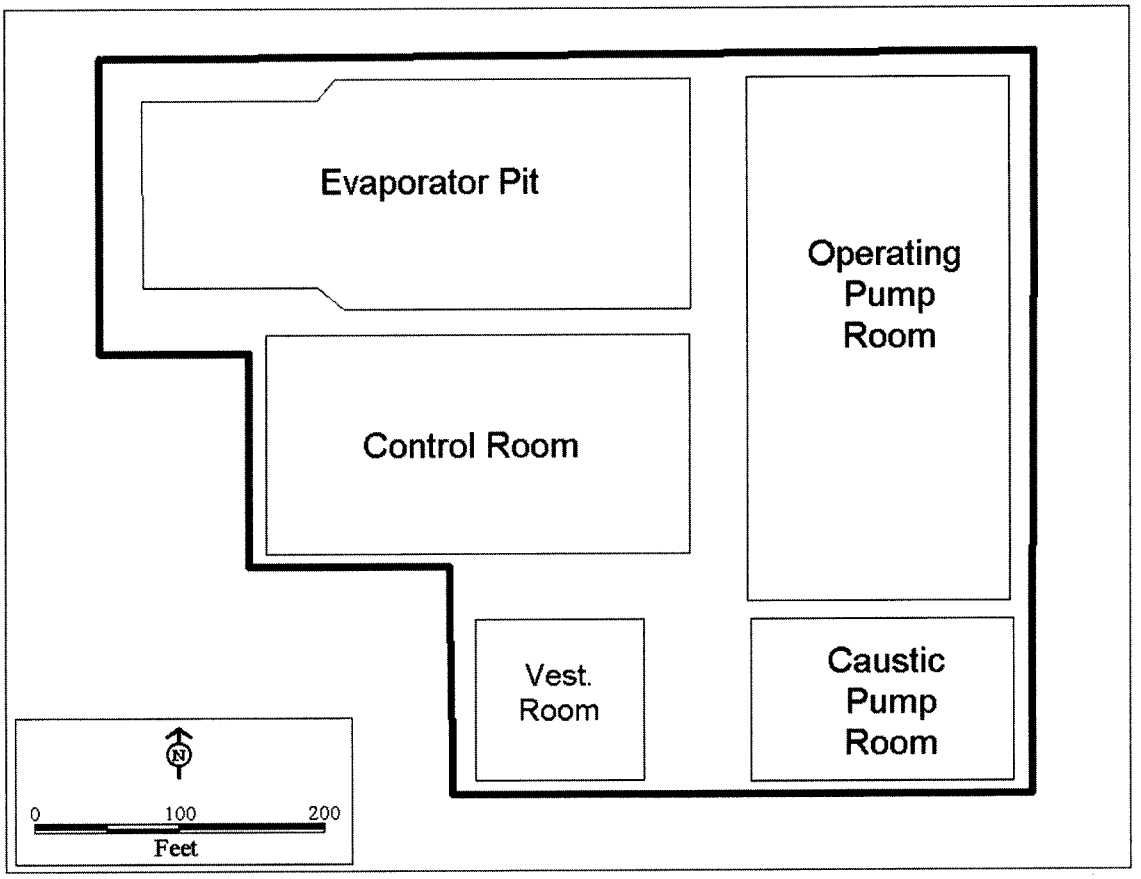
3.1 Test Area North-Building 616 Portion

The Test Area North-Building 616 Portion consists of one building (Building 616) at the Test Area North facility. This building has been contaminated with solvents, PCBs, and various transuranic/other radionuclides. The specific remedial strategy has not been determined; however, it is anticipated that remediation will be completed by 2006. Due to expected residual contamination, long-term stewardship will be required; however, the specific details have yet to be determined.

TEST AREA NORTH-BUILDING 616 PORTION HIGHLIGHTS

Major Long-Term Stewardship Activities - institutional control enforcement
Portion Size - 0.02 hectares (0.05 acres)
Estimated Volume of Residual Contaminants - facilities to be determined
Long-Term Stewardship Start-End Years - 2006-2095

Building 616 is located in the center of a cluster of buildings within the operation area known as the Technical Support Facility. The Technical Support Facility is the main administration, assembly, and maintenance area for Test Area North. Buildings in the Technical Support Facility area were used to build reactors for the nuclear-powered aircraft. Within this area, Building 616 was used to collect and treat liquid wastes from various operations. Building 616 occupies a 275-square-meter (2,958-square-foot) area. The exterior dimensions are 11 meters by 14 meters (36 feet by 46 feet) and the building, with the addition of the new roof, is approximately seven meters (23 feet) tall. Inside Building 616 there are four rooms and an evaporator pit. Currently, the building is not being used and previous deterioration has resulted in infiltration of precipitation.



Building 616

3.1.1 Facilities

Due to past operations, potential sources of contamination within Building 616 include the evaporator pit, the waste process piping, and the pump room. Waste processed through the evaporator included solvents, such as trichloroethylene (TCE). Due to the evaporation process, concentrated radionuclide-contaminated waste remains within the building. In addition, one of the liquid waste collecting tanks was removed from service because of the presence of large quantities of oil. Later it was determined that the tanks were contaminated with polychlorinated biphenyls (PCBs). Overall, the potential contaminants of concern that have been identified to date are

Building 616 Contaminants

Americium-241	Plutonium-239
Cesium-137	Uranium-235
Cobalt-60	Uranium-238
Curium-244	TCE
Neptunium-237	PCBs
Plutonium-238	Metals

included in the table above (*Building 616 Contaminants*). In addition, the paint in the facility is likely to be lead-based.

Although contamination has been identified, characterization of the sources and contaminants has not yet been completed. The regulatory status of this portion is undetermined; however, it could involve CERCLA, RCRA, and/or a Voluntary Consent Order (see *Voluntary Consent Order* text box). The resolution of which regulations apply will determine the remediation approach for the portion. Remedial activities are anticipated to be completed by 2006. Specific post-cleanup institutional controls will be prepared in consultation with appropriate regulators for residually contaminated areas.

Facilities Long-Term Stewardship Activities

Resolution of the remedial strategy will determine the ultimate long-term stewardship activities. However, the anticipated long-term stewardship activities include ensuring institutional controls remain effective, restricting access through the use of fences and warning signs posted along the portion boundary, and enforcing the pre-determined prohibited activities (e.g. excavation). A detailed description of the institutional controls will be provided to EPA, IDHW, and the Bureau of Land Management.

VOLUNTARY CONSENT ORDER

INEEL actively initiates identification and characterization of potential legacy equipment (such as old hazardous waste tanks). This is done voluntarily, rather than being required due to violations issued by the regulators. INEEL's proactive involvement helps to establish a more positive relationship with the regulators and the community.

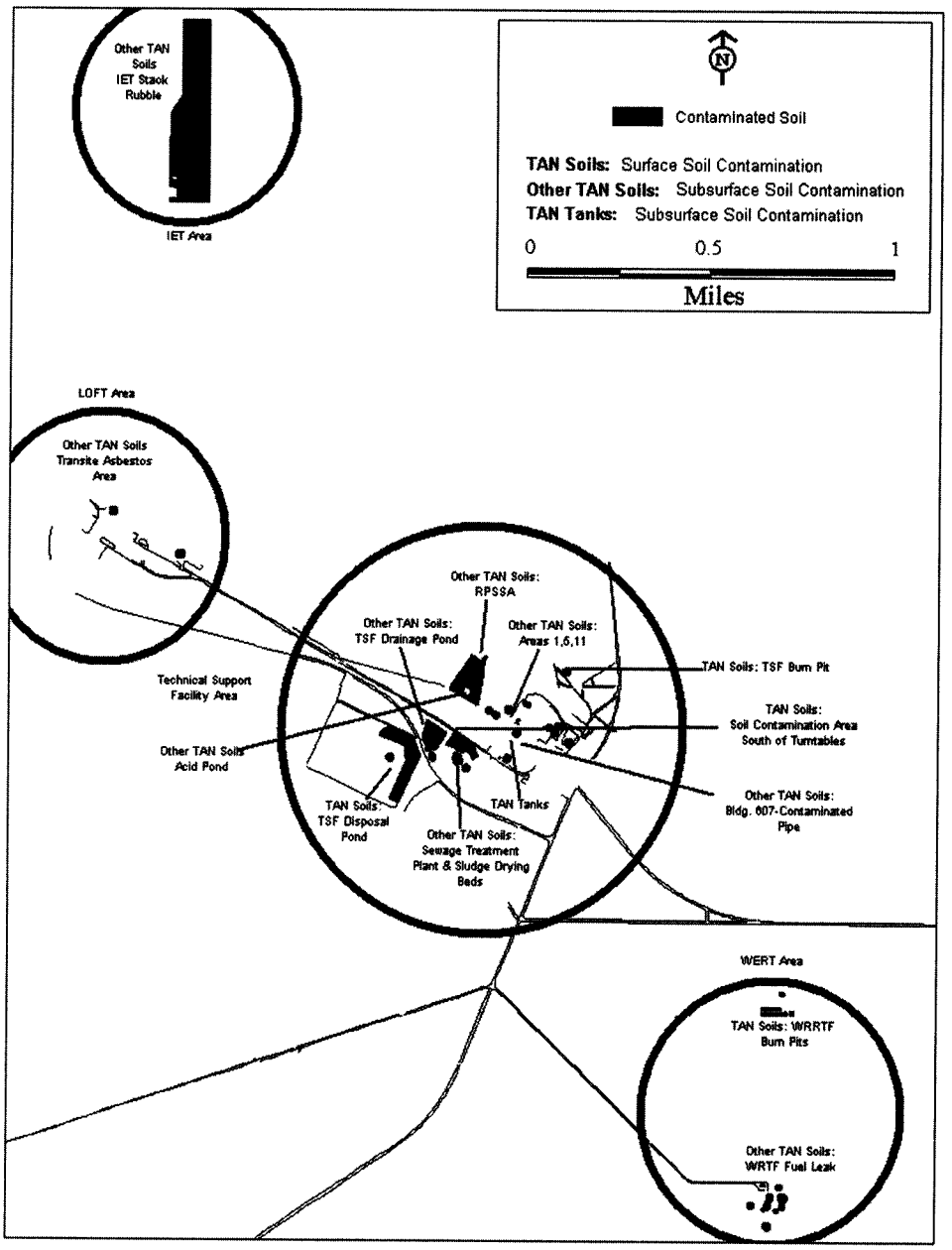
3.2 Test Area North Tanks Portion

TEST AREA NORTH TANKS PORTION HIGHLIGHTS

Major Long-Term Stewardship Activities - institutional control enforcement
Portion Size - 0.04 hectares (0.1 acres)
Estimated Volume of Residual Contaminants - soil 8,570 cubic meters (11,210 cubic yards)
Long-Term Stewardship Start-End Years - 2003-2099

The Test Area North Tanks Portion consists of six storage tanks within the Technical Support Facility operation area at Test Area North. The six abandoned underground storage tanks include four V-Tanks and two PM-2A Tanks. Three of the V-Tanks are 40 cubic meters (50 cubic yards) and one is 1.5 cubic meters (1.9 cubic yards). The PM-2A Tanks are each 950 cubic meters (1,240 cubic yards). All six tanks are in fairly close geographic proximity, approximately 300 meters (1,000 feet) apart, and will require similar long-term stewardship activities. All of the tanks were installed in the early 1950s as part of a system designed to collect and treat radioactively contaminated liquid effluents from Test Area North operations. Currently, the tanks have only sludge remaining and no liquid. The soil is contaminated with cesium-137 due to spills when waste was transferred to and from the tanks.

The areas containing the tanks are fenced and posted with warning signs identifying them as CERCLA sites. They will be remediated and the underlying contaminated soil will be excavated. By 2004, the V-Tanks will be removed and disposed of at an approved disposal facility. The excavated area will be filled with clean soil and then contoured and graded to the surrounding environment. The two PM-2A Tanks will be left in place, decontaminated, and filled with an inert material by 2004. However, these two tanks might be removed in the future if appropriate funding can be secured. Regardless, the area will be filled with clean soil, and then contoured and graded to the surrounding environment.



Test Area North Tanks

3.2.1 Soil

To date, contamination consists of surface and subsurface soil found under and around the tanks. Based on sampling records, approximately 8,570 cubic meters (11,210 cubic yards) of soil are contaminated with cesium-137. Contaminated soil has been detected to a depth of 14 meters (47 feet) at the four V-Tank areas, and to a depth of five meters (17 feet) at the two PM-2A Tank areas. Calculated risks greater than or equal to one x 10^{-4} at these tanks include external radiation exposure of current workers by cesium-137 and cobalt-60, and external radiation exposure of future workers and residents by cesium-137 from surface and subsurface soil. Consequently, excavation of contaminated soils at the two PM-2A tank areas and disposal at an approved site

began during the Summer of 2000 and is ongoing. Contaminated soil excavation at the four V-Tank areas has not yet begun. The remediation goal for the contaminated areas is to cleanup cesium-137 to 23.3 picocuries per gram of soil (pCi/g).

Soil Long-Term Stewardship Activities

Depending on the results of the post-remediation sampling, institutional controls may be required. Institutional controls would consist of posting and maintaining warning signs, controlling access with locked gates, and establishing and maintaining land-use restrictions for 100 years, if necessary due to applicable regulatory requirements. In accordance with CERCLA, five-year reviews would be conducted if residual contamination remains. The two PM-2A Tanks might be removed in the future; however, if the tanks remain in place, more stringent institutional controls will be necessary and the area may require monitoring depending on the results of the post-remediation sampling. For both the V-Tanks and PM-2A Tanks area, evaluation and determination of these institutional controls will be documented in each Record of Decision specific institutional controls plan.

3.3 Test Area North Soils Portion

The Test Area North Soils Portion includes contaminated soils in two Test Area North operation areas: the Water Reactor Research Test Facility and the Technical Support Facility (see map on page 16). The portion includes low-level radionuclide-contaminated soils at the Soil Contamination Area South of the Turntable and the Disposal Pond, as well as nonradionuclide-contaminated soils at the Burn Pits and the Fuel Leak. The relative proximity of these soil areas and the similar nature of the anticipated long-term stewardship activities designate their combination into one portion.

TEST AREA NORTH SOILS PORTION HIGHLIGHTS

Major Long-Term Stewardship Activities - institutional control enforcement
Portion Size - 3.2 hectare (8 acres)
Estimated Volume of Residual Contaminants - soil 198,000 cubic meters (275,000 cubic yards)
Long-Term Stewardship Start-End Years - 2004-2099

The Water Reactor Research Test Facility was used for support tests on water reactors, such as the Loss-of-Fluid Test Program. Located in the Water Reactor Research Test Facility area is the Fuel Leak, which was caused by tanks and associated piping holding petroleum hydrocarbons (i.e., diesel fuel) and heating oil.

Test Area North Soil Contaminants of Concern

Area	*Contaminant of Concern*	*Volume of Residual Contamination cubic meters (cubic yards)*	*Target Cleanup Levels*
South of the Turntable	Cesium-137	800 (1,000) asphalt and 680 (18,000) soil	23.3 pCi/g
Disposal Pond	Cesium-137	196,000 (256,000) soil	23.3 pCi/g
Burn Pits	Lead	Undetermined	400 mig/kg
Fuel Leak	Diesel	300 (400) soil	*To Be Determined

The Technical Support Facility area was used for assembling and maintaining nuclear-powered aircraft reactors. The Disposal Pond is located within this area and historically received sanitary waste, low-level radioactive waste discharges, industrial waste water, and treated sewage effluent. Approximately one hectare (2.5 acres) of the 14-hectare (35-acre) Disposal Pond continues to receive sanitary and industrial waste, as permitted by the State of Idaho.

Surface soil was contaminated by windblown radioactive particles from contaminated soil at the storage tanks within the Technical Support Facility. This 152-by-30-meter (500-by-100-foot) area is referred to as the Soil Contamination Area South of the Turntable. Additionally, there are five Burn Pits, one located in the Technical Support Facility area and four located in the Water Reactor Research Test Facility. All five of the Burn Pits were used for open burning of construction debris.

3.3.1 Soil

Due to past operations, the soils in the Test Area North soils portion were contaminated with cesium-137, lead, and diesel, as illustrated in the previous table (*Test Area North Soil Contaminants of Concern*). All areas within this portion are actively being remediated. The Soil Contamination Area South of the Turntable is being excavated and disposed at an approved facility and the disturbed area backfilled with clean soil. In the Fuel Leak area, several tanks and transfer lines were removed and disposed in the early 1990s. The excavation areas were backfilled, yet some contamination remains in the soil. Remediation of the Disposal Pond consists of soil sampling and implementing institutional controls to limit access. The Burn Pits, which cover approximately 6,450 square meters (69,427 square feet), have been backfilled and a native soil cover (clean soil) has been placed over the contaminated soils. For all areas within this portion, as remediation is complete, areas will be reseeded, fences installed and maintained, and restriction signs and permanent markers posted. These controls will prevent contaminated soil from spreading and reduce current and future occupational exposure to acceptable levels.

Soil Long-Term Stewardship Activities

Depending on the final results of the remediation activities and based on post-remedial action sampling, institutional controls may be required. Institutional controls would consist of posting and maintaining signs, controlling access with locked gates, and establishing and maintaining land-use restrictions for 100 years, if necessary due to regulatory requirements. In accordance with CERCLA, five-year reviews would be conducted if residual contamination remains. Additional controls consist of property lease requirements that stipulate future land use and property transfer requirements that identify when land is suitable for transfer with specific land use controls.

For the Soil Contamination Area South of the Turntable, long-term institutional controls will only be required if contamination is left in place that exceeds the 10^{-4} risk level. Institutional controls, if required, will be implemented until risk is less than or equal to 10^{-4}, as documented in a CERCLA five-year review. Conversely, the Burn Pits will require institutional controls indefinitely, unless the site is released based upon the results of a CERCLA five-year review.

The Fuel Leak area will only require long-term institutional controls if contamination is left in place that exceeds the Final Remediation Goals, which have yet to be determined. If required, institutional controls will be implemented until the remaining risk meets acceptable State of Idaho Risk-Based Corrective Action Guidance levels, as documented in a CERCLA five-year review. For the Disposal Pond, institutional controls will be maintained until 2099 or until risk is less than or equal to 10^{-4}, as documented in a CERCLA five-year review.

3.4 Other Test Area North Soils Portion

This portion includes other residually contaminated soils within the Test Area North facility in the operation areas known as the Initial Engine Test and the Technical Support Facility (see map on page 16). Specifically, this portion includes contaminated soils in

OTHER TEST AREA NORTH SOILS PORTION HIGHLIGHTS

Major Long-Term Stewardship Activities - institutional control enforcement
Portion Size - 16 hectares (40 acres)
Estimated Volume of Residual Contaminants - soil unknown
Long-Term Stewardship Start-End Years - 2004-2095

the following areas: Initial Engine Test Stack Rubble; Areas 1, 5, and 11 at Technical Support Facility; Drainage Pond; Sewage Treatment Plant and Sludge Drying Beds; Acid Pond; Transite Asbestos; Contaminated Pipe in Building 607-A; and the Radioactive Parts Service and Storage Area Buildings 647/648 and Pads.

These areas are classified as "No Further Action," which means they either require no further remedial action or the land will not be released for unrestricted use due to the known remaining contaminants. "No Further Action" sites have a current residential risk greater than 10^{-4}, but a current occupational and future residential risk less than or equal to 10^{-4}. Therefore, the land will not be released for unrestricted use, and institutional controls will be required as a best management practice. Due to the similar remedial strategy and similar long-term stewardship activities (i.e., institutional controls), these areas are considered one portion.

3.4.1 Soil

Within the 16-hectare (40-acre) Other Test Area North Soils Portion, approximately two hectares (five acres) of soil are contaminated. Specifically, the contaminants of concern include both radionuclides and hazardous contaminants, including asbestos, heavy metals, low-level radionuclides, hydrocarbons, cobalt-60, and cesium-137. The actual volume of residual contamination is undetermined. The target cleanup levels for the soils is to be determined sufficient to lower the risk level at or below 10^{-4}. The specific areas of contamination are discussed in further detail below.

The Initial Engine Test Stack Rubble area contains buried rubble from the Initial Engine Test area exhaust stack and monitoring vault. From1986 through 1987, the exhaust stack and monitoring vault were decontaminated and decommissioned. The rubble was buried 4.6 to 6.1 meters (15 to 20 feet) below the surface. Consequently, the soil is suspected to have concentrations which pose risks greater than 10^{-4} based on the residential land use scenario. Similarly, the Areas 1, 5, and 11 at Technical Support Facility, consist of soil with risks greater than 10^{-4} based on the residential land use scenario.

The Drainage Pond, which received waste from facilities within the Technical Support Facility area, was surveyed, yet no evidence was detected that contamination existed. However, based on historical knowledge, INEEL conservatively assumes that metals and low-level radionuclide contamination may be present. Also within the Technical Support Facility area is the Sewage Treatment Plant, which received small quantities of paint thinner and radioactive contamination during operation. Detected levels of cobalt-60 and cesium-137 were determined to pose an acceptable risk to human health; however, additional sample data are needed to document a determination of "No Further Action." Therefore, the Sewage Treatment Plant and its associated Sludge Drying Beds will require institutional controls until further risk assessment determines the risk is below 10^{-4}.

The Acid Pond was used to dispose of acids from the processing operations at the Technical Support Facility. The pond was backfilled when it was taken out of service. Data collected at the pond indicated random, isolated radioactive particles in the backfilled soil, which indicate institutional controls are required. Also within the Technical Support Facility is the Transite Asbestos area, which was used to dispose of cement rubble. The area contains small pieces of asbestos cement, yet inspections have determined that the asbestos is tightly encapsulated in cement and is not likely to be released. However, friable asbestos may be released if pulverized or crushed; therefore, institutional controls are necessary to ensure continued protection of human health and the environment. Contamination is also fixed and no environmental releases have occurred at the pipe located in Building 607-A. The pipe is internally contaminated with radioactive material, surrounded by concrete, and located under the floor of Room 161. The pipe was used to transfer liquid waste to the holding facility from the processing facility.

A different situation exists at the Radioactive Parts Service and Storage Area, Buildings 647 and 648, and the related Pads. This area was considered an interim status storage unit for certain hazardous wastes under the

INEEL RCRA interim status program. Any contamination that creates a future risk will be removed during the closure of this area as an Interim Status facility.

Soil Long-Term Stewardship Activities

Due to the residual contamination, institutional controls will remain in place at each area for at least 100 years or until the area is released for unrestricted use based on a CERCLA five-year review. Continuous monitoring and periodic sampling will be conducted to support the CERCLA five-year reviews. Institutional controls, including fences, signs, and markers, will be maintained for the residually contaminated soil areas mentioned above. In addition, property lease requirements, including control of land use or property transfer requirements and issuance of a finding of suitability to transfer and control land use, will be implemented in some areas as they are identified.

3.5 Test Reactor Area Ponds Portion

This portion consists of several ponds and an associated area located immediately outside the Test Reactor Area. Specifically, this portion consists of the Warm Waste Pond, Chemical Waste Pond, Sewage Leach Pond, and the Sewage Leach Pond Berm and Soil Contamination Area. The ponds are in relatively close geographic proximity, have similar contamination profiles, and will require similar long-term stewardship activities.

TEST REACTOR AREA PONDS PORTION HIGHLIGHTS

Major Long-Term Stewardship Activities - cells and capped soil monitoring; institutional control enforcement
Portion Size - three hectares (8 acres)
Estimated Volume of Residual Contaminants - engineered units 33,000 cubic meters (43,000 cubic yards)
Long-Term Stewardship Start-End Years - 2000-2099

3.5.1 Engineered Units

This three-hectare (eight-acre) portion includes old disposal ponds within the Test Reactor Area that contain residually contaminated soils and remaining sediments. The specific contaminants of concern, estimated volume of contaminants, and the target remediation levels for each pond are listed in the following table (*Test Reactor Area Ponds Contaminants of Concern*).

The Warm Waste Pond is located 27 meters (90 feet) east of the Test Reactor Area facilities along the security fence and consists of three disposal cells (1952, 1957 and 1964) that received low-level radionuclide and RCRA-listed hazardous wastewater discharged from reactor operations. The Warm Waste Pond was taken out of service in 1993 and was replaced by a lined evaporation pond. To reduce the immediate risk, an interim remedial action was conducted, which consisted of backfilling and covering the cells with clean soil. The final remedial strategy was to cap the area with a three-layer cobble gravel cover, designed for a 270-year life. The barrier was shaped

Test Reactor Area Ponds Contaminants of Concern

Pond Name	*Volume of Residual Contamination in cubic meters (cubic yards)*	*Contaminant Name*	*Remediation Level*
Warm Waste	24,750 (32,372)	Silver-108m	0.39 pCi/g
		Cesium-137	7.78 pCi/g
		Europium-152	99.9 pCi/g
Chemical Waste	403 (527)	Barium	926 mg/kg
		Manganese	146 mg/kg

Test Reactor Area Ponds Contaminants of Concern			
Pond Name	***Volume of Residual Contamination in cubic meters (cubic yards)***	***Contaminant Name***	***Remediation Level***
Chemical Waste	403 (527)	Mercury	0.47 mg/kg
		Zinc	43.3 mg/kg
Sewage Leach	5,530 (7,233)	Mercury	0.94 mg/kg
		Zinc	86.6 mg/kg
		Silver-108m	0.58 pCi/g
		Cesium-137	11.7 pCi/g
Sewage Leach Berm	2,110 (2,760)	Cesium-137	23.3 pCi/g

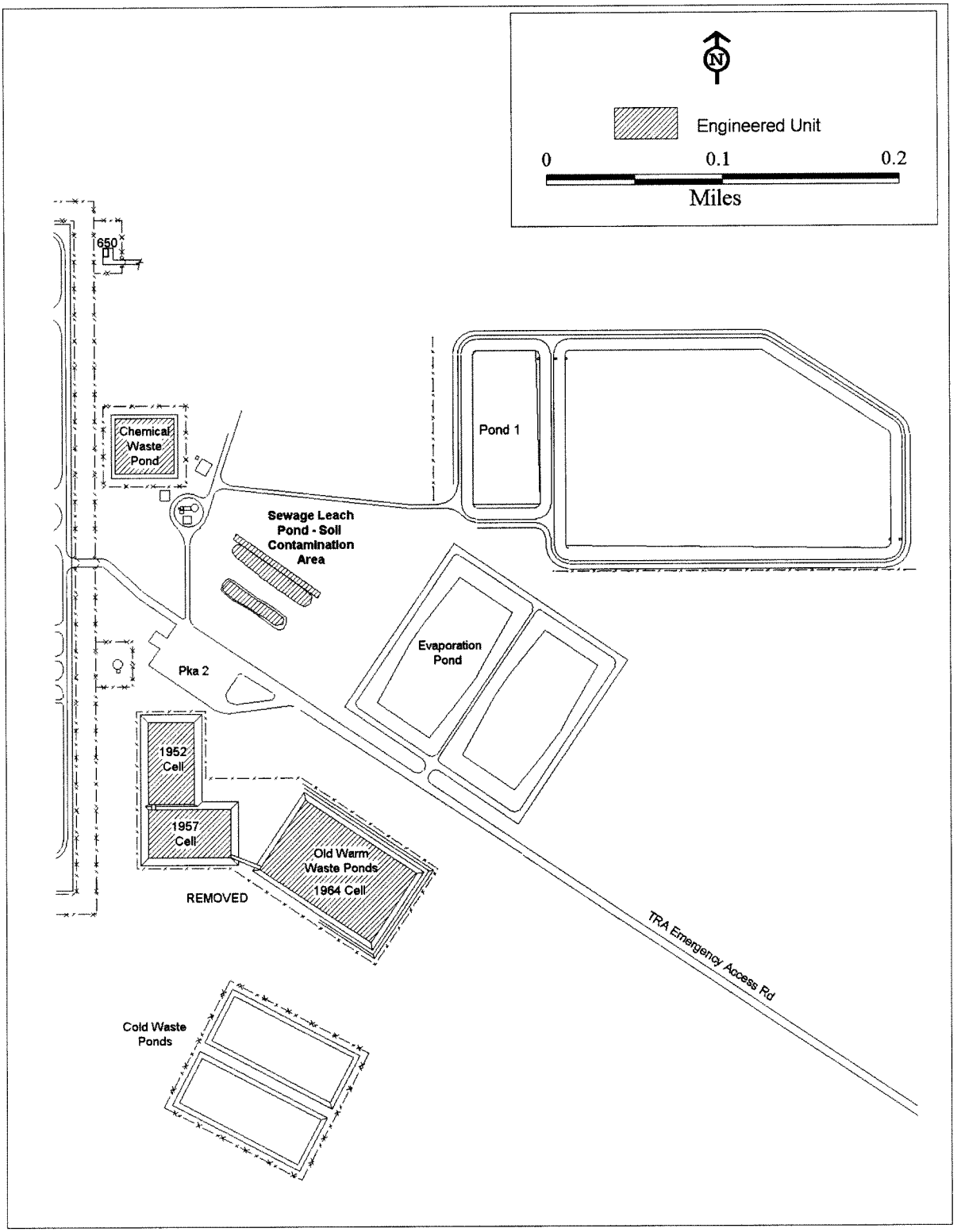
to existing land contours to the largest extent possible. Surface water controls have been implemented to direct surface water away from the engineered cover. Long-term permanent markers (e.g., signs and monuments) were placed on the north, south, east, and west boundaries of the Warm Waste Pond.

The Chemical Waste Pond, located northeast of the Test Reactor Area and adjacent to the security fence, began operating in1962 as an unlined infiltration pond designed to receive wastewater from a demineralization plant at the Test Reactor Area. However, the pond evolved into an all-purpose waste pond and received solid and liquid wastes containing mineral salts, primarily calcium and magnesium carbonate. Records show that acid from the vehicle storage facility at the Central Facilities Area was drained directly into the Chemical Waste Pond. In 1998, remedial action was taken to cover the contamination with a natural soil cap. The final native soil cover design consists of a sloped surface with a 0.3-meter (one-foot) peak. The cover surface was completed with vegetation.

The Sewage Leach Pond Berm and Soil Contamination Area is a fence-enclosed radiation control area surrounding the Sewage Leach Pond. The fenced area is approximately 145 meters by 146 meters (475 feet by 480 feet). The source of the surface soil contamination has been attributed to windblown deposition of soils originating from the Warm Waste Pond. The remedial strategy for the Sewage Leach Pond Berm and Soil Contamination Area consisted of placing all contaminated soil from the berm into the Sewage Leach Pond. The Sewage Leach Pond is located 46 meters (150 feet) outside the Test Reactor Area security fence, directly east of the central part of the Test Reactor Area. The pond consists of two cells (1950 and 1965) where effluent was discharged from sanitary sewer drains throughout the Test Reactor Area. Knowledge of process operations indicates that effluent was limited to domestic sewage. However, low-level radionuclides were detected in the bottom of Cell 1950 that have been attributed to windblown deposition of soils originating from the Warm Waste Pond. The Sewage Leach Pond was removed from service in 1995. The remedial strategy for the Sewage Leach Pond was to contain the contamination with a native soil cover. Before the cover was constructed, the pond was backfilled with contaminated soils from the Sewage Leach Pond Berm, then filled with remaining clean soil to grade. The final cover design will consist of a sloped surface with a 0.3-meter (one-foot) peak. The cover surface was completed with vegetation.

Engineered Units Long-Term Stewardship Activities

This portion requires long-term stewardship activities, such as continually maintaining and monitoring the engineered controls (i.e., soil and rock caps) and enforcing the institutional controls. In accordance with CERCLA, five-year reviews will be conducted to ensure the remedy remains protective and appropriate. Access will be restricted through locked gates, fences and warning signs posted on the perimeter. These will be



Test Reactor Area Ponds Portion

maintained and replaced as necessary. The land will be maintained as restricted use for 100 years, if necessary due to regulatory requirements. Additional controls consist of property lease requirements that stipulate future land use and property transfer requirements that identify when land is suitable for transfer with specific land use controls.

Although the nature of the institutional controls for the constituent areas of this portion are sufficiently similar, some differences in the specific length of controls do exist. For the Warm Waste Pond and the Sewage Leach Pond cells, institutional controls, meaning land use restrictions, will need to be exercised for a considerably longer time (400 years and 1,000 years, respectively) than for the Chemical Waste Pond. The Chemical Waste Pond is currently available for industrial land use, but residential use is restricted at depths less than four meters (14 feet) because of the nature of the contaminant mercury.

3.6 Test Reactor Area Subsurface Soils Portion

TEST REACTOR AREA SUBSURFACE SOILS PORTION HIGHLIGHTS

Major Long-Term Stewardship Activities - institutional controls enforcement
Portion Size - 0.008 hectares (0.02 acres)
Estimated Volume of Residual Contaminants - soil 800 cubic meters (1,000 cubic yards)
Long-Term Stewardship Start-End Years - 2000-2099

This portion consists of contaminated subsurface soils currently underneath buildings or structures, and surrounding subsurface structures, within the Test Reactor Area. Specifically, the contaminated subsurface soils are located in the following areas: surrounding the Hot Waste Tanks at Building-613 (see map on page 24), surrounding Tanks 1 and 2 at Building-630 (Catch Tank Pumphouse), and the Brass Cap Area (see map on page 25). These areas are considered one portion because they are in fairly close geographic proximity within the Test Reactor Area, have similar contaminants, and require similar long-term stewardship activities.

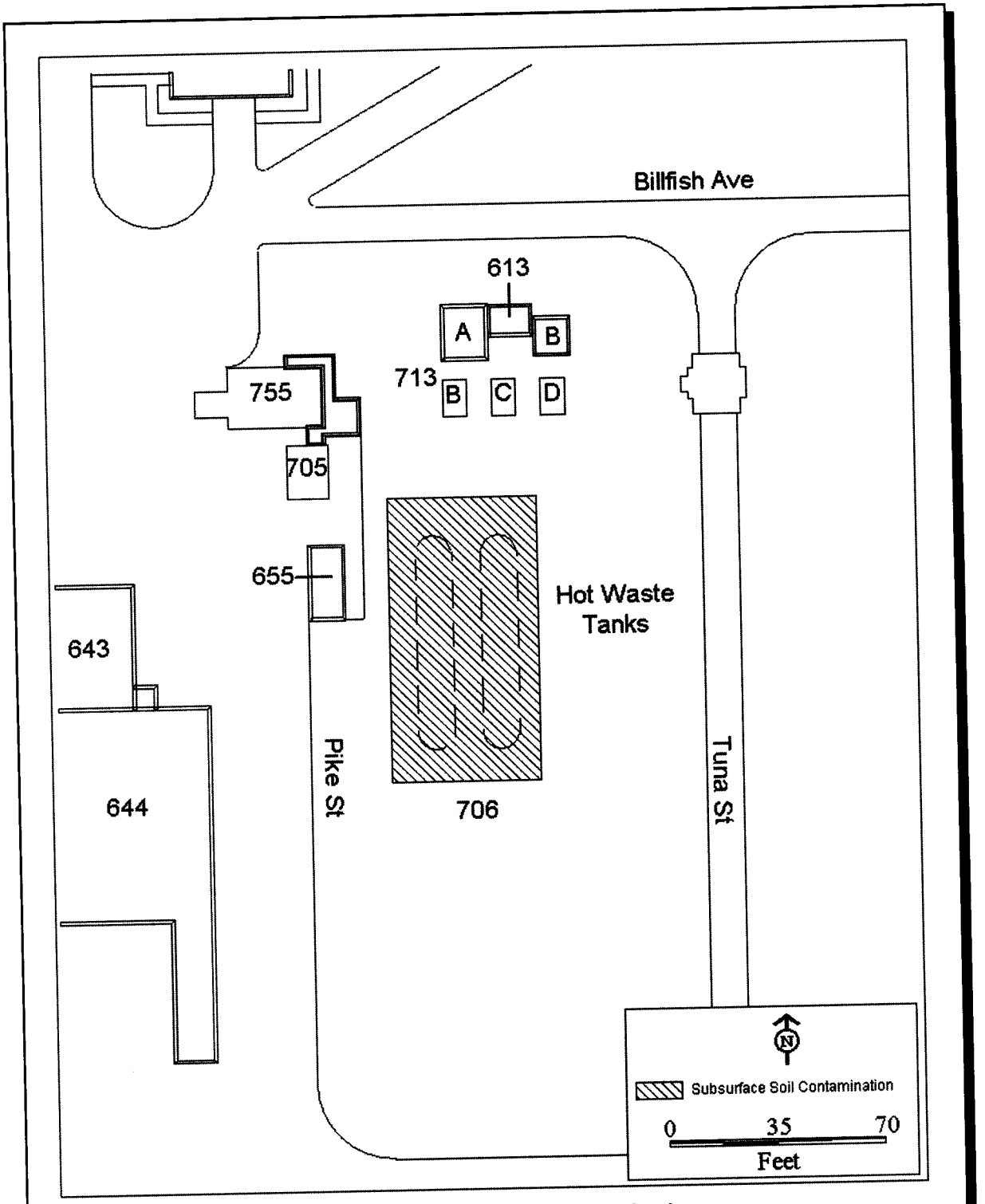
3.6.1 Soil

The soil surrounding the tanks at Building 613 and 630, as well as the soil underlying the Brass Cap area, were contaminated as a result of pipeline leaks from waste drain lines in the Test Reactor Area. The potential contaminants of concern for this portion are listed in the table at right (*Test Reactor Area Subsurface Soils Potential Contaminants of Concern*). The estimated volume of contaminated soil surrounding the tanks at building TRA-613 and building TRA-630 is 677 cubic meters (885 cubic yards) and 17 cubic meters (22 cubic yards), respectively. The volume of contaminated soil underlying the Brass Cap area is approximately 80 cubic meters (105 cubic yards).

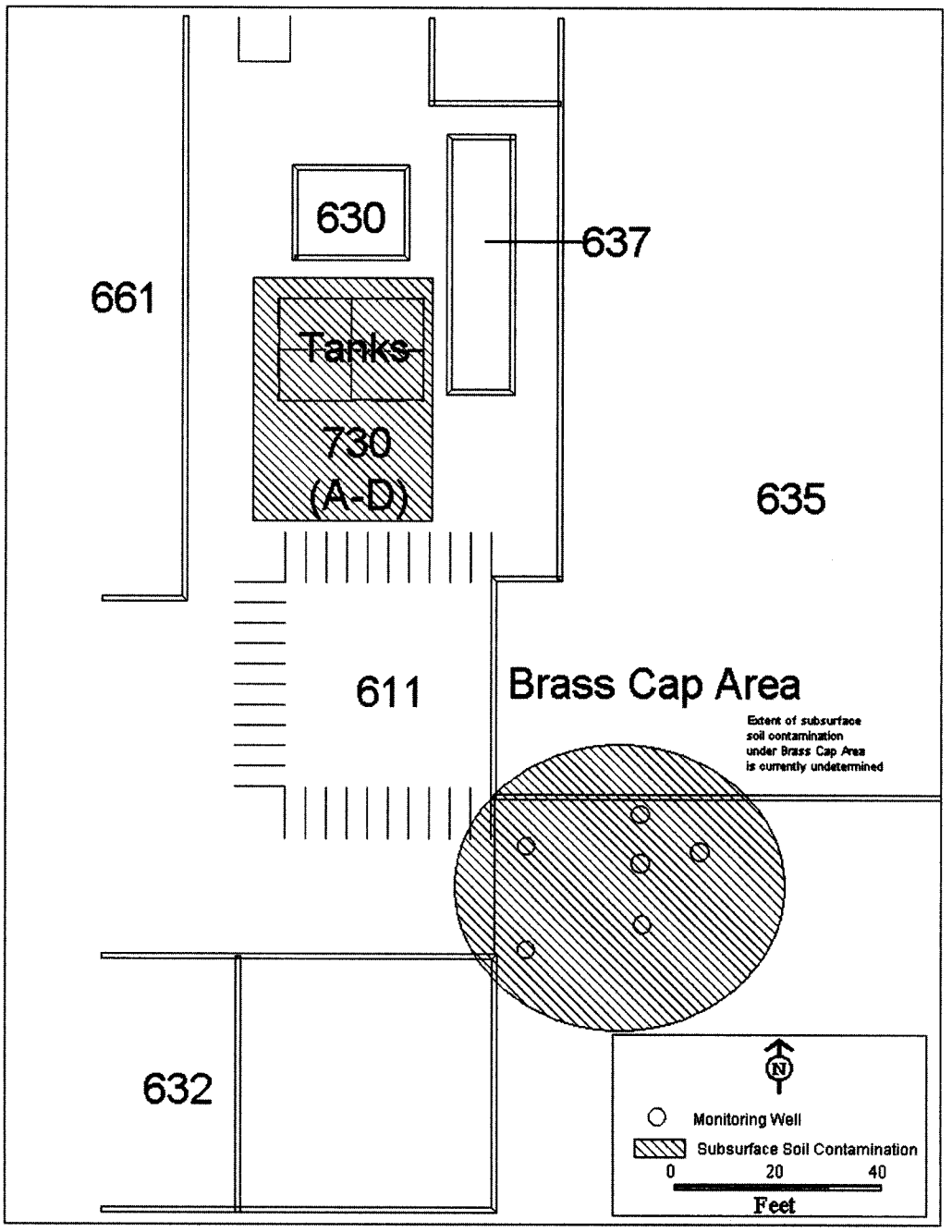
Test Reactor Area Subsurface Soils Potential Contaminants of Concern

Arsenic	Cobalt-60
Cesium-137	Lead
Cesium-134	Strontium-90
Chromium	Silver-108m
Europium-152	PCBs
Europium-154	Acrylonitrile
Americium-241	Beryllium
Plutonium-238	Mercury
Plutonium-239	Metals
Thorium-228	Uranium-238

Access to the contaminated areas is currently restricted. For the Brass Cap Area, a previous excavation of contaminated soil and concrete was followed by backfilling with clean soil, replacement of the concrete, and emplacement of a brass marker over the area to indicate subsurface contamination. Further remediation is not anticipated until the Test Reactor Area operations cease. The remaining contaminated soils in this portion will be excavated and disposed at an approved facility, on a contingency basis. Inaccessible soil contamination beneath facilities will be left in place and addressed when the Test Reactor facilities are removed. The final remediation goal for all areas within this portion is 23.3 mg/kg for nonradionuclides and 23.3 pCi/g for radionuclides.



Test Reactor Subsurface Area Soils Portion



Test Reactor Area Subsurface Soils Portion

Soil Long-Term Stewardship Activities

The primary long-term stewardship activity is enforcing institutional controls. Although the nature of the institutional controls for the constituent areas of this portion are sufficiently similar to group these areas into one portion, some differences in the institutional controls do exist. For the soil surrounding the Hot Waste Tanks at Building TRA-613, because of the depth of the contaminant (greater than four meters (13 feet) deep), the land

will be restricted to occupational access until 2095. However, after that time the land use will still be restricted at depths greater than three meters (ten feet), unless otherwise determined during a CERCLA five-year review. For the soil surrounding both Tanks 1 and 2 at TRA-630 and the Brass Cap Area, the land will be restricted to occupational access, with no residential development, until the soil is removed or the status is changed in a CERCLA five-year review.

The *INEEL Comprehensive Facility and Land Use Plan* will contain a description of the areas where access will be restricted, the specific controls (e.g. fences, signs) that will be used to ensure that access will be restricted, the types of activities that will be prohibited in certain areas (e.g. excavation), and the anticipated duration of such controls. DOE will also provide the Bureau of Land Management, EPA, and IDHW the detailed description of controls identified above. DOE-Idaho Operations Office will submit a written evaluation of the effectiveness of the institutional controls at the Test Reactor Area as part of every CERCLA five-year review. This report, at a minimum, will include a description of a walk-through of the areas subject to institutional controls conducted at the time of each five-year review.

3.7 Idaho Nuclear Technology & Engineering Center Sites Portion

This portion includes contaminated soil, groundwater, and facilities located in the Idaho Nuclear Technology & Engineering Center (INTEC). The INTEC facility is a geographically distinct area within INEEL, and the components of this portion all lie within or in close proximity to the INTEC facility fence. The portion encompasses approximately 230 hectares (570 acres).

INTEC SITES PORTION HIGHLIGHTS

Major Long-Term Stewardship Activities - monitoring and maintaining engineered controls; monitoring groundwater; enforcing institutional controls
Portion Size - 230 hectares (570 acres)
Estimated Volume of Residual Contaminants - soil 7.9 million cubic meters (8.7 million cubic yards); groundwater 18 billion cubic meters (23 billion cubic yards); facilities 8,000-69,000 cubic meters (10,000-90,000 cubic yards)
Long-Term Stewardship Start-End Years - 2008-2095

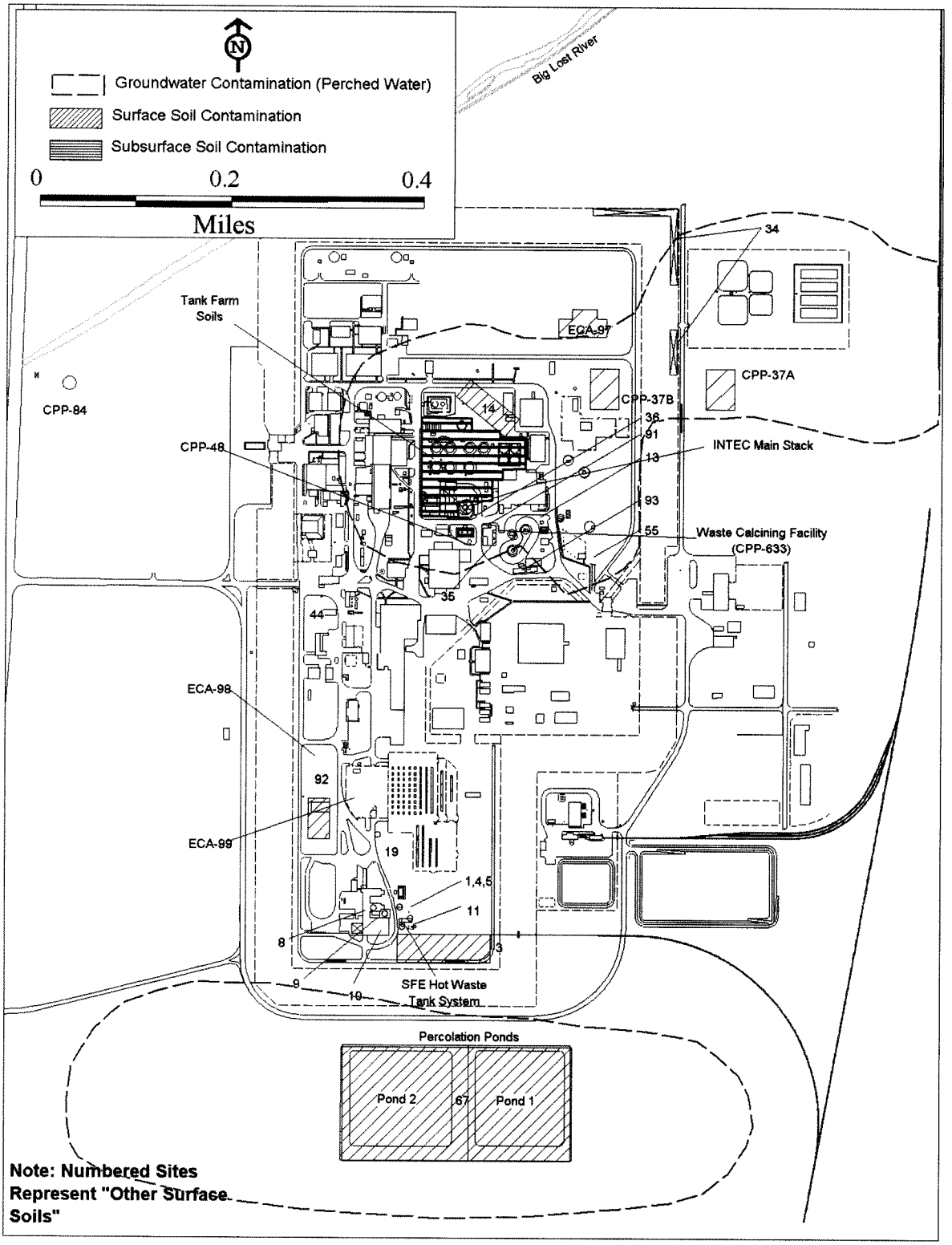
Several components of this portion are undergoing interim remedial action and have contingency plans in the event that identified remedial options are substituted with alternatives. These interim actions are anticipated to be complete by 2006 and require long-term stewardship; thus they are included in this portion. The remediation decision for the INTEC high-level waste tanks is in the process of being made and, consequently, is not addressed in this report.

3.7.1 Soil

This area is comprised of surface soils, subsurface soils, and soils under existing buildings within INTEC. Specifically, the areas of contaminated soil include the Tank Farm Soils, Other Surface Soils, Buried Gas Cylinders, and No Further Action Sites. The estimated volume of contaminated soil is 7.9 million cubic meters (8.7 million cubic yards), which is based on a surface area of approximately 70 hectares (180 acres) of soil at an average depth of 10 meters (30 feet). Some of the contaminated soil is intended to be disposed of at the INEEL Consolidated Disposal Facility (ICDF), to be constructed in 2003. The ICDF will be RCRA-compliant, and will contain only low-level and mixed low-level waste from CERCLA remediation projects across the site. The potential contaminants of concern and their remediation goals are listed in the table at right (*INTEC Sites Contaminants of Concern*). The risk-based

INTEC Sites Contaminants of Concern

Contaminant Name	***Remediation Level***
Americium-241	290 pCi/g
Cesium-137	23 pCi/g
Europium-152	270 pCi/g
Europium-154	5200 pCi/g
Plutonium-238	670 pCi/g
Plutonium-239/240	250 pCi/g
Plutonium-241	56,000 pCi/g
Strontium-90	223 pCi/g
Mercury	23 mg/kg



Idaho Nuclear Engineering & Technology Center Sites Portion

remediation goals will be used to verify the effectiveness of the selected remedial action and to determine if additional remedial action (such as additional excavation) is necessary prior to closing the release site. A detailed description of the contaminated areas is provided in the paragraphs below.

The Tank Farm Soils are located in the Tank Farm area and adjacent to the Process Evaporation Waste evaporator building. These areas consist of soil contamination that resulted from spills and pipeline leaks of radioactive liquids from plant liquid waste transfer operations. Some spills and releases were cleaned up and excavated soils were replaced with contaminated backfill. The primary soil contaminants include radionuclides, as listed in the table below (*Tank Farm Soils Contaminants of Concern*), and nonradionuclides, such as mercury and nitrate. The interim remedial action, which is anticipated to be implemented by 2006, involves leaving the residual soil in place, using surface water control to limit leaching and transportation of contamination, and enforcing institutional controls to restrict access.

The Other Surface Soils consists of release sites located in the following areas:

- Old Sewage Treatment Plant,
- Percolation Ponds,
- Calcined Solids Storage Bins,
- Disposal Trenches,
- Grease Pit,
- Former Gravel Pits,
- Excess Chemical Dump Tank, and
- Buildings within INTEC (i.e., Building-603, 633, 1619, 1).

The soil contamination in these areas was a result of inadvertent spills and leaks from radioactive waste, decontamination solutions, spent fuel storage water, storage of radionuclide-contaminated equipment, and other plant-generated wastewaters. Based on currently available cost information, all Other Surface Soils will be disposed of in the ICDF. Data indicate that the contamination generally occurs in the upper few feet of the soils; however, some sites have contamination that extends to the surface soil/basalt interface, at a depth of about 10 meters (40 feet). The contaminants of concern for these soils consist of cesium-137, europium-152, and strontium-90.

Tank Farm Soils Contaminants of Concern

Cesium-137	Plutonium-240
Europium-154	Plutonium-241
Plutonium-238	
Strontium-90	
Plutonium-239	
Uranium-235	

The Buried Gas Cylinders area consists of a buried trench where compressed gas cylinders were previously disposed and four exposed gas cylinders believed to contain hydrofluoric acid. The cylinders at the burial site originated from INTEC and contain gases (considered low-level threat wastes) used for construction. The exact number and contents of the discarded cylinders is not known, but it is believed that 40 to 100 cylinders were disposed at the site. The potential for cylinder over-pressurization and bursting is considered to be the most serious hazard. No known release of the cylinder contents has occurred. By 2006, remedial action is anticipated to be complete. Remedial action will consist of removing and disposing of the cylinders in an approved facility. Institutional controls will be required if any residual contamination remains after remediation.

The No Further Action Sites includes the following areas:

- Trench east of the fuel storage basin that was used to dispose of fuel storage basin water from Building-603;

- Soil storage area south of the Peach Bottom fuel storage area that was used for storing piles of construction debris. Sludge and liquid generated during Building-603 fuel storage basin maintenance activities may have been deposited in these areas, resulting in contamination of the underlying soils. The soil was containerized in approximately 653 standard radioactive waste boxes;
- Particulate air release south of Building-603, which is the location of surface contamination resulting from a 1958 air release from a filter failure associated with the Fuel Element Cutting Facility. Contamination from this airborne release has most likely been removed or covered with soil over time since 1958, as a result of construction activities in the area;
- Radioactively contaminated soil, which consists of the radioactively-contaminated soils within the current INTEC security fence that have not been attributed to another specific release area;
- A ruthenium detection site, which consists of soil contaminated by leaks in service waste transfer lines
- between Building-709 and the injection well; and
- An airborne contaminant plume, which is a contaminated soil area, outside the current INTEC perimeter fence, as a result of wind dispersion of radionuclides from facility operations.

The State of Idaho and EPA, in partnership with DOE, have determined that these areas are "No Further Action" sites because, although the current residential risks are not acceptable, the future risks are acceptable. The contaminants of concern are listed in the table at right (*No Further Action Sites Contaminants of Concern*).

No Further Action Sites Contaminants of Concern

Americium-241	Plutonium-239
Arsenic	Plutonium-240
Benzo(a)pyrene	Phenanthrene
Cesium-134	Plutonium-238
Cesium-137	Potassium-40
Cobalt-57	Strontium-90
Cobalt-58	Technicium-99
Europium-152	Thallium
Europium-154	Uranium-233
Europium-155	Uranium-235
Niobium-95	

Soil Long-Term Stewardship Activities

Long-term stewardship activities involve monitoring and maintaining engineered controls (i.e., surface water control), enforcing institutional controls, and restricting access to residually contaminated areas. CERCLA five-year reviews are required for soils with residual contamination. The site will also conduct surface soil and air monitoring. Monitoring is expected to be conducted annually for the first 30 years and every five years for the remaining 70 years of monitoring.

Institutional controls appropriate to the nature of residual soil contamination will be implemented. These controls will be designed to limit site access to an annual duration such that exposure to radionuclides and other contaminants of concern do not result in an imminent and substantial endangerment to public health or the environment, as consistent with the identified current and future land use assumptions. For example, if less than a day's exposure would represent an unacceptable risk to a trespasser (high-risk potential), the requirement for fencing, warning signs, and administrative controls would be necessary. Consequently, fences and signs would be repaired and replaced, as necessary.

Conversely, the "No Further Action" sites require years of exposure to result in a potential unacceptable hazard and, hence, only administrative controls are necessary to be protective. The effectiveness of the institutional controls will be periodically evaluated during five-year reviews and modified as necessary. Any new information acquired regarding the nature and extent of contamination at these sites will be considered during each review.

Several areas in this medium are undergoing interim action and have contingency actions in the event that further characterization indicates further remediation is necessary, or in the event that an anticipated treatment or disposal option is not available as planned. For instance, the contingency action for the Buried Gas Cylinders area is to leave the cylinders in place and cap the area if removing the cylinders is too dangerous. If this occurs,

additional long-term stewardship activities will be required, such as monitoring and maintaining the engineered cap.

3.7.2 Groundwater

This medium consists of groundwater underlying INTEC, specifically portions of the Snake River Plain Aquifer (SRPA) and the perched water zone. These areas have unique contaminant profiles and unique long term stewardship requirements. The estimated volume of contamination is 18 billion cubic meters (23 billion cubic yards).

The SRPA underlies the Eastern Snake River Plain and extends about 300 kilometers (200 miles) through eastern Idaho. The aquifer lies at a depth of about 140 meters (450 feet) beneath INTEC. The aquifer is the source of all drinking water on the INEEL site and has been designated by EPA as the sole source aquifer for the region. The contaminants of concern are listed in the table below (*Snake River Plain Aquifer Contaminants of Concern*). However, iodine-129, strontium-90, and plutonium isotopes are the only contaminants that pose an unacceptable risk to a hypothetical future resident beyond the year 2095. Target cleanup levels for the SRPA consist of the following: a total of beta-gamma emitting radionuclides shall not exceed four mrem/yr effective dose equivalent; for strontium-90 and daughters, the cleanup level is eight pCi/l, for Tritium it is 20,000 pCi/l, and for iodine-129 it is one pCi/l. The source of contamination in the SRPA originates primarily from the injection well (CPP-23). However, contaminated soils and perched water are predicted to contribute to future SRPA contamination. Due to the uncertainty associated with the contaminant source estimates, the remedial measures taken for the SRPA are designated as an interim action. The interim action consists of three components: (1) maintaining existing and additional institutional controls over the areas of the SRPA contaminant plume to prevent exposure to contaminated groundwater during the time the aquifer is expected to remain above maximum concentration levels; (2) groundwater monitoring to determine if concentrations of contaminants of concern exceed drinking water standards; and (3) contingent active pump and treat remediation if drinking water standards are exceeded.

Perched water occurs at depths ranging between 30 and 130 meters (100 and 420 feet) in the basalts and the sedimentary interbeds beneath INTEC. Perched water consists of variably saturated groundwater zones above the regional SRPA. The perched water zones result from local recharge from various INTEC water sources and ultimately recharges the SRPA. Perched water has been contaminated by leaching and downward transport of contaminants, primarily strontium-90 and tritium from the overlying surface soils, and from two instances in which the INTEC injection well collapsed and service wastewater was released to the perched zones.

Snake River Plain Aquifer Contaminants of Concern

Americium-241 *	Plutonium *
Chromium	Strontium-90 *
Iodine-129	Tritium
Mercury Uranium *	
Neptunium-237 *	

** Includes daughter products*

The remedial action for the perched water zone involves institutional controls and aquifer recharge control. Water flow into the perched zone will be restricted and as the area drains naturally, monitoring will be necessary to ensure minimal releases occur to the SRPA. The target cleanup levels for the perched water zone include the following: 15 pCi/l for alpha-emitting radionuclides; 15 pCi/l for the total of uranium and daughters; 15 pCi/l for the total of neptunium-237 and daughters; 15 pCi/l for the total of plutonium and daughters; and 15 pCi/l for the total of americium-241 and daughters. The nonradionuclides target cleanup levels for chromium is100 micrograms/l and for mercury is two micrograms/l. Modeling predicts that the applicable State of Idaho groundwater standards will be naturally achieved by 2095, except for strontium-90, iodine-129, and plutonium isotopes.

If the remediation activities for the perched water do not sufficiently reduce the moisture content and contaminant flux, then additional infiltration controls will be implemented to achieve the necessary de-saturation and corresponding reduction in contamination transport rate. These additional controls include (in order): (1) lining the Big Lost River; (2) closing and relocating the existing Sewage Treatment Plant lagoons and infiltration galleries; and (3) upgrading the INTEC-wide drainage controls, repairing leaking fire water lines, and eliminating steam condensate discharges. However, these additional controls are not anticipated to be implemented prior to 2006.

Groundwater Long-Term Stewardship Activities

Since contaminants from INTEC operations will remain in the SRPA and perched water zone, a CERCLA five-year review is required. Five-year reviews will be conducted by DOE until determined that they are no longer necessary. The five-year reviews will evaluate the effectiveness of the alternative and the need for its continuation or will consider a different alternative. Existing institutional controls will prevent the groundwater ingestion exposure route from being completed by preventing direct access to the contaminated SRPA until the year 2095. Land use controls will remain in place indefinitely to prevent unauthorized drilling through the contaminated perched zone.

Institutional controls will remain in place until 2095 and include area access restrictions, land use restrictions to prevent the installation of water supply wells, a notice of agreement with affected federal and local government stakeholders, and warning signs, as well as locks and labels on monitoring wells. In addition to institutional controls, environmental monitoring and general maintenance and upkeep of monitoring wells will be conducted for as long as it is determined that monitoring is required.

3.7.3 Facilities

The following facilities are included in this medium: the Hot Waste Tank System and the Waste Calcining Facility (CPP-633). The total volume of residual contamination is estimated to be between 8,000 and 69,000 cubic meters (10,000 to 90,000 cubic yards). The CERCLA remedial activities and corresponding institutional controls are distinct from those of other media within this portion. Additionally, the regulatory regime differs from that of the other media (CERCLA). One of the facilities within this medium, the Waste Calcining Facility, was closed in accordance with RCRA requirements.

The Hot Waste Tank System consists of a concrete vault containing an out-of-service radioactive liquid waste storage tank. The top of the tank vault is located about three meters (ten feet) below the surface. The tank system consists of the tank contents ((1.5 cubic meters (1.9 cubic yards) of liquid, 0.2 cubic meter (0.3 cubic yard) of sludge), tank, and associated structures located east of Building-603. In 1976, the Hot Waste Tank System was taken out of service and the inlet pipe was disconnected and capped. Contaminated soil may have been used as backfill material for the excavation. The contaminants of concern are listed in the table at right (*Hot Waste Tank System Contaminants of Concern*). The anticipated remediation strategy will involve excavating the tanks, after the contents have been removed, and associated structures and disposing of them onsite. The disturbed area will be backfilled with clean soil to grade, and appropriate institutional controls will be implemented to limit access.

Hot Waste Tank System Contaminants of Concern

Antimony-125	Europium-154
Cesium-134	Europium-155
Cesium-137	Plutonium-239
Cobalt-60	Plutonium-240
Europium-152	Strontium-90

The Waste Calcining Facility, which operated from 1963 until 1987, was designed and constructed to calcine and evaporate aqueous wastes generated from the reprocessing of spent nuclear fuel. The Waste Calcining Facility was a heavily reinforced concrete structure, which occupies approximately 1,600 square meters (17,222

square feet). The high-level mixed waste and the low-level mixed waste (sodium) historically processed through the Waste Calcining Facility had hazardous waste characteristics such as chromium, lead, mercury, and silver. Therefore, in accordance with the Waste Calcining Facility RCRA closure plan, the facility has been closed as a landfill with a RCRA-compliant cap. The concrete cap extends approximately two meter (five feet) beyond the Waste Calcining Facility perimeter.

Facilities Long-Term Stewardship Activities

Long-term stewardship activities required for this medium consist of monitoring and maintaining engineered controls (i.e., concrete barrier cap), restricting access, and enforcing institutional controls. The entombed Waste Calcining Facility requires surveillance and maintenance to ensure the engineered cap remains protective of human health and the environment. Appropriate institutional controls will be implemented to limit access to the Waste Calcining Facility and the Hot Waste Tank System. In addition, a brass plaque marks the concrete entombment with a notice that it was a RCRA closure and that contamination still exists under the cap. Land use restrictions will prohibit the reuse of the area. Survey boundaries and a monitoring plan will be prepared and published in the *INEEL Comprehensive Facility and Land Use Plan*. CERCLA five-year reviews will be required at the Hot Waste Tank System area until it is determined that they are no longer necessary.

3.8 Central Facilities Area Portion

This portion includes three separate landfills (Landfill I, II, and III) and the Sewage Treatment Plant Drainfield at the Central Facility Area within INEEL. This is considered one portion because all areas, although geographically distinct, are in reasonable proximity and will be managed under a similar long-term stewardship approach. The portion encompasses approximately 162,000 square meters (1,742,400 square feet) and includes four engineered units (unlined trenches) that contain multiple types of waste.

CENTRAL FACILITIES AREA PORTION HIGHLIGHTS

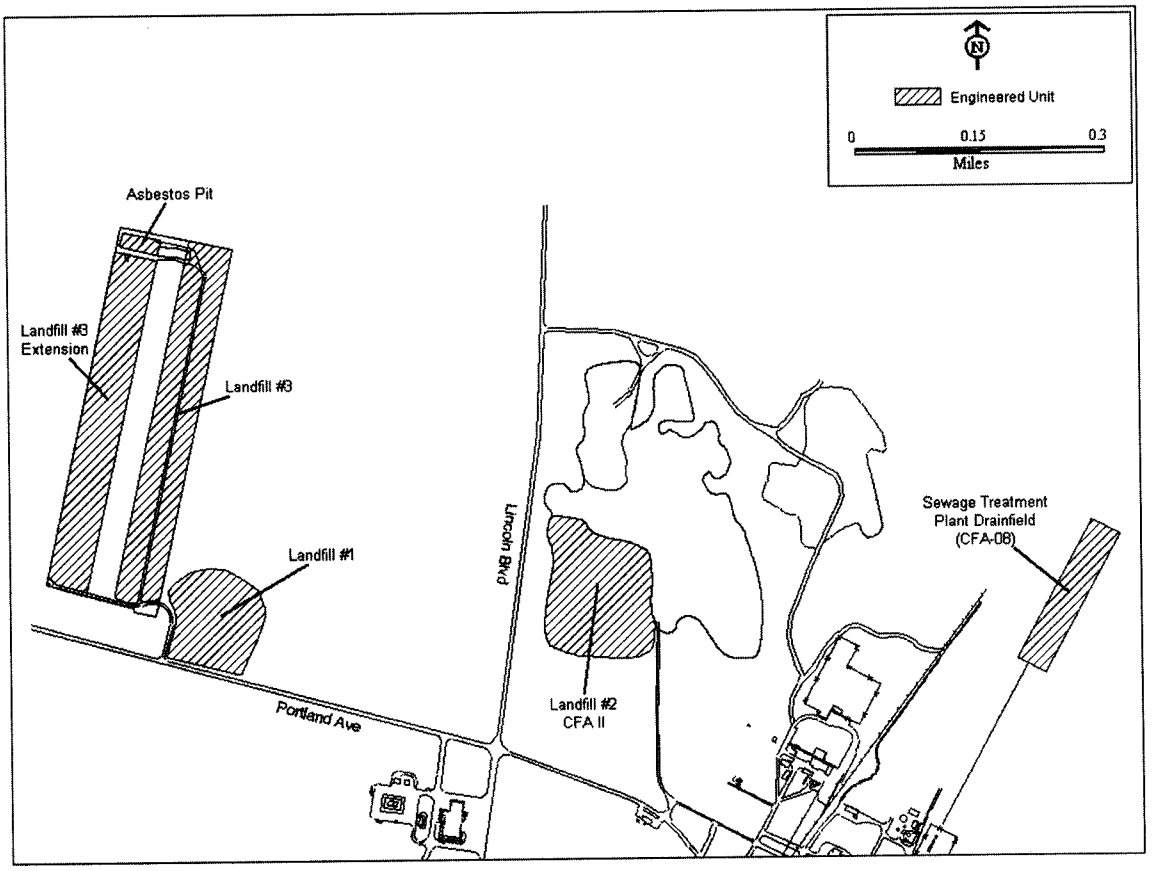
Major Long-Term Stewardship Activities - engineered unit monitoring; institutional control enforcement
Portion Size - 16 hectares (40 acres)
Estimated Volume of Residual Contaminants - engineered units 57 cubic meters (74,000 cubic yards)
Long-Term Stewardship Start-End Years - 1996-2099

3.8.1 Engineered Units

Landfills I, II, and III began as excavations where wastes, primarily construction-related wastes, from INEEL operations were disposed and buried. The landfills are no longer in use and have not received waste since 1984. A soil cover was placed over each of the landfills, as listed in the table at right (*Approximate Area of Landfills*). There is a significant degree of uncertainty associated with the types and volumes of wastes disposed in the Central Facilities Area Landfills, particularly with Landfill I. However, based on records, the wastes primarily included construction debris, paper, cafeteria garbage, and other solid and liquid wastes typically found in municipal landfills. Liquid wastes, such as waste asphalt and paint, were also disposed in the landfill. Although not intended for disposal of radioactive-contaminated materials, it is possible that infrequent, inadvertent disposal occurred. The overall depth of contamination is not known with certainty, but the estimated volume of contaminated soil is based on the assumption that the contamination is three meters (ten feet) deep. The landfills were capped in 1996 and 1997 with a native soil cover, in combination with the existing soil cover. The area was compacted and graded to minimize erosion and infiltration by controlling surface water runoff, resulting from seasonal precipitation. In addition,

Approximate Area of Landfills

Landfill	*Approximate Area in hectares (acres)*
I	3 (8)
II	6 (15)
III	5 (12)



Central Facilities Area Portion

groundwater infiltration and/or vadose zone monitoring is conducted to ensure the remedy remains protective.

The Sewage Treatment Plant Drainfield is a 61-by-305 meter (200-by-1,000-foot) area with five sections. The drainfield was used from 1944 until 1995, when the plant was replaced with a new sewage treatment plant. Sampling indicates that the soil is contaminated by cesium-137, with the highest contamination in the top 0.9 meter (three feet) of soil. The total depth of contamination is uncertain; however, the extent of contamination is believed to encompass the entire drainfield, which is approximately 57 cubic meters (74,000 cubic yards). The remedy has not been selected; however, it is anticipated that remediation will consist of installing an engineered cover, beginning in 2001 and completed by 2002. The contaminated area will be cleared of vegetation, the soil compacted in place, and the area capped with a protective cover. The cover will be constructed of impermeable asphalt, concrete, or geosynthetic material, with layers of rock and soil on top.

Engineered Units Long-Term Stewardship Activities

The Central Facilities Area portion requires long-term stewardship activities, including monitoring and maintenance of the engineered units and ensuring institutional controls remain effective. Groundwater monitoring related to the engineered units is being conducted on a quarterly basis. Additional monitoring activities will include cap monitoring, soil gas monitoring, inspections for landfill infiltration, and fences to restrict access. The estimated end-year for long-term stewardship activities is based on the 100-year DOE-controlled land use assumption.

Specifically, the three landfills require periodic inspections and maintenance to ensure the covers remain protective of human health and the environment. A deed restriction will be obtained for the landfill area with a 15-meter (50-foot) buffer zone around each landfill boundary. The restriction will limit the use and sale of the property. The borders will be delineated by posting signs warning of the landfill's existence and potentially contaminated soils.

The Sewage Treatment Plant Drainfield will require long-term maintenance and monitoring to ensure the integrity of the cover. In addition, access and deed restrictions will be required so that the area remains protective of human health and the environment.

3.9 Auxiliary Reactor Area Soils Portion

This portion consists of surface soils at the Auxiliary Reactor Area (ARA) within INEEL, excluding the Stationary Low Power Reactor-I burial ground. The elements of this portion are in relatively close geographic proximity within the Auxiliary Reactor Area and have similar long-term stewardship requirements. The surface soils were contaminated as a result of operations within the Auxiliary Reactor Area. The Auxiliary Reactor Area consisted of the Auxiliary Reactor Area-I, -II, and -III facilities and support buildings. Auxiliary Reactor Area-I was constructed in the late 1950s to provide support facilities for various INEEL programs and was active until the spring of 1988. Auxiliary Reactor Area II housed the Stationary Low Power Reactor-I, which the Army operated between August 1958 and December 1960. The reactor was destroyed in an accident on January 3, 1961. After cleanup, the three main buildings were converted into offices and welding shops. Auxiliary Reactor Area-III was the site of a plant used between 1960 and 1965 to test gas-cooled reactors for the United States Army. After 1966, the plant served as a laboratory for testing reactor components and instruments. Auxiliary Reactor Area-I, -II, and -III have all been decontaminated and demolished.

This portion is approximately 40 hectares (100 acres), which includes the area that will most likely require long-term stewardship; however, the area does not include a substantial section of open buffer land in the Power Burst Facility/Auxiliary Reactor Area.

AUXILIARY REACTOR AREA SOILS PORTION HIGHLIGHTS

Major Long-Term Stewardship Activities - institutional controls enforcement
Portion Size - 40 hectare (100 acres)
Estimated Volume of Residual Contaminants - soil 119,000 cubic meters (155,000 cubic yards)
Long-Term Stewardship Start-End Years - 1996-2095

Auxiliary Reactor Area Soils Portion Volume of Residual Contamination

Location Name	*Estimated Volume of Contamination in cubic meters (cubic yards)*
Chemical Evaporation Pond	1,821 (2,382)
Sanitary Waste System Seepage Pit	13 (17)
Radioactive Waste Leach Pond	12,255 (16,029)
Radionuclide Tank Soils	187 (245)
Soils Associated with ARA-I and -II	104,251 (136,355)
Soils Beneath Hot Cells	54 (71)

3.9.1 Soil

The overall area of soil contamination is 28 hectares (69 acres), and the volume of residually contaminated soils is listed in the table at right (*Auxiliary Reactor Area Soils Portion Volume of Residual Contamination*). This includes the following constituent release areas: Chemical Evaporation Pond, Radioactive Waste Leach Pond,

the Soils Beneath the Hot Cells, the Radioactive Surface Soils and Subsurface Structures Associated with Auxiliary Reactor Area-I and -II, the Radioactive Tank Soils, Sanitary Waste System seepage pit, and the Windblown Soils.

The Chemical Evaporation Pond is a shallow, unlined surface impoundment, roughly 30 by 90 meters (100 by 300 feet) in size, that was used to dispose of laboratory wastewater from the Auxiliary Reactor Area-I Shop and Maintenance Building. From 1970 to 1988, the pond received process discharges that contained small quantities of radioactive substances, acids, bases, and volatile organic compounds. Since 1988, the pond has been dry except during spring runoff and heavy precipitation. The contaminants of concern and their respective target remediation levels are listed in the table at right (*Chemical Evaporation Pond Contaminants of Concern*).

Chemical Evaporation Pond Contaminants of Concern

Contaminant Name	***Remediation Level (mg/kg)***
Arsenic	10
Selenium	2.2
Thallium	4.3

The Radioactive Waste Leach Pond is an unlined surface impoundment area with approximate dimensions of 115 by 50 meters (370 by 150 feet). The pond was constructed in a natural depression west of Auxiliary Reactor Area-III to dispose of low-level liquid waste from reactor research operations. The Auxiliary Reactor Area-III plant was shut down in 1987, leaving the pond dry except during spring runoff and heavy precipitation. In 1991, the culvert was plugged in preparation for decontamination and decommission operations at the Auxiliary Reactor Area-III facility, and in 1993, the tanks and waste lines to the leach pond were removed. Contaminant concentrations were detected throughout most of the soil to a depth of 1.5 to 2.1 meters (five to seven feet) and are listed in the table at right (*Radioactive Waste Leach Pond Contaminants of Concern*).

Radioactive Waste Leach Pond Contaminants of Concern

Contaminant Name	***Remediation Level***
Silver-108m	0.75 pCi/g
Copper	220 mg/kg
Mercury	0.5 mg/kg
Selenium	2.2 mg/kg

The radiologically contaminated surface soils consist of a 19-hectare (48-acre) windblown contamination area surrounding Auxiliary Reactor Area-I and -II. The area also contains subsurface structures remaining after decontamination and decommission within the Auxiliary Reactor Area-I and -II facilities. Soils were radiologically contaminated by the 1961 Stationary Low Power Reactor-I accident and subsequent cleanup. Minor amounts of contamination may have been added by other Auxiliary Reactor Area operations. Over time, winds dispersed the contamination over an area roughly 100 hectares (240 acres) in size, but soil concentrations over most of the area are significantly less than risk-based remediation goals. The contaminant of concern in this area is cesium-137, and the target cleanup level is 23 pCi/g.

The Soils Beneath the Auxiliary Reactor Hot Cells area comprises contaminated soil that was discovered beneath the hot cells during the decontamination and decommission of the Auxiliary Reactor Area-I facility in 1998. The contaminated area is estimated to be five by seven meters (16 by 24 feet). Specifically, the contaminants of concern for this area are cesium-137, radium-226, arsenic, and lead. The target cleanup levels for arsenic is 5.8 mg/kg, cesium-137 is 23 pCi/g, radium-226 is 2.1 pCi/g, copper is 220 mg/kg, and for lead is 400 mg/kg.

The Radionuclide Tank Soils area consists of the soils that will remain after the removal of the ARA-Radionuclide Tank and associated pipes. The area also contains the remaining concrete vault and gravel around the tank. This tank is a 3,785 liter (1,000 gallon) stainless steel underground holding tank resting within a lidless concrete vault and covered by approximately 1.1 meters (3.5 feet) of soil. From 1959 to 1988, the tank received radioactive liquid waste from operations within the ARA facility. Specific contaminants detected in the tank waste were not detected outside of the tank, which indicates that the tank had not leaked. The soil contamination in the area was probably originally caused by the cleanup of the Stationary Low Power Reactor-I accident and mixed into the soil around the tank during excavation and sampling. Some contamination may have been caused

by small spills as the tank was periodically emptied. Based on human health risks, the only contaminant of concern in this area is cesium-137, and the target cleanup level is 23 pCi/g.

A similar remedial strategy was selected for the contaminated soils in the following areas: Chemical Evaporation Pond, Radioactive Waste Leach Pond, the Soils Beneath the Hot Cells, the Radioactive Surface Soils and Subsurface Structures Associated with ARA-I and -II, and the Radionuclide Tanks Soils area. Contaminated soils are being removed and disposed in an approved facility onsite. Excavated areas will be backfilled with uncontaminated soil and sloped to promote drainage. All excavations will be contoured to match the surrounding terrain and vegetation. In addition, institutional controls will be required.

The Sanitary Waste System seepage pit is a sanitary septic system comprising three septic tanks in series, a seepage pit, and the associated piping. The system was built in 1960 and serviced permanent and temporary Auxiliary Reactor Area-I buildings until 1988, when Auxiliary Reactor Area-I was deactivated. The Sanitary Waste System was designed and intended exclusively for sanitary waste. However, periodic surveys indicated radiological contamination. The source of the contamination is unknown. Because the septic tanks and seepage pit are some distance apart, the risk for the soil surrounding the three septic tanks was evaluated separately from the seepage pit. Only the contaminants in the seepage pit sludge are identified as contaminants of concern, as listed in the table (*Sanitary Waste System Contaminants of Concern*). The selected remedy consists of excavation and removal of the sludge, ex situ thermal treatment, and disposal. The soil will be removed from around the seepage pit. If concentrations of contaminants in the soil exceed the remediation goals, then the soil will be disposed in conjunction with the sludge. However, if the remediation goals are not exceeded, then the soil is anticipated to be returned to the excavation.

Sanitary Waste System Contaminants of Concern

Contaminant Name	***Remediation Level***
Aroclor-1242	1 mg/kg
Cesium-137	8.5 pCi/g
Radium-226	2.1 pCi/g
Uranium-235	6.2 pCi/g
Uranium-238	10.6 pCi/g
Lead	400 mg/kg

The Windblown Soils area consists of the surface soils surrounding the Auxiliary Reactor Area-III facility, excluding the Radioactive Waste Leach Pond and including the area within the Auxiliary Reactor Area-III facility fence. Nearly all Auxiliary Reactor Area-III structures have been removed. The contaminants of concern are listed in the table at right (*Windblown Soils Contaminants of Concern*). This area will only require institutional controls.

Windblown Soils Contaminants of Concern

Americium-241	Manganese
Cesium-137	Plutonium-238
Chromium	Silver-108m
Cobalt-60	Uranium-234
Lead	Uranium-238

Soil Long-Term Stewardship Activities

Long-term stewardship activities include enforcing institutional controls, restricting access, and monitoring the selected remedy to ensure continued protection. Institutional controls will not be required after remediation if all contaminated media are removed to basalt or if contaminant concentrations are comparable to local background values. Otherwise, post-remediation institutional controls consisting of signs, access controls, and land-use restrictions will be established and maintained either until 2095 or for a shorter time period based on the results of a CERCLA five-year review.

DOE will provide institutional controls for areas subject to land-use restrictions over the next 100 years unless a five-year review concludes that unrestricted land use is allowable. After 100 years, DOE may no longer manage INEEL activities and controls may take the form of land-use restrictions. For the Chemical Evaporation Pond, the Soils Beneath the Hot Cells, and the Radioactive Tank Soils, remedial actions are anticipated to result in no residual contamination. Therefore, long-term institutional controls for these areas will be determined based

on the analysis of post-remediation confirmation samples. Until that time, interim institutional controls include primarily access and activity restrictions. Long-term institutional controls include control of activities, publication of surveyed boundaries and descriptions in the *INEEL Comprehensive Facility and Land Use Plan*, property lease requirements (including control of land use consistent with the ROD), notice to affected stakeholders (e.g. Bureau of Land Management, Shoshone-Bannock Tribal Council, local county governments, IDHW, and the EPA) of any change in land-use designation, restriction, or land users, and property transfer requirements (including issuance of a finding of suitability to transfer).

3.10 Power Burst Facility Soils Portion

POWER BURST FACILITY SOILS PORTION HIGHLIGHTS

Major Long-Term Stewardship Activities - institutional controls enforcement
Portion Size - 550 hectares (1,350 acres)
Estimated Volume of Residual Contaminants - soil 16,000 cubic meters (21,000 cubic yards); engineered units 8,000 cubic meters (10,000 cubic yards)
Long-Term Stewardship Start-End Years - 1996-2095

This portion consists of several areas which are in relatively close geographic proximity to the Auxiliary Reactor Area/Power Burst Facility, but are geographically distinct from the cluster of areas addressed in the Auxiliary Reactor Area Soils Portion. The contaminated areas within this portion include a lake, a rubble pit, and several ponds. Since the release areas within this portion share similar contamination profiles (i.e., surface soils) and require similar long-term stewardship activities, the release areas are considered one portion. This portion is approximately 550 hectares (1,350 acres), which includes the area that will most likely require long-term stewardship; however, the area does not include a substantial section of open buffer land in the Power Burst Facility/Auxiliary Reactor Area.

The Power Burst Facility/Waste Reduction Operations Complex area, originally known as the Special Power Excursion Reactor Tests area, initially consisted of four reactors used to test reactor behavior during off-normal operating conditions and to conduct safety studies on light-water-moderated, enriched-fuel reactor systems. The Special Power Excursion Reactor Tests began in the late 1950s and were some of the first tests to help set safe operating parameters for reactors worldwide. The Special Power Excursion Reactor Test (SPERT)-I reactor began operation in 1956. Upon completion of its mission, it was dismantled and the Power Burst Facility reactor was constructed at the same site for nuclear reactor safety experiments. SPERT-II began operating in 1960; today it contains the Waste Reduction Operations Complex Lead Storage Facility. SPERT-III began operating in 1958; today, the SPERT-III reactor building contains the Waste Experimental Reduction Facility. SPERT-IV began operating in 1961 and is currently a storage building for mixed waste containing both radioactive and hazardous components.

Estimated Volume of Residual Contamination	
Location Name	***Volume of Residual Contamination in cubic meters (cubic feet)***
SPERT-IV Leach Pond	15,270 (539,320)
SPERT-IV Lake	310 (10,890)
Reactor Area Rubble Pit	960 (33,750)
SPERT-III Large Leach Pond	990 (35,000)
Reactor Area Evaporation Pond	5,550 (196,000)
SPERT-I Leach Pond	190 (6,750)

3.10.1 Soil

The experiments conducted at the Special Power Excursion Reactor Tests area contaminated the soil. The estimated volume of contamination is listed in the table at right for both soil and engineered units (*Estimated Volume of Residual Contamination*). The specific areas of contamination include the SPERT-IV Leach Pond and the SPERT-IV Lake. All contaminated areas have been remediated. Based on current occupational and

future residential risk scenarios, further remediation will not occur; however, institutional controls are being implemented. The specific remedial strategies for each area are described in the following paragraphs, and the contaminants of concern are listed in the table at right for soil and engineered units (*Power Burst Facility Portion Contaminants of Concern*).

Power Burst Facility Potential Contaminants of Concern	
Location Name	***Contaminants of Concern***
SPERT-IV Leach Pond	arsenic, lead, manganese, americium-241, cesium-137, plutonium-238, plutonium-239, thorium-228, thorium-230, thorium-232, uranium-234, uranium-238
SPERT-IV Lake	arsenic, lead, aroclor-1242, cesium-137
Reactor Area Rubble Pit	friable asbestos
SPERT-III Large Leach Pond	chloride, orthophosphate, sulfate, cobalt-60, cesium-137, uranium-234, uranium-235, uranium-238
Reactor Area Evaporation Pond	chromium, cesium-137
SPERT-I Leach Pond	cobalt-60, cesium-137, plutonium-238, strontium-90, uranium-234, uranium-238

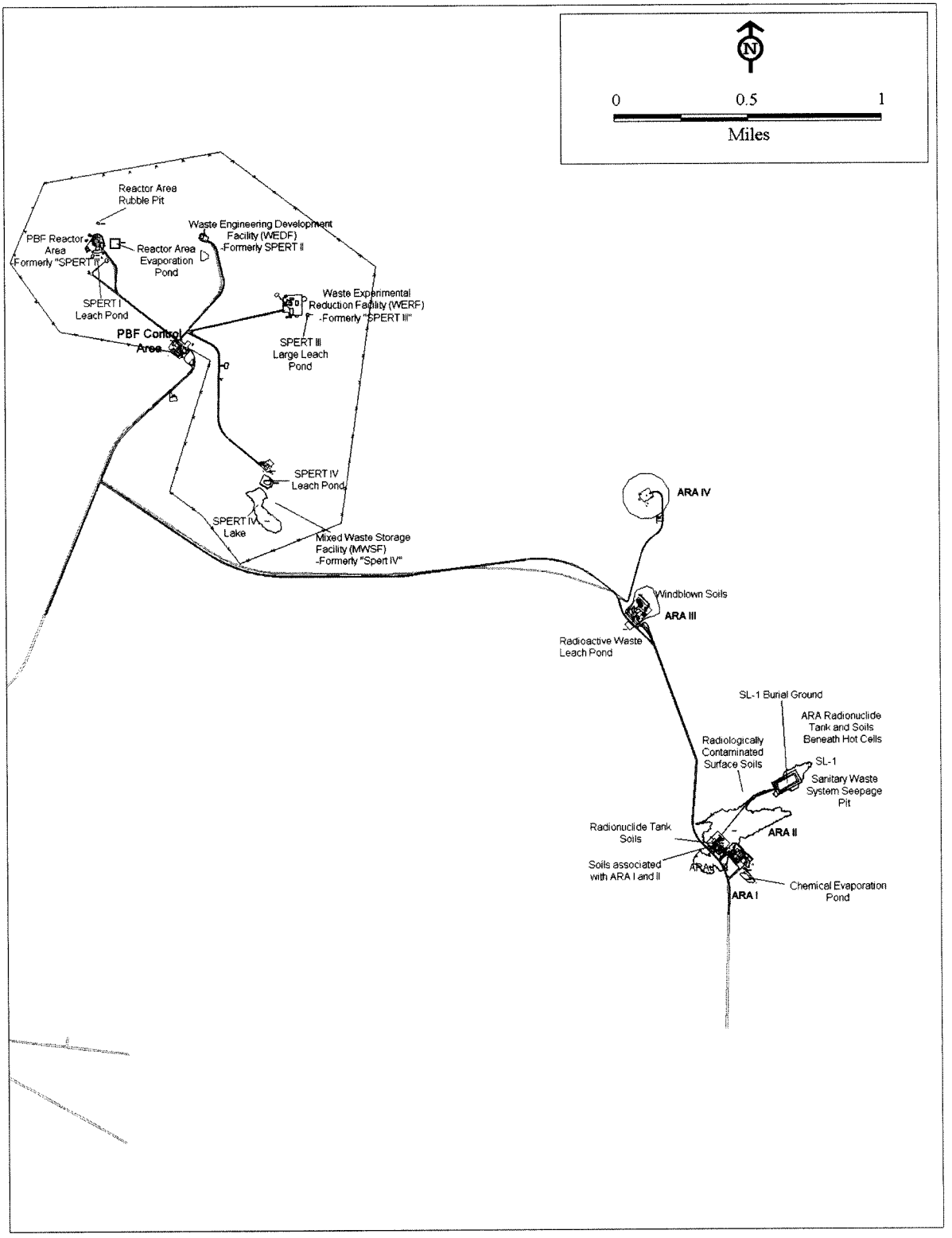
The SPERT-IV Leach Pond was a 5,010 square-meter (53,927 square-foot) unlined surface impoundment that received effluent from the SPERT-IV reactor from 1961 to 1970. Effluent to the pond consisted of radioactively contaminated wastewater, emergency shower water, and demineralizer discharges. In 1985, approximately six boxes of soil were removed and transported to the Radioactive Waste Management Complex.

The SPERT-IV Lake is a 20,150 square meter (216,893 square feet) surface impoundment that was constructed in 1960 by raising a soil and rock dike to close off an irregularly shaped natural depression. The approximate capacity of the resulting containment area is 22,700 cubic meters (29,700 cubic yards); the impoundment was called a lake, even though it was never used at capacity. Typically, only small quantities of water were observed over short durations. From 1961 to 1970, the lake received uncontaminated cooling water from the secondary loop of the SPERT-IV reactor. After 1970, and until 1985, the lake was inactive and dry except for occasional accumulations of natural precipitation. From 1985 to 1992, the only discharges to the lake were uncontaminated effluent from Three Mile Island studies and discharges generated by periodic testing of emergency eye wash and shower stations. The pipeline to the lake was removed in 1992, ending all discharges.

Soil Long-Term Stewardship Activities

Long-term stewardship activities include enforcing institutional controls, restricting access, and monitoring the selected remedy to ensure continued protection. Surveillance and maintenance requirements will include annual reviews for the first five years, followed by five-year reviews, in accordance with CERCLA.

DOE will provide institutional controls through land-use restrictions over the next 100 years, unless a five-year review concludes that unrestricted land use is allowable. After 100 years, DOE may no longer manage INEEL activities, and controls will take the form of land-use restrictions. Until that time, interim institutional controls include primarily access and activity restrictions. Long-term institutional controls include control of activities, publication of surveyed boundaries and descriptions in the *INEEL Comprehensive Facility and Land Use Plan*, property lease requirements (including control of land use consistent with the ROD), notice to affected stakeholders (e.g. Bureau of Land Management, Shoshone-Bannock Tribal Council, local county governments, IDHW, and the EPA) of any change in land-use designation, restriction, or land users, and property transfer requirements (including issuance of a finding of suitability to transfer).



Power Burst Facility Soils Portion

3.10.2 Engineered Units

The experiments conducted at the Special Power Excursion Reactor Tests area contaminated the soil. The specific areas of contamination include the Reactor Area Evaporation Pond, the SPERT-I Leach Pond, the Reactor Area Rubble Pit, and the SPERT-III Large Leach Pond. All contaminated areas have been remediated. Based on current occupational and future residential risk scenarios, further remediation will not occur; however, institutional controls are being implemented. The specific remedial strategies for each area are described in the following paragraphs.

The Reactor Area Evaporation Pond area was a hypalon-lined surface impoundment, with an approximate area of 1,820 square meters (20 square feet). Effluent routed to the pond from 1972 to 1984 included chromium-contaminated water from the Power Burst Facility Reactor secondary coolant loop and discharges containing resins, sulfuric acid, and sulfur dioxide from the demineralizer system. In 1994, an interim action was implemented to address chromium and cesium-137 concentrations in greater-than-risk-based levels. This interim action included excavation of sediments from the pond in areas with chromium concentrations greater than 800 mg/kg or cesium-137 concentrations greater than 30 pCi/g. In 1995, the pond liner was removed and disposed of in the Central Facilities Area Bulky Waste Landfill. The berm was pushed into the pond and the area was graded and seeded with native grasses. Visible asbestos was removed and the site was covered with a three-meter (10 foot) thick layer of soil and rip rap.

The SPERT-I Leach Pond was a five-by-fourteen meter (15-by-45 foot) surface impoundment used for operations associated with the SPERT-I facility. Now, the area is mounded and distinguishable from the surrounding desert only by a cement location marker, with a brass plate indicating the presence of subsurface residual radioactive contamination 2.4 meters (eight feet) below-grade. In 1984, the top one meter (three feet) of soils in the pond area was removed and backfilled with radiologically clean soil.

The Reactor Area Rubble Pit was first used to dispose of soil and basalt pieces excavated during facility construction in the late 1960s. Later, the rubble pit was used (until the mid-1970s) as a dump for a variety of construction materials. Fence posts mark the location of the dumping area, which is 23-by-14 by three meters (75 by 45 by10 feet). All visible materials containing asbestos were removed from the pit in 1993. Any small quantity that remains was covered when the pit was backfilled with one-to-four meters (three-to-twelve feet) of clean soil and basalt rubble.

The SPERT-III Large Leach Pond, 325 square meters (3,498 square feet), received waste from the sump pump in the SPERT-III Reactor Building from 1958 to1968. In 1983 the pond was backfilled and reseeded. The volume of residual contamination is 990 cubic meters (1,300 cubic yards), which includes the contaminants listed in the previous table.

Engineered Units Long-Term Stewardship Activities

Long-term stewardship activities include enforcing institutional controls, restricting access, and monitoring the selected remedy to ensure continued protection. Surveillance and maintenance requirements will include annual reviews for the first five years, followed by five-year reviews, in accordance with CERCLA.

DOE will provide institutional controls through land-use restrictions over the next 100 years, unless a five-year review concludes that unrestricted land use is allowable. After 100 years, DOE may no longer manage INEEL activities, and controls will take the form of land-use restrictions. Until that time, interim institutional controls include primarily access and activity restrictions. Long-term institutional controls include control of activities, publication of surveyed boundaries and descriptions in the *INEEL Comprehensive Facility and Land Use Plan*, property lease requirements (including control of land use consistent with the ROD), notice to affected

stakeholders (e.g. Bureau of Land Management, Shoshone-Bannock Tribal Council, local county governments, IDHW, and the EPA) of any change in land-use designation, restriction, or land users, and property transfer requirements (including issuance of a finding of suitability to transfer).

One exception is for the Reactor Area Evaporation Pond, where land use will have additional controls to prohibit potential exposure to friable asbestos. Recommendations for appropriate land use restrictions, after the institutional control period, will accompany any land transfer. The existing institutional controls in the Reactor Area Evaporation Pond will be augmented with visible access restriction/warning signs, control of activities while under DOE control, and maintenance of the existing cover. Periodic inspections will be defined in the institutional control plan.

3.11 Stationary Low-Power Reactor-I Burial Ground Portion

This portion is part of the Power Burst Facility/Auxiliary Reactor Area. However, this portion is a distinct, fenced-in burial ground for the Stationary Low-Power Reactor-I. It is located just outside of the Auxiliary Reactor Area cluster of facilities. The Stationary Low-Power Reactor-I Burial Ground is a geographically distinct area (fenced) and has unique contamination due to the nature of the contaminating event (reactor steam explosion); therefore, it is considered one portion.

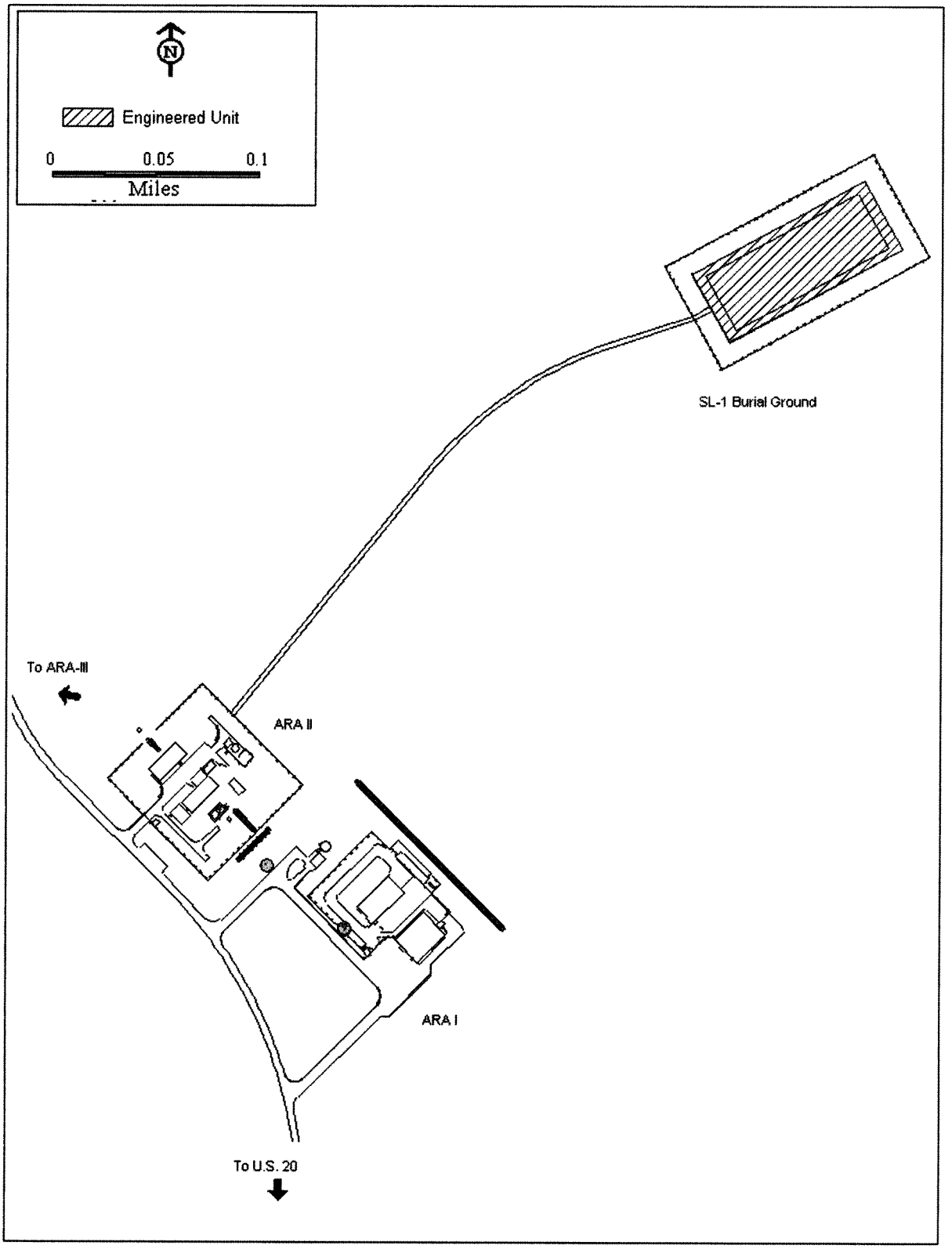
STATIONARY LOW-POWER REACTOR-I BURIAL GROUND PORTION HIGHLIGHTS

Major Long-Term Stewardship Activities - engineered unit monitoring and maintenance
Portion Size - 1.65 hectares (4.1 acres)
Estimated Volume of Residual Contaminants - engineered units 2,800 cubic meters (3,700 cubic yards)
Long-Term Stewardship Start-End Years - 1997-2396

3.11.1 Engineered Units

This portion consists of one engineered unit, an unlined trench that contains low-level waste, which occupies a 16,723 square-meter (180,000 square-foot) area. The estimated volume of buried contaminated material is 2,800 cubic meters (3,700 cubic yards). The contaminants of concern in the surface soils and subsurface soils are listed in the table below (*Surface Soils Contaminants of Concern* and *Subsurface Soils Potential Contaminants of Concern*). Subsurface contamination is restricted to the excavations that received contaminated building debris, equipment, and gravel and soil from the demolition and cleanup following the Stationary Low-Power Reactor-I reactor accident. The initial remedial response to the Stationary Low-Power Reactor-I contamination event was to dismantle and dispose of the reactor and the building. The recovered reactor fuel was taken to the Test Area North for study, then reprocessed at the Idaho Chemical Processing Plant (now the INTEC). The entire reactor building, contaminated materials from nearby buildings, and soil and gravel contaminated during the initial cleanup were disposed of in the burial ground. In1962, the Stationary Low-Power Reactor-I burial ground

Surface Soils Contaminants of Concern					
Cobalt-60	Thorium-228	Europium-154	Uranium-234	Strontium-90	Thorium-232
Cesium-137	Thorium-230				
Subsurface Soils Potential Contaminants of Concern					
Cesium-137	Europium-154/155	Zirconium-93	Uranium-236	Antimony-126	Americium-242m
Strontium-90	Plutonium-239	Niobium-93m	Tellurium-125m	Neptunium-237	Actinium-227
Krypton-85	Technetium-99	Antimony-125	Antimony-126m	Iodine-129	Americium-243
Samarium-151	Plutonium-238	Europium-152	Tin-126	Palladium-107	Protactinium-234
Promethium-147	Americium-241	Uranium-235	Cesium-134	Uranium-234/238	Curium-243
Plutonium-241	Plutonium-240	Cesium-135	Tin-121m	Protactinium-231	Francium-223



Stationary Low-Power Reactor-I Burial Ground Portion

consisted of three excavations in which this waste was deposited. In 1996, the remedial strategy for the burial ground consisted of containment and excavations. Containment was accomplished by capping the burial ground with an engineered barrier constructed primarily of native materials, with a barrier to inhibit biotic and inadvertent human intrusion. The area was contoured and graded to the surrounding terrain to direct surface water runoff away from the cap. A 7.6-meter (25-foot) buffer zone was established around the perimeter of the containment area, and a barbed wire fence was erected around the perimeter.

Within the fenced-in burial ground, there is residual contamination due to windblown radioactive particles deposited within the existing site soil. The contamination is largely contained within the upper 15 centimeters (six inches) of soil and is characterized as cesium-137. The contaminated soil area is one hectare (two acres), and the volume of residual contamination is 1,147 cubic meters (1,500 cubic yards).

Engineered Units Long-Term Stewardship Activities

Long-term stewardship consists primarily of monitoring, barrier maintenance, and access control of engineered units. Specifically, long-term stewardship activities include periodic inspection and maintenance to ensure cap integrity and surface drainage away from the barriers. Access restrictions are enforced by fences, posted signs, and permanent markers. Groundwater monitoring needs will be determined under the sitewide Remedial Investigation/Feasibility Study. In the unlikely event that the burial ground is suspected of contributing to groundwater contamination, additional site-specific monitoring wells or other means of contaminant migration detection can be installed.

The institutional controls consist of restrictions limiting land use to industrial applications for at least 100 years. The remedy will be reviewed every five years until determined by the regulatory agencies to be unnecessary. In addition, institutional controls will include written notification of the remedial action in the facility land use master plan, and a copy of the notification will be given to the Bureau of Land Management, together with a request that a similar notification be placed in the Bureau of Land Management property management records

3.12 Boiling Water Reactor Experiment Area Portion

BOILING WATER REACTOR EXPERIMENT AREA PORTION HIGHLIGHTS

Major Long-Term Stewardship Activities - engineered unit monitoring and maintenance
Portion Size - 0.8 hectares (1.9 acres)
Estimated Volume of Residual Contaminants - engineered units 179 cubic meters (234 cubic yards)
Long-Term Stewardship Start-End Years - 1997-2316

This portion is part of the Experimental Breeder Reactor-I/ Boiling Water Reactor Experiment Area (BORAX) area. The portion consists of the BORAX-I Burial Ground and the residually contaminated soils. The BORAX-I Burial Ground is a geographically distinct area (i.e., fenced) located approximately 800 meters (2,600 feet) northwest of the Experimental Breeder Reactor-I facility, with unique contamination due to the nature of the contaminating event (the reactor was intentionally destroyed at the end of its mission). There are no buildings left at the Boiling Water Reactor Experiment Area.

3.12.1 Engineered Units

This portion consists of one engineered unit, an unlined trench containing low-level waste, which occupies approximately 7,800 square meters (84,000 square feet). The trench contains buried radioactively-contaminated debris and soil from the intentional destruction of the BORAX-I Reactor.

Surface Soils Contaminants of Concern	
Contaminant Name	***Remediation Level***
Cesium-137	16.7 pCi/g
Strontium-90	10.8 pCi/g
Uranium-235	13.2 pCi/g

The burial ground is contained within the foundation of the BORAX-I facility. Additional contaminated soil from within the 7,800 square meter (84,000 square foot) area was consolidated within a 40-by 40-meter (120-by 120-foot) area directly on top of the buried reactor . The material was contained by capping with an engineered barrier constructed primarily of native materials, with a barrier to inhibit inadvertent human intrusion. The area was contoured and graded to the surrounding terrain to direct surface water runoff away from the cap.

Buried materials at the site consist of unrecovered uranium fuel residue, irradiated metal scrap, and contaminated soil and debris. The BORAX-I site includes a 60-by-130-meter (200-by- 420-foot) surface-soil contamination area surrounding the fenced burial ground. The volume of surface contamination is approximately 2,400 cubic meters (3,000 cubic yards), based on the given contaminated surface area and the assumption that surface soil contamination is restricted to the upper 0.3 meter (one foot). The contaminants of concern and the target remediation levels are listed in the previous table (*Surface Soils Contaminants of Concern*). Subsurface contamination, as listed in the table below (*Subsurface Soils Potential Contaminants of Concern*), is restricted to the contaminated soil and materials deposited in the concrete foundation of the reactor structure. The volume of contaminated material in the subsurface is estimated to be 179 cubic meters (234 cubic yards).

Subsurface Soils Potential Contaminants of Concern

Cesium-137	Uranium-235	Promethium-147	Protactinium-231	Antimony-125	Protactinium-234
Strontium-90	Krypton-85	Uranium-238	Tin-126	Radium-226	Europium-154
Uranium-234	Technetium-99	Zirconium-93	Actinium-227	Lead-210	Niobium-94
Samarium-151	Thorium-230	Niobium-93	Cesium-135	Iodine-129	

Engineered Units Long-Term Stewardship Activities

Long-term stewardship activities consist primarily of monitoring, barrier maintenance, and access control of the engineered unit. Specifically, long-term stewardship activities include periodic inspection and maintenance to ensure cap integrity and surface drainage away from the barriers. Access restrictions are enforced by fences, posted signs, and permanent markers. Groundwater monitoring needs will be determined under the sitewide Remedial Investigation/Feasibility Study. In the unlikely event that the burial ground is suspected of contributing to groundwater contamination, additional site-specific monitoring wells or other means of contaminant migration detection can be installed.

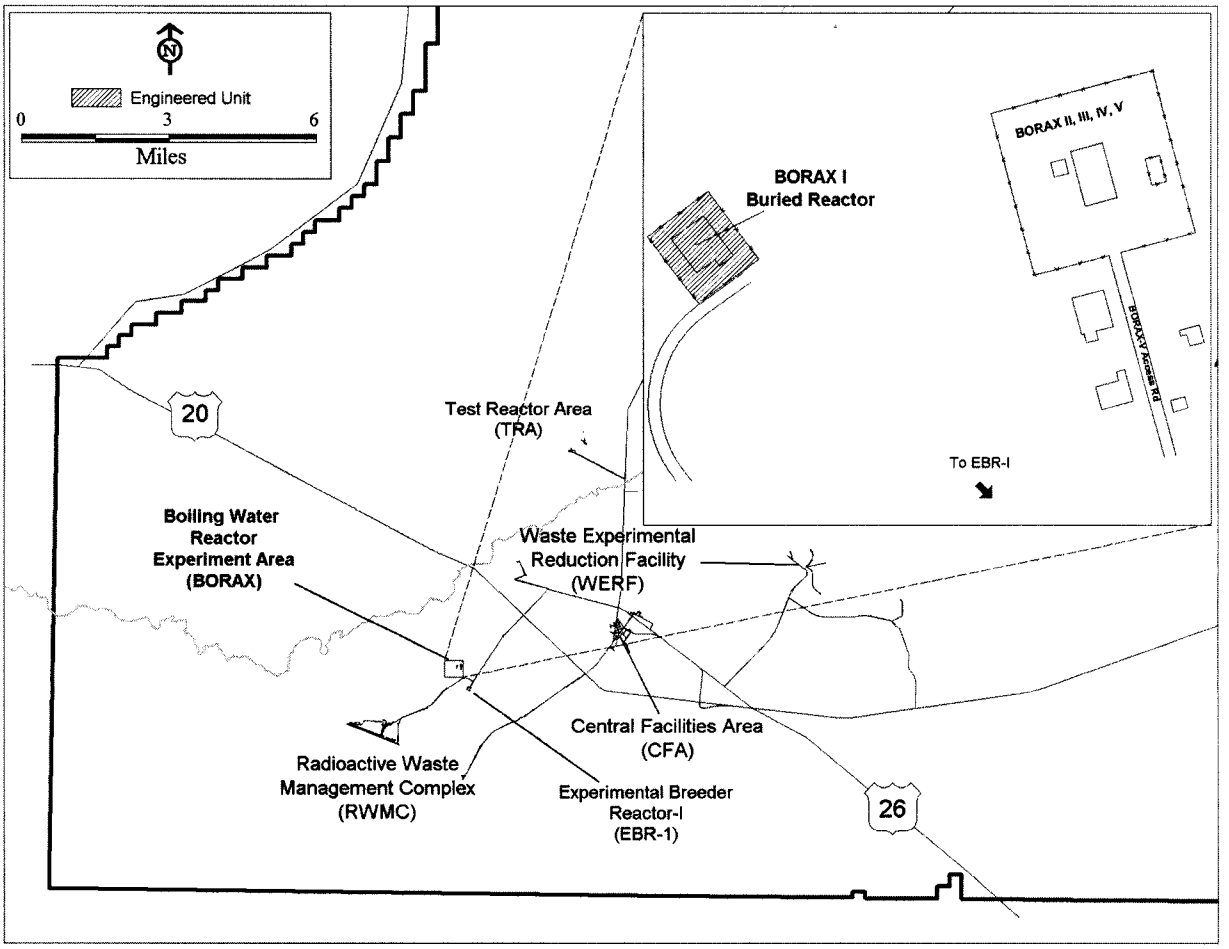
The institutional controls consist of restrictions limiting land use to industrial applications for at least 100 years. The remedy will be reviewed every five years until determined by the regulatory agencies to be unnecessary. In addition, institutional controls include written notification of the remedial action in the facility land use master plan, and a copy of the notification will be given to the Bureau of Land Management, together with a request that a similar notification be placed in the Bureau of Land Management property management records. Estimation of the length of long-term stewardship is based on the half lives of cesium-137 and uranium-235. It is anticipated that over the 320 years of institutional controls, risk will decrease to acceptable levels due to radioactive decay.

3.13 Experimental Breeder Reactor-I Portion

This portion includes the Experimental Breeder Reactor-I complex located within the Breeder Reactor area. The Experimental Breeder Reactor-I experienced a core meltdown in 1955, resulting in radiological contamination of the building. The complex consists of the Reactor Building and Annex (EBR-601 and 601A) and the Security Control House (EBR-602).

EXPERIMENTAL BREEDER REACTOR-I PORTION HIGHLIGHTS

Major Long-Term Stewardship Activities - restricting access and maintaining records
Portion Size - 2 hectares (4 acres)
Estimated Volume of Residual Contaminants - facilities unknown
Long-Term Stewardship Start-End Years - 1964-2095



Boiling Water Reactor Experiment Area Portion

Approximately 60 meters (200 feet) northeast of the buildings are two nuclear aircraft prototype engines on display in the parking lot; these are known as the Heat Transfer Reactor Experiment Test Assemblies (HTRE-2 and HTRE-3). The Experimental Breeder Reactor-I complex is considered one portion because it is a geographically distinct unit within INEEL. In addition, the complex presents unique long-term stewardship challenges because it is a National Historic Landmark, open to the public, yet still contains areas of surface and internal contamination. The area of contaminated surface soil is confined within the fenced perimeter around the buildings.

3.13.1 Facilities

The portion occupies approximately two hectares (four acres) and includes the four facilities mentioned above. The total surface area of the EBRI-601 building and annex is 2,200 square meters (23,700 square feet). The actual fenced area within which the EBR-I complex is currently located is over 15,600 square meters (168,000 square feet). The contamination, remedial strategy, and long-term stewardship activities for the facility and the two nuclear engines are described in greater detail below.

The Reactor Building (EBR-601) is a multi-level structure, 37 meters long by 23 meters wide (122 feet long by 77 feet wide). In addition to housing the reactor, its associated controls, cooling and power generation systems,

heating, utility and maintenance provisions, the building housed facilities and equipment for handling, storage, and wash-down of nuclear fuel elements. Consequently, even though all nuclear elements had been removed from this building many years ago, some areas of the building retained radioactivity. In addition, the primary coolant system, containing 17 cubic meters (22 cubic yards) of NaK (sodium potassium), had been radioactively contaminated by the core meltdown that took place in 1955. Radiological contamination primarily includes cesium-137 and cobalt, as well as contaminated solidified caustic sludge. The volume of the residual contamination was approximately 1,160 pounds of solidified contaminated caustic sludge. Decontamination and decommissioning of the Experimental Breeder Reactor-I and grounds has been accomplished to the extent that radioactivity in all areas accessible to the public is within the acceptable safe standards. Some areas where minor radioactive or other hazards exist have been placarded with caution signs and closed off to prevent unauthorized entry.

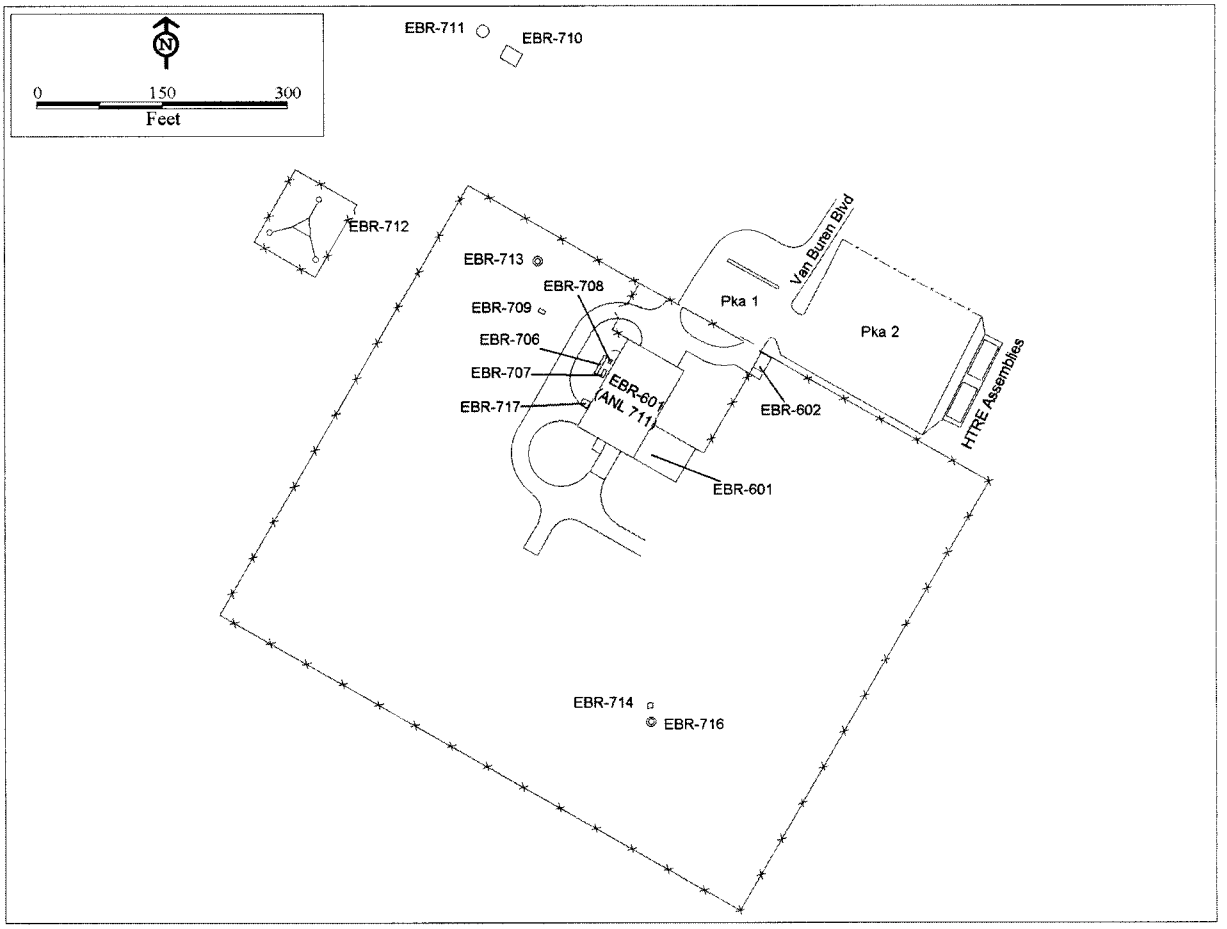
The Heat Transfer Reactor Experiment (HTRE) power plants were developed and tested from the 1950s to 1961 as part of the Aircraft Nuclear Propulsion Program. Three experiments were successfully conducted under the program: HTRE-1, HTRE-2, and HTRE-3. HTRE-1 and HTRE-2 are actually the same piece of equipment, as the HTRE-2 reactor was a modification of the HTRE-1 core that allowed removal of a center fuel assembly. Each of the HTRE assemblies is 7.6 meters (25 feet) wide, 18 meters (60 feet) long, and nine meters (30 feet) high, with an approximate weight of 100 tons (90,600 kilograms). Due to past operations, the HTRE test assemblies have trace amounts of mercury inside the assembly piping systems; potentially trace amounts of other metals associated with the nickel-chromium, uranium-oxide dispersion fuel elements. Beryllium oxide fuel elements may also have left residual contamination.

Following the termination of the Aircraft Nuclear Propulsion program, the HTRE-2 and HTRE-3 assemblies were made available for salvaging of components by other programs. The diesel engines for fan/auxiliary power were removed, the instrumentation was taken, and the HTRE-3 turbojets were removed and buried at the Radioactive Waste Management Complex. Following decontamination and decommissioning of the test assemblies, the HTRE-2 and HTRE-3 assemblies were placed in the parking lot at EBR-I. Following removal of mercury from the shield system components, mercury-absorbent material was placed in the shield tank of HTRE-3, and all openings to shield system components were permanently sealed. Walkways have been paved around and between the assemblies, and fences have been erected to prevent direct access to the assemblies. Interpretive panels telling the history and significance of the assemblies are mounted inside a gazebo next to the assemblies. The assemblies are placarded with warning signs to indicate the presence of internal contamination. Post-relocation radiological surveys of the HTRE assemblies were conducted and routine radiological surveys are also conducted.

Facilities Long-Term Stewardship Activities

Institutional controls consist primarily of record-keeping, control of worker access to residually contaminated areas, and control of public access to residually contaminated areas during tours. A project data package, describing the decontamination and decommissioning of the two HTRE assemblies, contains all relevant data to the performance of this project and will be stored along with other project data packages at INEEL indefinitely. Information on contamination locations and radiological surveys within the EBR-I facility is maintained in the official INEEL electronic Administrative Record. Public tours are conducted only within the decontaminated, accessible areas of the facility; tour guides are briefed on access restrictions and have been required to have Radiological Worker I training.

In the Experimental Breeder Reactor-1 and the Boiling Water Reactor Experiment Area, most of the buildings and equipment were completely dismantled and removed, with the exception of the EBR-I facility itself (a



Experimental Breeder Reactor-I Portion

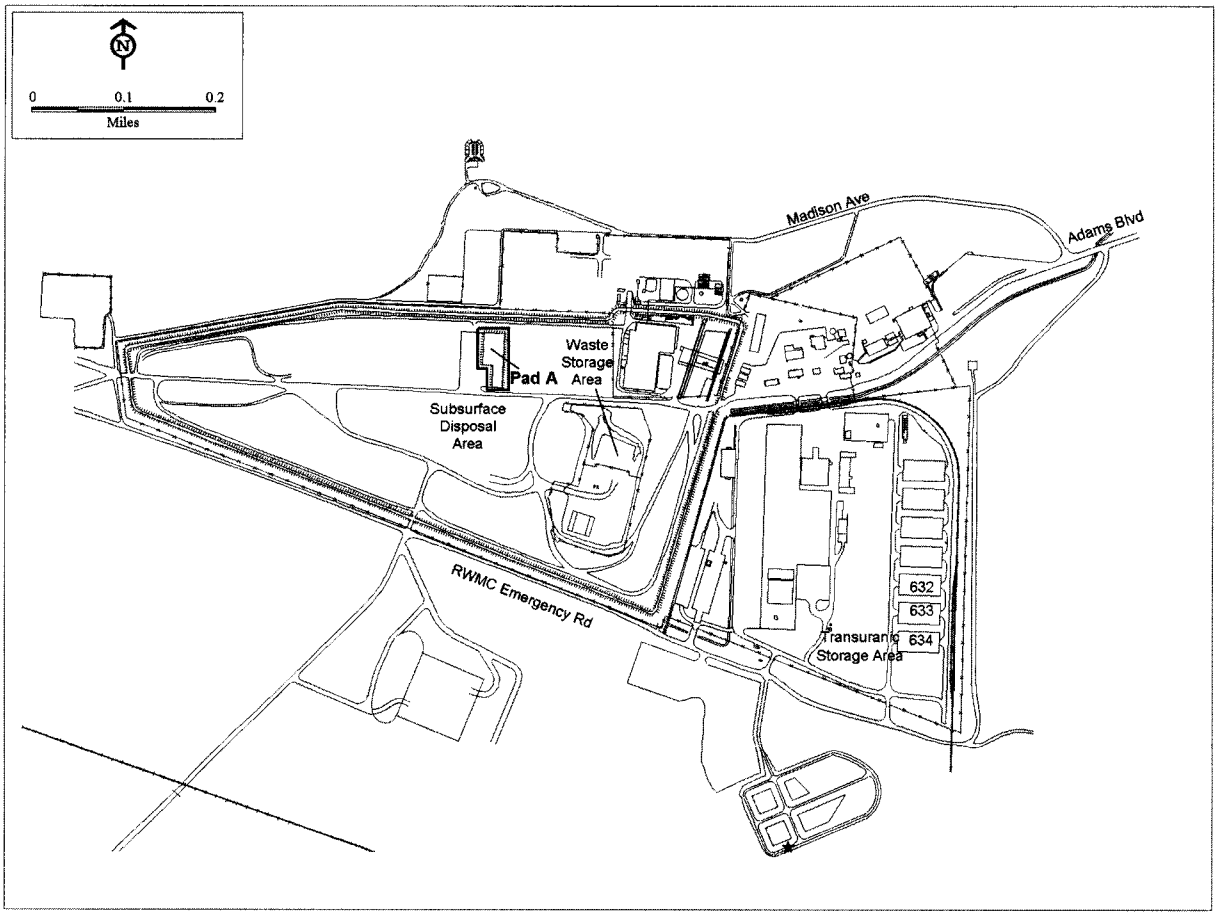
National Historic Landmark), and no operations other than monitoring are conducted. Historical process knowledge is maintained in local engineering files, in the INEEL administrative record, and in the National Archives (in documentation associated with the designation of the facility as a National Historic Landmark). Requirements to maintain the facility and HTRE assemblies in good order are well understood, and include DOE Orders and the National Historic Preservation Act. Regulatory interfaces are somewhat complex, as the HTRE-3 Assembly was RCRA clean-closed in January 2000, while the National Historic Landmark remains, along with the rest of the INEEL, on the National Priority List. Because the EBR-I facility is a National Historic Landmark, and the historic display includes the HTRE assemblies, (the facility and HTREs are designated as "museums/shrines/national landmarks/historic building"), they will be maintained as such indefinitely.

3.14 Pad A Portion

The Pad A Portion is part of the Subsurface Disposal Area within the Radioactive Waste Management Complex of INEEL. The Subsurface Disposal Area, a 39-hectare (97-acre) area located in the western section of the facility, is dedicated to permanent shallow-land

PAD A PORTION HIGHLIGHTS

Major Long-Term Stewardship Activities - containment structure monitoring
Portion Size - 0.7 hectares (1.8 acres)
Estimated Volume of Residual Contaminants - engineered units 9,560 cubic meters (12,500 cubic yards)
Long-Term Stewardship Start-End Years - 1995-2095



Pad A Portion

disposal of solid, low-level waste. The Subsurface Disposal Area is surrounded by a security fence and contains pits, trenches, and vaults for underground waste disposal. The Pad A Portion is a geographically distinct area within the Subsurface Disposal Area, covering 0.7 hectare (1.8 acres), and was used as a storage pad for containerized solid mixed wastes from September 1972 until August 1978. The portion contains a single-lined disposal cell, approximately 7,000 square meters (80,400 square feet), which contains multiple types of waste. Essentially, this engineered unit is a soil-covered mound of waste containers sitting on top of an asphalt pad. The remedial action taken for the subsurface Disposal Area will impact the final status of Pad A, as Pad A is surrounded by the Subsurface Disposal Area. Long-term management of Pad A will be folded in with the long-term stewardship strategy for the entire Radioactive Waste Management complex when that strategy is developed.

3.14.1 Engineered Units

Pad A was constructed as a five-to-eight- centimeter (two-to-three-inch) thick asphalt area, used to stack disposed solid mixed waste packages. The wastes are composed primarily of nitrate salts, depleted uranium waste, and sewer sludge. The estimated total volume of wastes is 9,560 cubic meters (12,500 cubic yards). Pad A waste was packaged in over 18,000 0.2 cubic-meter (0.3 cubic-yard) drums and over 2,000 1.2-by-1.2-by-2.1 meter (four-by-four-by-seven feet) plywood boxes. Closure of Pad A consisted of placing plywood and/or polyethylene over the exposed containers and then covering the waste pile with a soil layer between one and two meters (three

and six feet) thick. Subsequent remediation involved recontouring and correcting the slope by adding soil and rock armor on one side. The area was reseeded and transplanted with native vegetation.

Engineered Units Long-Term Stewardship Activities

Long-term stewardship of the engineered unit consists of maintaining and monitoring the integrity of the soil cover in accordance with CERCLA and the five-year review process. Ongoing environmental monitoring will be conducted to detect contaminant migration from Pad A, including the monitoring of surface water, groundwater, soil and biota. DOE will continue to enforce institutional controls, such as land use restrictions, and maintain fences and signs to control public access to the area.

The regulatory requirements for remediation and long-term stewardship have been well documented in a Record of Decision, and long-term stewardship considerations are based on conservative uncertainty assessments. The long-term stewardship end-year of 2098 is estimated based on the 100-year DOE-controlled land use assumption.

3.15 Argonne West Portion

The Argonne West Portion is part of the Argonne National Laboratory-West (ANL-W) area, which is located in the southeastern portion of the INEEL site, and contains the Experimental Breeder Reactor-II and associated facilities. The components of this portion include surface soils and sediments in six locations: the Industrial Waste Pond, Ditch A, Ditch B, the Main Cooling Tower Blowdown Ditch, the Interceptor Canal and Mound, and the Industrial Waste Lift Station Discharge Ditch. These areas comprise one portion because the components are located in relatively close geographic proximity within the Argonne National Laboratory-West area, have similar contaminant profiles (i.e., surface soils/sediments), and will require similar long-term stewardship activities once remediation is complete.

ARGONNE WEST PORTION HIGHLIGHTS

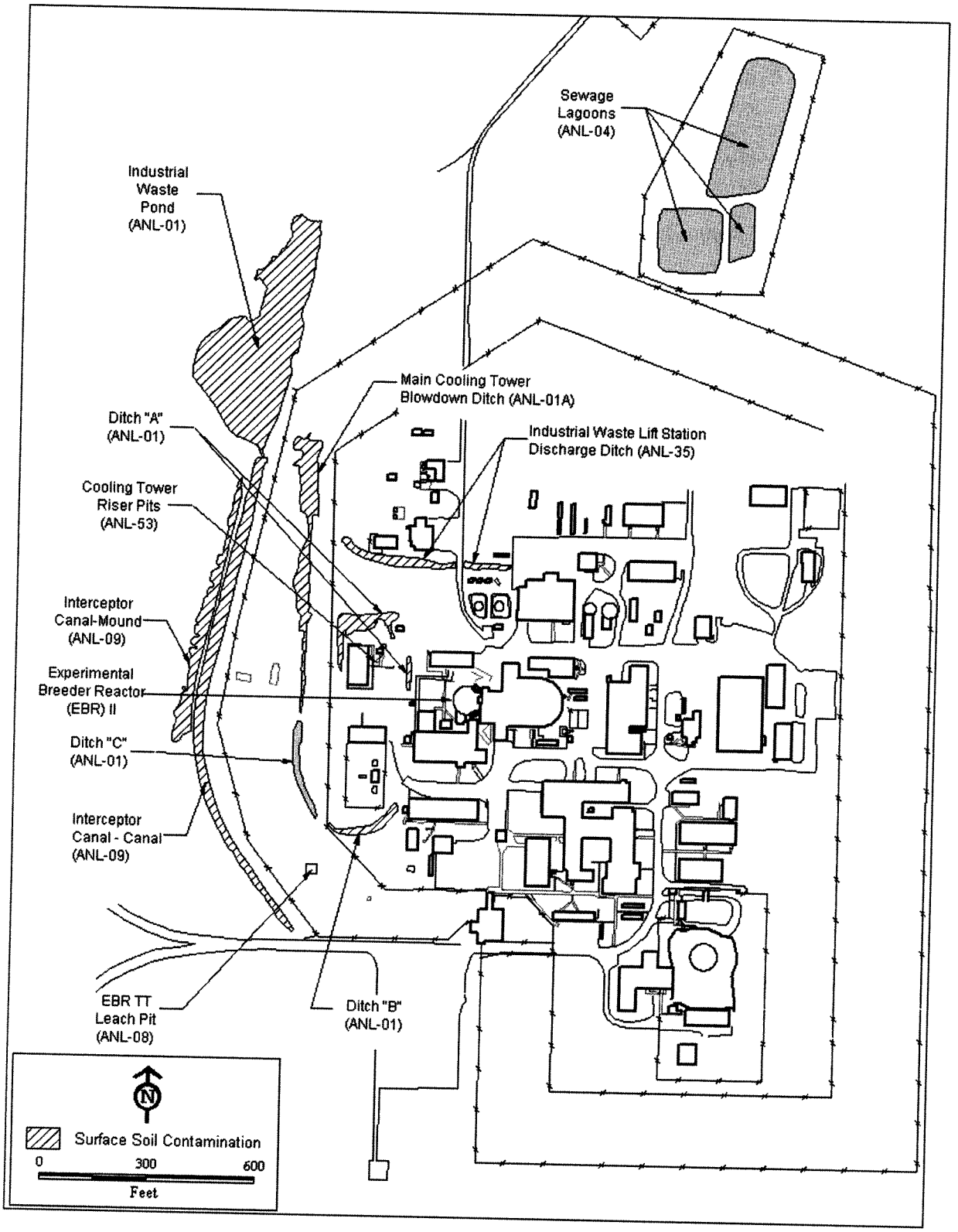
Major Long-Term Stewardship Activities - access restrictions; institutional control enforcement
Portion Size - 2.4 hectares (6 acres)
Estimated Volume of Residual Contaminants - soil 2,200 cubic meters (2,900 cubic yards)
Long-Term Stewardship Start-End Years - 2006-2098
Average Annual Long-Term Stewardship Costs FY 2000-2006 - n/a (costs begin in FY 2006)

3.15.1 Soil

The Experimental Breeder Reactor II, located in Argonne National Laboratory-West, was the leader in research on advanced reactor development. The reactor operated from 1964 to 1994, when it was shut down and defueled for eventual decommissioning. Operations at the Experimental Breeder Reactor II and associated facilities resulted in contaminated surface soils and sediments. These surface soils and sediments cover approximately two hectares (six acres), with an estimated volume of 2,000 cubic meters (2,900 cubic yards). The volume of contamination at each of the six locations in this portion is shown in the table at right (*Argonne West Estimated Volume of Contaminated Soils*), and additional details on soil and sediment contamination areas are described in the following paragraphs. Of the six areas undergoing remediation, only two sites pose risks to human health. These

Argonne West Estimated Volume of Contaminated Soils

Area Name	*Volume (in cubic meters (cubic yards))*
Industrial Waste Pond	708 (926)
Ditch A	28 (37)
Ditch B	23 (30)
Main Cooling Tower Blowdown Ditch	238 (311)
Interceptor Canal and Mound	1,132 (1,481)
Industrial Waste Life Station Discharge Ditch	57 (74)



Argonne West Portion

are the Interceptor Canal Mound and the Industrial Waste Pond sediments.

The Interceptor Canal was built in 1962 and is still being used to transport industrial waste and cooling tower effluent to the Industrial Waste Pond, as well as to divert spring runoff and other natural waters around the ANL-W facility for flood control. The contaminant of concern is cesium-137 with a concentration level of 18 pCi/g, which is found throughout the entire length of the ditch. The ditch is 9-by-434-by-1.8 meters (30-by-1,425-by-6 feet). As the 18 pCi/g concentration is less than the remediation goal of 23.3 pCi/g, the Interceptor Canal will be placed under institutional control for 100 years to allow the cesium to radioactively decay.

The potential contaminant of concern for the Interceptor Canal Mound area is cesium-137 with an estimated concentration of 30 pCi/g. The Mound was formed when 1,384 cubic meters (1,810 cubic yards) of dredged material was placed on the bank of the Interceptor Canal in 1975. This site will undergo phytoremediation (also known as phytoextraction, which consists of removing contaminants via normal plant uptake processes) to reach the remediation goal of 23.3 pCi/g. Once this goal is reached, the site will be placed under institutional controls until 2098.

The Industrial Waste Pond is an unlined, approximately one-hectare (three-acre), evaporative seepage pond fed by the Interceptor Canal and site drainage ditches. DOE anticipates that the Industrial Waste Pond will continue to be used for storm water disposal, as well as future releases of liquid cooling water discharges from the Sodium Process Facility. The residual contaminants of concern are identified in the table at right (*Industrial Waste Pond Contaminants of Concern*).

Industrial Waste Pond Contaminants of Concern

Contaminant Name	***Estimated Concentration***
Cesium-137	57.91 pCi/g
Trivalent Chromium	11,400 mg/kg
Mercury	6.8 mg/kg
Selenium	37.9 mg/kg
Zinc	5,850 mg/kg

Four soil sites pose risks to ecological (plant and animal) receptors because of contamination with nonradioactive inorganic chemicals. These five soil sites are termed Ditch A, Ditch B, the Main Cooling Tower Blowdown Ditch, and the Industrial Lift Station Discharge Ditch. Ditch A is still being used today to transport storm water runoff, as well as intermittent auxiliary cooling tower waters. The residual contamination in Ditch A consists of mercury, which is spread through the entire length of the ditch. The ditch is 1.5 meters (five feet) wide and 122 meters (400 feet) long. Ditch B was also used to transport storm water runoff, as well as industrial wastewater; however, only a small 38-meter (125-feet) portion of Ditch B is still being used today. The majority of the 389 meters (1,275 feet) of Ditch B was backfilled with clean soil during the installation of a secondary security fence. The residual contamination at Ditch B consists of two inorganics, trivalent chromium and zinc.

The Main Cooling Tower Blowdown Ditch is an unlined channel, approximately 200 meters (700 feet) in length and 0.9-to-4.5 meters (three-to-15 feet) wide. The ditch was utilized from 1962 to 1980 to convey industrial wastewater from the Cooling Tower to the Industrial Waste Pond. The Main Cooling Tower Blowdown Ditch contaminants of potential concern include two inorganics, trivalent chromium and mercury.

The Industrial Waste Life Station Discharge Ditch, also known as the North Ditch, is approximately 150 meters (500 feet) in length, with a bottom width of 0.9-to-1.2 meters (three-to-four feet). The ditch currently receives industrial waste water, primarily cooling water and non-silver bearing photo processing wastes. The potential contaminant of concern is silver, from past releases of silver-bearing photo processing wastes. The cleanup action addresses only those past releases of these processing wastes. The ongoing and future discharges of these processing waste are regulated under RCRA.

For the above areas, except the Industrial Waste Pond, the selected remedy, phytoremediation, is anticipated to

be in place by 2001. The start of phytoremediation for the Industrial Waste Pond will not be initiated until the cooling water discharges from the sodium processing facility are completed, and any standing water has evaporated, anticipated to be in 2002. The remediation goals for this portion, as identified in the table at right (*Argonne West Soil Contaminants of Concern*), are expected to be reached by 2006. If it is determined that the selected remedy does not adequately reduce the principle risks to human health and the environment after completing a two-year season, a contingent alternative of excavation and disposal will be implemented. During the implementation of the remedy, access is controlled through fences and warning signs posted along the area's perimeter.

Argonne West Soil Contaminants of Concern	
Contaminant Name	***Remediation Level***
Cesium-137	23.3 pCi/g
Trivalent Chromium	500 mg/kg
Mercury	0.74 mg/kg
Selenium	3.4 mg/kg
Zinc	2,200 mg/kg
Silver	112 mg/kg

Soil Long-Term Stewardship Activities

The required long-term stewardship activities include monitoring and maintaining the restricted areas, as well as enforcing institutional controls. Fences and warning signs will be replaced and repaired as necessary. Groundwater monitoring will continue until 2018. In accordance with CERCLA, the selected remedy will be reviewed every five years until 2098. DOE will also be responsible for enforcing institutional controls that will restrict residential land use for at least 100 years.

Due to the nature of the selected remedy, after 2006 the three cesium-137 contaminated areas (i.e., the Interceptor Canal-Mound, the Interceptor Canal itself, and the Industrial Waste Pond) will have access restrictions until 2098 to allow the remaining cesium not extracted by phytoremediation to decay away. These restrictions include signs and fencing to prevent human contact with the soils in these sites. The remediation goal is to reduce the cesium concentration to the point where natural decay will permit unrestricted use of the sites after 2098.

3.15.2 Estimated Long-Term Stewardship Costs for Argonne West

Long-term stewardship costs for the Argonne West Portion include monitoring and maintaining the restricted areas and monitoring groundwater. These long-term stewardship activities are funded by DOE's Chicago Operations Office. Cost estimates reflect the current site agreements and monitoring frequencies. Contingency costs, such as groundwater monitoring well replacement, have not been incorporated into the cost estimate.

Long-Term Stewardship Costs (Constant 2000 Dollars)							
FY 2000 - FY 2010	***FY 2011 - FY 2020***	***FY 2021 - FY 2030***	***FY 2031 - FY 2040***	***FY 2041 - FY 2050***	***FY 2051 - FY 2060***	***FY 2061 - FY 2070***	***Estimated Total***
$2,436,000	$1,434,000	$859,000	$204,000	$53,000	$52,000	$52,000	$5,090,000

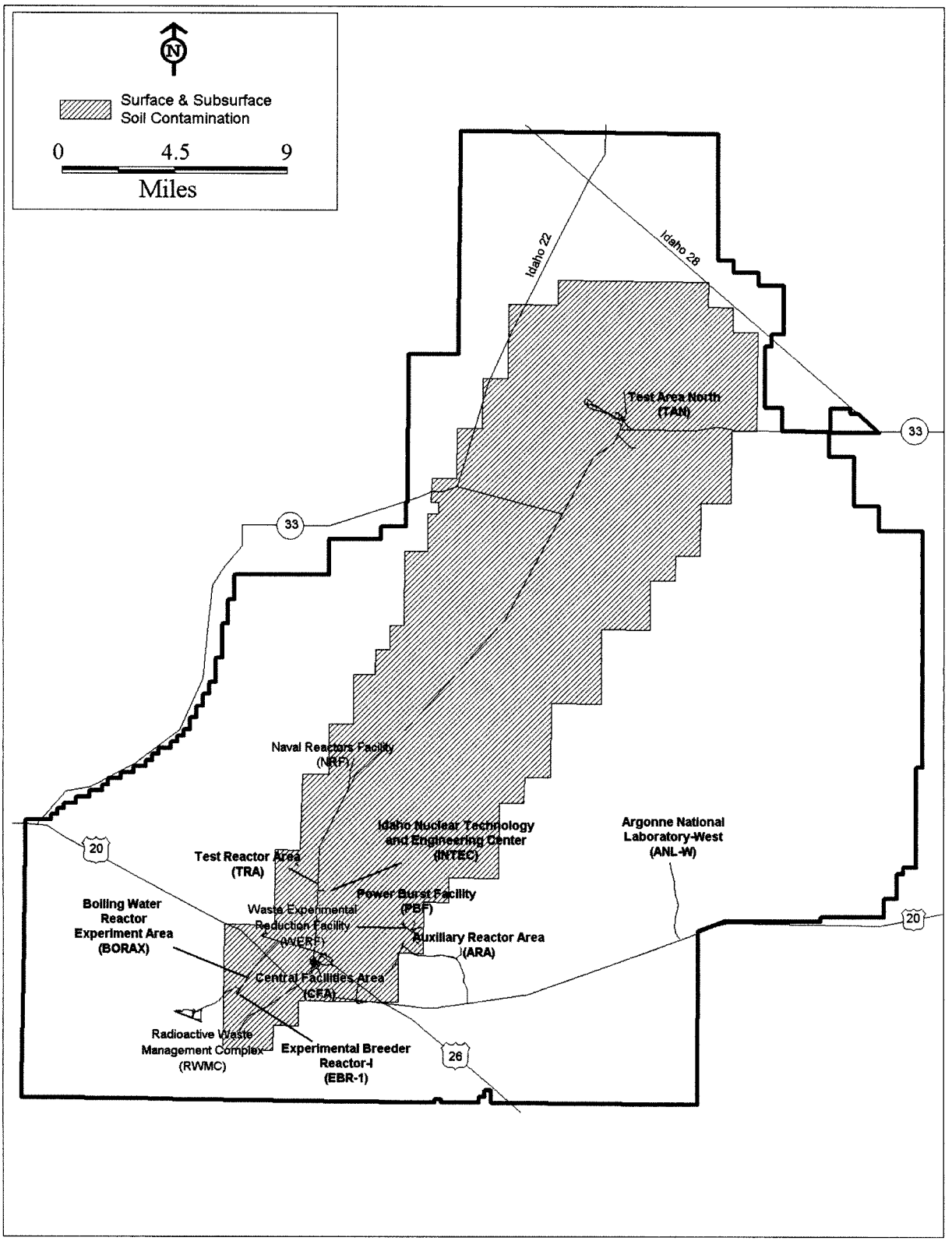
** The estimated costs above are not included in the INEEL site-wide long-term stewardship costs because Argonne National Laboratory-West is funded through DOE's Chicago Operations Office. Please refer to Section 2.4 for estimated site-wide INEEL cost information.*

3.16 Ordnance Area Portion

The Ordnance Area Portion consists of a very large surface soil area, which was used as a Naval bombing range and artillery target practice range in the 1940s. Unlike a discrete gun "range," this is a roughly "ragged cone or fan" area that spreads up through the center of

ORDNANCE AREA PORTION HIGHLIGHTS

Major Long-Term Stewardship Activities - institutional control enforcement
Portion Size - 84,816 hectares (209,586 acres)
Estimated Volume of Residual Contaminants - soil unknown
Long-Term Stewardship Start-End Years - 1993-2095



Ordnance Area

the site. This portion is unique in that it consists of both defined release areas and as-yet-undefined release areas in the approximate center of the INEEL complex. The contaminant is actually unexploded projectiles and high explosives, and the occurrence of the contaminant is related to geologic cycles of freeze and thaw. For instance, frost and erosive processes tend to expose previously undetected ordnance. The medium of concern in this portion is soil.

3.16.1 Soil

This medium consists of multiple soil areas throughout INEEL, excluding the soil areas addressed in other portions that have undergone remedial activity to remove unexploded ordnance and contaminated soils, as well as yet-to-be-determined areas within INEEL. The ordnance area is estimated to be 84,816 hectares (209,586 acres); however, this only includes the known areas of unexploded ordnance that have been cleared to date. These areas are non-contiguous. The overall volume of the residual contamination is undetermined.

All remediation activities in this portion are conducted in accordance with CERCLA. From 1993 to 1997, clearance of unexploded ordnance has occurred each field season. Funding constraints limited further remediation activities in 1998 and 1999. Clearance of each site included systematic visual and geophysical searches of the removal areas to locate surface and near-surface (0.6 meter (two feet)) ordnance. Ordnance discovered in the search was marked, identified, and investigated to determine if the item was unexploded (contains explosives) or inert (practice rounds containing no explosives). Pieces of explosives were collected, transported to the Mass Detonation Area and destroyed by detonation.

Although 19 of the 29 original ordnance sites identified have been cleared and recommended for no further remedial action, a high degree of risk remains that multiple items of unexploded ordnance may exist at or close to the surface. The nature of residual contamination consists of trinitrotoluene (TNT), cyclotrimethylene trinitroamine (also known as Research Development Explosive (RDX)), and dinitrotoluene (DNT). The remediation goals include TNT at 47 mg/kg, RDX at 180 mg/kg, and DNT at 35 mg/kg. Ordnance identification and clearance still occurs and is anticipated to occur into the future.

Soil Long-Term Stewardship Activities

Long-term stewardship activities include enforcing institutional controls in the ordnance area. Existing institutional controls consist of restricting public access, publicizing ordnance area maps in such INEEL planning documents as the *INEEL Comprehensive Facilities and Land Use Plan*, and training personnel to recognize and report discoveries to ordnance disposal personnel.

A study was conducted in 1999 to examine the potential of an RDX/TNT-contaminated soil remediation technique. The results were favorable and indicated that this technique may be appropriate to evaluate as an alternative for remediating explosives-contaminated soil, thus potentially reducing the scope and cost of long-term stewardship responsibilities for this portion of INEEL. Currently, however, the risk remains for a potential unexploded ordnance to remain onsite, yet it is cost-prohibitive to conduct further removal actions to remove this threat. Alternative measures, such as deed restrictions, may be recommended for consideration and will be evaluated in future studies. The final determination for these sites will be made by the U.S. EPA, State of Idaho, and DOE and will be documented in the Record of Decision in April 2002.

4.0 FUTURE USES

Based on an analysis of the INEEL site land use for the next 100 years, the anticipated future land uses include grazing (open space) and re-use of industrial sites. In addition, special use areas, including a significant locality near the Middle and East buttes, have been made accessible to Shoshone-Bannock Tribal members. The INEEL

site will also contain an onsite disposal cell, known as the INEEL Consolidated Disposal Facility, south of the INTEC facility area for contact-handled low-level waste. Also, the site is currently planning to store spent nuclear fuel until fiscal year 2035, as well as treat and store high-level waste. High-level waste will be ready for shipment to an approved offsite facility in fiscal year 2035.

In addition, INEEL has implemented a long-range plan (i.e., *INEEL Comprehensive Facility and Land Use Plan*, December 1997) to transition the site into a national multi-program engineering and environmental laboratory. In order to support this ongoing mission, it is likely that Test Area North, Test Reactor Area, and Central Facilities Area will be in continuous use. Buildings within the Power Burst Facility/Auxiliary Reactor Area are currently in use as operating storage, treatment, or disposal facilities. The Experimental Breeder Reactor-I will remain as a National Historic Landmark because it was the first nuclear reactor in the world to generate usable amounts of electricity. There is a remote possibility that the ownership and/or management of the Experimental Breeder Reactor-I may be turned back over to the U.S. Department of the Interior at some point in the future, to continue to be managed as a national landmark.

For additional information about the Idaho National Engineering and Environmental Laboratory, please contact:

Alan Jines, Congressional Liaison
U.S. Department of Energy, Idaho Operations Office
850 Energy Drive
Mail Stop 1214
Idaho Falls, ID 83401
Phone: 208-526-7524
or visit the Internet website at http://www.ineel.gov

LOWMAN SITE

1.0 SITE SUMMARY

1.1 Site Description and Mission

The Lowman Site is the location of a former mechanical concentrator for sands containing rare-earth elements that operated from 1955 to 1960. The site now contains a disposal cell for contaminated soil, sand, and debris resulting from processing operations. The site is located on a 7.3-hectare (18-acre) tract of land in Boise County, Idaho, approximately 117 kilometers (73 miles) northeast of Boise and 0.8 kilometers (0.5 miles) northeast of the town of Lowman.

LONG-TERM STEWARDSHIP HIGHLIGHTS

Major Long-Term Stewardship Activities - disposal cell monitoring; institutional control enforcement; access restrictions
Total Site Area - 7.3 hectares (18 acres)
Volume of Residual Contaminants - engineered units 99,000 cubic meters (129,400 cubic yards)
Long-Term Stewardship Start-End Years - 1994-in perpetuity
Average Annual Long-Term Stewardship Cost FY 2000-2006 - $71,000
Landlord - U.S. Department of Energy, Grand Junction Office

As a result of past processing operations, contamination at the site consisted of approximately 99,000 cubic meters (129,400 cubic yards) of uranium, radium, and thorium in residual sand, soil, and construction debris. Initially, radioactive sands with low-leachability characteristics, some enriched in uranium, remained in piles at the site in 10 separate locations and occupied approximately two hectares (5 acres). The U.S. Department of Energy (DOE) completed surface remediation activities at the site in 1992. Currently, the site contains a 33,259-square meter (358,000-square foot) engineered disposal cell with a radon barrier, a thick soil layer, and a layer of rock on top for erosion control.

DOE's current mission at the Lowman Site is performing long-term stewardship activities, including monitoring and maintaining the disposal cell. The former mill site is subject to Title I of the *Uranium Mill Tailings Radiation Control Act of 1978* (UMTRCA). As such, DOE is responsible for remediation and long-term stewardship activities at the site. The land was acquired by the State of Idaho for remedial action and was transferred to DOE for long-term care.

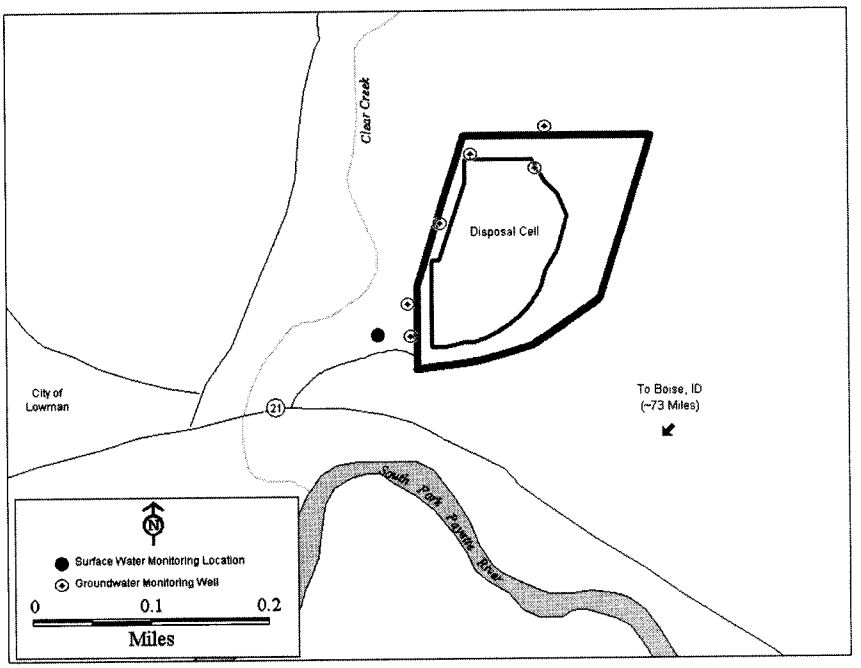
The historic mission of the Lowman Site was to provide rare-earth elements to Mallinckrodt Chemical Works. From 1955 to 1960, Porter Brothers Corporation operated the Lowman mechanical concentrator, where columbite/euxenite and monazite concentrates were physically separated from placer ore dredged from Bear Creek. During these operations, approximately 200,000 tons (180,000 tonnes) of dredge concentrates were processed. Final concentrates were sent to Mallinckrodt Chemical Works at Hemstite, Missouri.

1.2 Site Cleanup and Accomplishments

Due to past processing operations, the site contained residual uranium, radium, and thorium in sand. These materials, along with demolished processing structures, settling pond residues, and vicinity properties, were stabilized in the disposal cell at the Lowman Site. The 33,259-square meter (358,000-square foot) disposal cell contains approximately 99,000 cubic meters (129,400 cubic yards) of contaminated material, with a total radioactivity of 12 curies of radium-226. The 358,000-square foot disposal cell was covered with a radon barrier and a rock erosion protection layer to meet U.S. Environmental Protection Agency (EPA) standards for longevity, radon control, and groundwater protection. In accordance with EPA standards, the cover is designed to remain effective for 200 to 1,000 years. After completing surface remediation actions at the site, DOE received concurrence in October 1994 from the U.S. Nuclear Regulatory Commission (NRC) that the site conformed to cleanup standards (Title 40 of the *Code of Federal Regulations,* Part 192). DOE also completed an erosion-

control project to reclaim land north of the disposal cell in 1998.

Groundwater at the site was not contaminated and has been found to comply with applicable water quality standards. Therefore, no groundwater remediation is expected.



Lowman Site

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

DOE's Grand Junction Office is responsible for long-term stewardship activities. Under the provisions of the site-specific long-term surveillance plan, the DOE conducts annual inspections of the site to evaluate the condition of surface features; performs site maintenance, as necessary; maintains institutional controls; and monitors the disposal cell. Annual inspections of the Lowman Site are conducted to detect progressive change caused by slow-acting natural processes and to identify potential problems before extensive maintenance, repairs, or corrective actions are needed. DOE does not plan to conduct significant maintenance at the Lowman Site. However, DOE will perform minor maintenance (e.g., replace signs, fix fences) or repairs, as needed or determined from site inspections.

The permanent surveillance features at the Lowman Site include survey and boundary monuments, site markers, an entrance sign, and perimeter signs. The Lowman Site boundary is not fenced; however, vehicle access is restricted by a locked gate across the entrance road. Warning signs are posted every 150 meters (500 feet) along the site boundary. In addition, DOE staffs a 24-hour phone line for reporting any site concerns. Human intrusion, vandalism, and livestock grazing are not expected to be problems given the site's remote location. If any of these issues become a problem, site security will be re-evaluated. No drilling or other intrusive activities are allowed within the property unless authorized by DOE.

DOE maintains and updates the specific records and reports required to document long-term stewardship activities at the Lowman Site. As required by NRC regulations in Title 10 of the *Code of Federal Regulations*, Part 27, Appendix A, Criterion 12, DOE submits an annual report to the NRC that documents the results of the annual inspection. Site records are kept in permanent storage at the DOE Grand Junction Office in Colorado, and real property records are retained at the DOE Albuquerque Office in New Mexico. Types of records maintained include site characterization data, remedial action design information, the site completion report, long-term monitoring plans, annual inspection reports, and current and historic monitoring data.

STAKEHOLDER INVOLVEMENT

Community interaction has been minimal since the remedial action was completed. Copies of the annual inspection report for the Lowman Site and other sites are distributed to the local library and to any stakeholders that request them. The annual inspection report is also published on the DOE Grand Junction Office website at www.doegjpo.com.

2.2 Specific Long-Term Stewardship Activities

Engineered Units

The site has one disposal cell which contains residual materials from the mechanical upgrading of radioactive ore. The disposal cell requires long-term surveillance and maintenance to ensure continued protection of human health and the environment. Long-term stewardship activities for the disposal cell include annual inspections, sign replacements, and minor maintenance, as necessary.

Groundwater

To demonstrate the integrity of the disposal cell, groundwater monitoring has been conducted annually since the disposal cell's completion. In 2000, the DOE will re-evaluate the need for continued groundwater monitoring.

2.3 Regulatory Regime

In October 1994, NRC issued a general license to the Lowman Site for custody and long-term care of residual radioactive disposal sites (contained at Title 10 of the *Code of Federal Regulations,* Section 40.27). The purpose of the general license is to ensure that such sites will be cared for in a manner that protects human health and safety and the environment. The general license went into effect when NRC concurred that the site conformed to cleanup standards and formally accepted the site-specific long-term surveillance plan.

Several other regulators govern the long-term stewardship of the Lowman Site, including the *Uranium Mill Tailings Radiation Control Act of 1978*; the *Atomic Energy Act of 1954,* as amended; EPA Groundwater Protection Standards, including Subparts A, B, and C of Title 40 of the *Code of Federal Regulations,* Part 192 - *Standards for Cleanup of Land and Buildings Contaminated with Residual Radioactive Materials from Inactive Uranium Processing Sites*; a cooperative agreement between DOE and th State of Idaho; and the *National Environmental Policy Act of 1969,* as amended.

2.4 Assumptions and Uncertainties

Because the site has been monitored since 1994, the long-term stewardship activities at the site are well known and are not expected to change dramatically. Groundwater monitoring will continue indefinitely or until cleanup levels are achieved and the disposal cell demonstrates infiltration control. The disposal cell cover is not expected to need replacement for a minimum of 200 years.

3.0 ESTIMATED LONG-TERM STEWARDSHIP COSTS

Estimated long-term stewardship costs for the Lowman Site are identified in the table below. Cost estimates are based on historic costs incurred while conducting actual surveillance and maintenance activities. Cost estimates reflect the current site agreements and monitoring frequencies. Contingency costs, such as cap replacement, have not been incorporated into the cost estimates. Costs from fiscal years (FY) 2001 through 2006 include prorated costs associated with decommissioning unnecessary monitoring wells at similar sites. Long-term stewardship costs could decrease if NRC approves the revised site-specific long-term stewardship plan that allows DOE to discontinue groundwater monitoring. For purposes of this report, long-term stewardship costs are shown until FY 2070; however, it is anticipated that long-term stewardship will be required in perpetuity.

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	*Amount*	*Year(s)*	*Amount*	*Year(s)*	*Amount*
FY 2000	$39,700	**FY 2008**	$22,900	**FY 2036-2040**	$120,000
FY 2001	$83,100	**FY 2009**	$22,900	**FY 2041-2045**	$120,000
FY 2002	$88,000	**FY 2010**	$22,900	**FY 2046-2050**	$120,100
FY 2003	$78,500	**FY 2011-2015**	$109,500	**FY 2051-2055**	$120,000
FY 2004	$88,500	**FY 2016-2020**	$109,400	**FY 2056-2060**	$120,000
FY 2005	$58,300	**FY 2021-2025**	$112,300	**FY 2061-2065**	$120,000
FY 2006	$59,300	**FY 2026-2030**	$118,800	**FY 2066-2070**	$120,100
FY 2007	$23,000	**FY 2031-2035**	$120,000		

4.0 FUTURE USES

Future use of the site will be limited to monitoring and maintaining the disposal cell in perpetuity. Public access to the disposal site will be restricted indefinitely. Land surrounding the site is currently used for logging, grazing, and recreational uses. These uses are expected to continue in the future.

For more information about the Lowman Site, please contact:

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Illinois

Long-Term Stewardship Site Highlights

Argonne National Laboratory - East (page 3)
Major Activities - surveillance and monitoring of engineered units; groundwater monitoring
Site Size - 607 hectares (1,500 acres)
Estimated Average Annual Cost FY 2000-2006
$216,500

Fermi National Accelerator Laboratory (page 21)
Major Activities - routine surveillance and monitoring
Site Size - 2,720 hectares (6,720 acres)
Start/End Years - engineered unit - 1999/in perpetuity; groundwater - 2000/2013
Estimated Average Annual Cost FY 2000-2006-
$150,000

Madison Site (page 27)
unknown

Palos Forest (Site A/Plot M) Preserve (page 29)
Major Activities - disposal cell monitoring; groundwater monitoring
Site Size - 16 hectares (40 acres)
Start/End Years - 1997/in perpetuity
Estimated Average Annual Cost FY 2000-2006
$170,000

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ARGONNE NATIONAL LABORATORY - EAST

1.0 SITE SUMMARY

1.1 Site Description and Mission

Argonne National Laboratory-East (ANL-E) is a multi-disciplinary research and development laboratory. The Laboratory site occupies a 607-hectare (1,500-acre) tract in DuPage County, approximately 24 kilometers (15 miles) southwest of metropolitan Chicago, Illinois. Approximately 80 hectares (200 acres) of the site are developed, while the remaining 525 hectares (1,300 acres) are open space. Sawmill Creek runs south through the site and enters the Des Plaines River 2.1 kilometers (1.3 miles) south of the site. The Waterfall Glen Forest Preserve that surrounds the ANL-E site is on property that was formerly owned by the U.S. Department of Energy's (DOE) predecessor agencies, but was deeded to DuPage County in 1973 for the establishment of the Forest Preserve. The Des Plaines River flows along the southern boundary of the Forest Preserve. More than eight million people live within an 80-kilometer (50-mile) radius of the ANL-E site.

LONG-TERM STEWARDSHIP HIGHLIGHTS

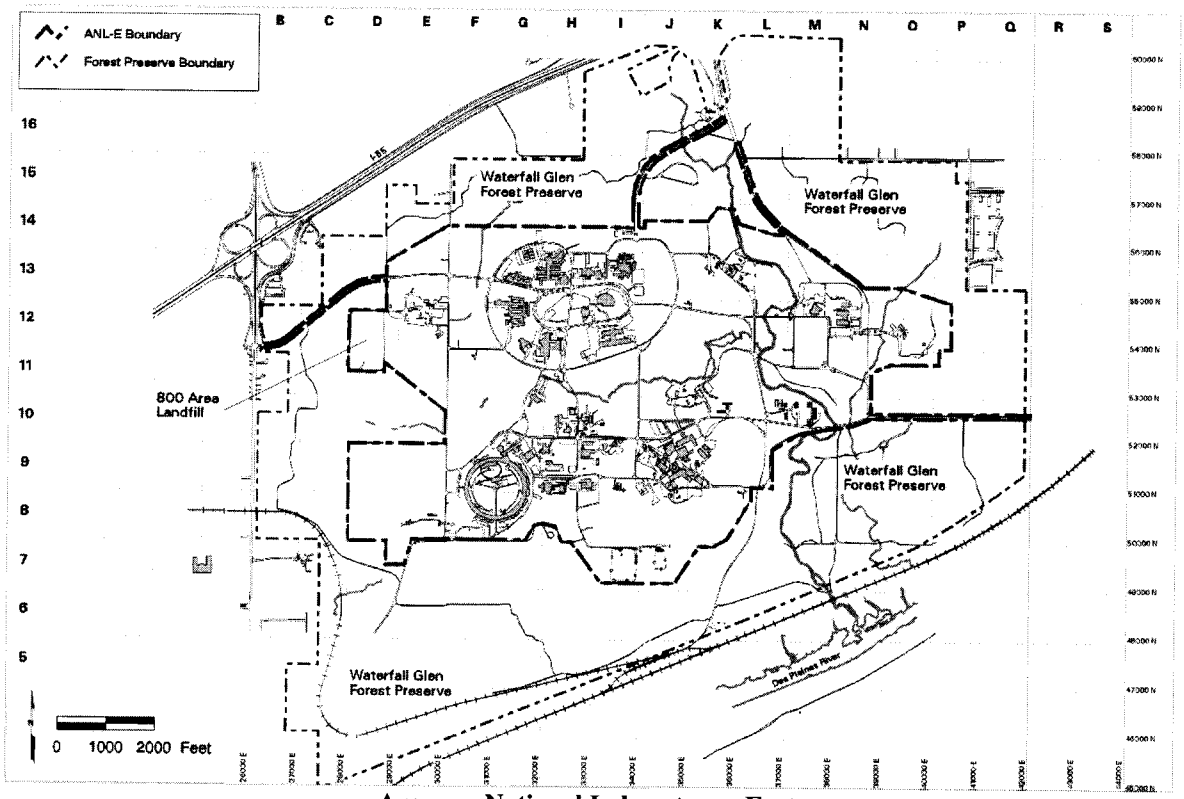
Major Long-Term Stewardship Activities - surveillance and monitoring of engineered units; groundwater monitoring
Total Site Area - 607 hectares (1,500 acres)
**Estimated Volume of Residual Contaminants* - soil 1.5 million cubic meters (1.9 million cubic yards); groundwater 77,215 cubic meters (101,000 cubic yards); engineered units 802,755 cubic meters (1.05 million cubic yards); facilities 2,900 cubic meters (3,793 cubic yards); surface water 8 cubic meters (10 cubic yards)
Portions Requiring Long-Term Stewardship as of 2006 - 4
Average Annual Long-Term Stewardship Cost FY 2000-2006 - $216,500
Landlord - U.S. Department of Energy, Office of Science
*The estimated volume indicates only the known amounts of residual contaminants. For certain portions discussed for this site, exact volume is not known at this point. For specific discussions, please see Section 3.0.

ANL-E moved to its present site in 1949 and has been involved in research and development activities in support of DOE missions and those of its predecessor agencies. Argonne National Laboratory-East's current mission is to serve as a multi-disciplinary research and development laboratory that conducts basic and applied research to support the development of energy-related technologies. Major research facilities at ANL-E include: the Advanced Photon Source; the Intense Pulsed Neutron Source; the Argonne Tandem-Linac Accelerator System; and the High Voltage Electron Microscope-Tandem Accelerator Facility. The Alpha-Gamma Hot Cell Facility supports examinations of materials for major laboratory programs. Argonne-East also houses administrative and technical support organizations, as well as DOE's Chicago Operations Office and New Brunswick Laboratory, both of which use facilities operated and maintained by the laboratory. The DOE Office of Science is the site landlord. The University of Chicago manages and operates the laboratory under a contract to DOE.

The principal environmental media of concern at ANL-E are groundwater, soils, and facilities. Contamination has occurred as a result of spills, past materials-management practices, and former waste disposal practices. Contaminants of concern include volatile organic compounds, semi-volatile organic compounds, petroleum hydrocarbons, metals, polychlorinated biphenyl compounds, and a variety of radioisotopes.

Historic operations at ANL-E focused on reactor research, which led to the construction of several of the site's reactors:

- The CP-5 Reactor, which operated from 1954 to 1979, and was used to produce neutrons for scientific research. The CP-5 Reactor was a heavy-water-cooled and moderated reactor and was fueled by enriched uranium for 19 years of its 25-year history.



Argonne National Laboratory - East

- The JANUS Reactor, which operated from 1963 to 1992, conducted animal neutron exposure research.
- The Juggernaut Reactor, which operated from 1962 to 1970, was used for basic research. It was a light-water moderated and cooled, graphite-reflected research reactor.
- The ZPR/ATSR Reactors, which operated from the 1950s to late 1980s, were used for reactor physics research and instrumentation studies.

1.2 Site Cleanup and Accomplishments

DOE will complete all site remediation and decontamination and decommissioning activities by 2003. However, residual contamination will remain at several areas, or portions of the ANL-E site, which will require long-term stewardship.

DOE has completed decontamination and decommissioning of the Experimental Boiling Water Reactor, the Building 212 glove boxes, the JANUS Reactor, and portions of the CP-5 Reactor. A total of nine facilities have undergone decontamination and decommissioning and are being remediated to below-free-release levels. Two of the buildings that will undergo decontamination and decommissioning, Buildings 301 and 330 (the CP-5 Reactor Building), have no future programmatic use. Deactivation, decontamination, and decommissioning of nuclear facilities that are no longer in service at ANL-E is being conducted in accordance with the provisions of the *Atomic Energy Act of 1954*, DOE Orders, environmental laws and regulations, and other applicable Federal, State, and local requirements.

The Illinois Environmental Protection Agency issued a Hazardous Waste Management *Resource Conservation and Recovery Act* (RCRA) Part B Permit to DOE (owner and co-operator) and ANL-E (co-operator) on September 30, 1997. The permit, which became effective on November 4, 1997, allows DOE and ANL-E to manage hazardous waste according to the operating conditions in the permit. There are 17 hazardous waste storage units and seven hazardous treatment units at the site.

The permit also requires DOE and ANL-E to develop a Corrective Action Program to investigate any environmental problems resulting from past waste management practices, including accidental releases, and, where necessary, perform remedial work. The Part B permit identifies five Areas of Concern and 49 Solid Waste Management Units at ANL-E and contains corrective action requirements for each unit. There are three additional release sites not under RCRA to be cleaned up.

DOE is remediating the Solid Waste Management Units in accordance with the RCRA Part B Permit for the site and the RCRA Corrective Action program under jurisdiction of the Illinois Environmental Protection Agency. Many of or most of these units will be remediated to free release levels. Remediation of the remaining Solid Waste Management Units, those that will not be remediated to unrestricted use levels, will require containment of residual contamination.

SITE ACCOMPLISHMENTS

- Decontaminated and decommissioned the Experimental Boiling Water Reactor (1996), Fast Neutron Generator (1996), the Building 212 glove boxes (1996), the Argonne Thermal Source Reactor (1998), the JANUS reactor and the CP-5 Reactor (May 2000)
- Installed leachate collection system and groundwater extraction system at 319 area landfill
- Completed 317 Area soil mixing treatment project
- Demolished southeast, southmiddle, and southwest vaults

ANTICIPATED ARGONNE-EAST ACCOMPLISHMENTS AS OF FY 2006

- Decontaminate, decommission, and remediate to below "unrestricted use" levels the Juggernaut reactor and Cyclotron facilities, Building 310, and inactive portions of zero Power Reactor 6 & 9 Complex
- Remediate to below "unrestricted use" levels 46 Solid Waste Management Units and Areas of Concern

As part of a CERCLA submission in 1988, ANL-E identified 12 onsite, inactive landfills, drains, decontaminated and decommissioned reactors, wastewater treatment units, and mixed waste storage units, and one inactive reactive waste disposal unit located offsite in the Forest Preserve. Most of these sites are included as Solid Waste Management Units in the RCRA Part B permit. However, several of the Solid Waste Management Units also contain radiological contamination that is not regulated pursuant to RCRA. These are being remediated pursuant to provisions of the *Atomic Energy Act of 1954* and DOE Orders.

A "Solid Waste Management Unit" is defined as "any discernible unit at which solid wastes have been placed at any time and from which hazardous constituents could migrate irrespective of whether the unit was intended for the management of solid or hazardous waste. Such units include any area at a facility at which solid wastes have been routinely and systematically released." An "Area of Concern" is a location where there has been a release or threat of release into the environment, but it is not a discernible unit — meaning that the source and boundaries of the contamination may not be defined.

ANL-E is conducting groundwater monitoring; soil excavation and treatment and in situ soil treatment (phytoremediation); and deactivation, decontamination and decommissioning of waste treatment and storage units and nuclear facilities that are no longer in service. Formerly used reactors and other ANL-E nuclear facilities are being decommissioned and decontaminated to allow for alternate uses of the facilities or to prepare them for demolition. The broad goals of the ANL-E site environmental restoration program are to remediate most Solid

Waste Management Units and Areas of Concern at the site to free release standards consistent with the site's ongoing mission as a research laboratory containment of residual contamination of the remaining solid waste management units and areas of concern, and decontaminate and decommission radiologically-contaminated facilities that are no longer in service by the end of 2003.

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

DOE has an ongoing research mission at this site and will, thus, be responsible for all long-term stewardship activities, funding, and future land use at ANL-E and will retain institutional control of the site. The sampling and monitoring of areas where contaminants remain in place and the maintenance of pumps, caps, fences, and other equipment are anticipated to be required through 2033. The basis for the selection of the 2033 date for completion of long-term stewardship activities is based on guidance provided by the Illinois Environmental Protection Agency related to closure of the Solid Waste Management Units identified in the RCRA Part B permit. The site will conduct sampling and monitoring where contaminants remain in place to ensure that they are not moving. DOE anticipates that the site's future land use will remain "industrial with restricted access" in accordance with DOE's ongoing research mission at the site.

> ***SITE LONG-TERM STEWARDSHIP GOALS***
>
> After the end state of each area has been reached, long-term stewardship responsibilities of Argonne National Laboratory-East will remain with DOE's Office of Science. DOE plans to continue supporting Argonne-East as a multipurpose national laboratory. The goal of long-term stewardship will be to provide monitoring and maintenance of contaminated areas and facilities to ensure the continued protection of human health and the environment, and to prevent residual contamination from migrating offsite.

Some of the Solid Waste Management Units will have deed restrictions to indicate the placement of hazardous materials (e.g., the burial of asbestos in part of the 800 Area Landfill) even though there are no plans to release any part of the site. Decontamination and decommissioning of the CP-5 Reactor Facility (CP-5 Reactor Facility portion) will be completed in 2000, and long-term stewardship costs will be incurred, beginning in 2001, for groundwater monitoring, primarily for tritium, around the reactor area. None of the other facilities that are to be decontaminated and decommissioned at ANL-E prior to the end of 2006 will require long-term stewardship. DOE anticipates that some ANL-E Solid Waste Management Units will require long-term stewardship until 2033.

Groundwater monitoring and other environmental monitoring activities related to long-term stewardship for ANL-E are being conducted in accordance with the RCRA Part B permit; DOE Order 5400.1, *General Environment Protection Requirements*; DOE Order 435.1, *Radioactive Waste Management*, (to detect any releases from low-level radioactive waste treatment storage or disposal facilities); and Illinois Environmental Protection Agency Groundwater Quality Standards (under 35 Illinois Annotated Code Subtitle F Part 620).

> ***STAKEHOLDER INVOLVEMENT***
>
> Long-term monitoring requirements for the Solid Waste Management Units will be directed by the Illinois Environmental Protection Agency as part of the Resource Conservation and Recovery Act Part B permit corrective actions activities. Local community groups, such as the Community Leaders Round Table, will be regularly briefed on DOE long-term stewardship activities.

DOE intends to integrate all long-term stewardship activities into the ANL-E site monitoring and surveillance program conducted at the laboratory. All data generated by long-term stewardship activities will become part of this program, and information will be managed within the monitoring program data management system. DOE will provide information as part of the annual site environmental report, and other reports as required.

2.2 Assumptions and Uncertainties

Some ANL-E Solid Waste Management Units are anticipated to require long-term stewardship until 2033.

2.3 Estimated Site-Wide Long-Term Stewardship Costs

Long-term stewardship costs for the ANL-E site, identified in the table below, are derived from baseline estimated costs of such activities as periodic inspections, groundwater sampling, and maintenance of engineered barriers. The $20,000 cost shown in the cost summary beginning in fiscal year (FY) 2001 is for groundwater monitoring, primarily for tritium, around the CP-5 reactor facility.

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	***Amount***	***Year(s)***	***Amount***	***Year(s)***	***Amount***
FY 2000	$0	**FY 2008**	$413,000	**FY 2036-2040**	$0
FY 2001	$20,000	**FY 2009**	$413,000	**FY 2041-2045**	$0
FY 2002	$20,000	**FY 2010**	$413,000	**FY 2046-2050**	$0
FY 2003	$20,000	**FY 2011-2015**	$1,903,000	**FY 2051-2055**	$0
FY 2004	$413,000	**FY 2016-2020**	$1,255,000	**FY 2056-2060**	$0
FY 2005	$413,000	**FY 2021-2025**	$1,255,000	**FY 2061-2065**	$0
FY 2006	$413,000	**FY 2026-2030**	$1,255,000	**FY 2066-2070**	$0
FY 2007	$413,000	**FY 2031-2035**	$753,000		

3.0 PORTION OVERVIEW

ANL-E has identified areas or portions of the site where long-term stewardship activities are required as of 2006 to allow for a more precise discussion of the geographic locations of long-term stewardship activities. For the purposes of this report, a "portion" is a geographically contiguous and distinct area (which may involve residually contaminated facilities, engineered units, soil, groundwater, an/or surface water/sediment) for which cleanup, disposal, or stabilization will have been completed and long-term stewardship will be required as of 2006. Some of the geographic areas of the ANL-E site are not represented as portions. These include areas that have an ongoing mission and/or for which long-term stewardship will not be required, remediation activities will not be complete, or stabilization will not occur within the 2006 time frame specified by the *National Defense Authorization Act for Fiscal Year 2000* (FY 2000 NDAA) language. Four portions of the ANL-E site — the 300 area, 800 area, CP-5 Reactor Facility, and the Rest of Site — will require some long-term stewardship as of 2006. The CP-5 Reactor Facility will begin long-term stewardship in 2001. For the other portions, remediation activities will be completed by the end of 2003.

The remaining sections discuss the portions of the ANL-E site that will require long-term stewardship. Each portion is listed in the table below, with accompanying discussion of cleanup and long-term stewardship activities in Sections 3.1 to 3.4.

Long-Term Stewardship Information		
Portion Name	***Long-Term Stewardship Start Year***	***Long-Term Stewardship End Year***
300 Area - represents a collection of Solid Waste Management Units (SWMU) that are grouped together due to their geographic location and many similar contaminants. This portion was primarily used for the management of radioactive and chemical wastes and includes the 319 Area Landfill and East-Northeast Landfill; 317 Area and 319 Area French Drains; subsurface concrete structures (vaults), which were used for the temporary storage of radioactive waste; and the 320 Area shooting range. The 317 Area includes active radioactive waste storage and treatment units.	2004	2033
800 Area- a 22-hectare (55-acre) geographically contiguous and distinct area that has residual contamination located mainly in the 800 Area Landfill; also includes a French Drain. All the solid waste management units within this portion are limited to chemical constituents with no radionuclides. The 800 Area Landfill was used for the disposal of demolition debris, general refuse, boiler-house ash, asbestos, and other nonradioactive waste	2004	2033
CP-5 Reactor Facility (Building 330)- a two-hectare (five-acre) reactor facility currently undergoing decontamination and decommissioning. The reactor was a heavy-water-cooled and moderated research reactor that operated between 1954 and 1979. The reactor and associated support facilities are a portion because they constitute a single purpose entity	2001	2033
Rest of Site - comprises all the remaining Solid Waste Management Units (28 in total) that are not included in the 300 Area, 800 Area, or CP-5 Reactor Facility portions of the ANL-E site. These Solid Waste Management Units in this site portion are less complex than those in other site portions and can be remediated with "traditional" engineering approaches, such as limited excavation and/or asphalt capping.	2004	2033

3.1 300 Area

The 300 Area represents 10 hectares (25 acres) comprising 49 Solid Waste Management Units. These 49 units were identified in the RCRA Part B permit and have been grouped together due to their geographic location and many similar contaminants. The 300 Area is primarily used for the management of radioactive and chemical wastes and includes the 319 Area Landfill and East-Northeast Landfill, 317 Area and 319 Area French Drains, and subsurface concrete structures (vaults), which were used for the temporary storage of radioactive waste, and the 320 Area shooting range. The 317 area includes active solid radioactive mixed waste storage vaults and treatment units. The 317 Area and 319 Area French Drains, which operated during the 1950s, were used for subsurface disposal of spent

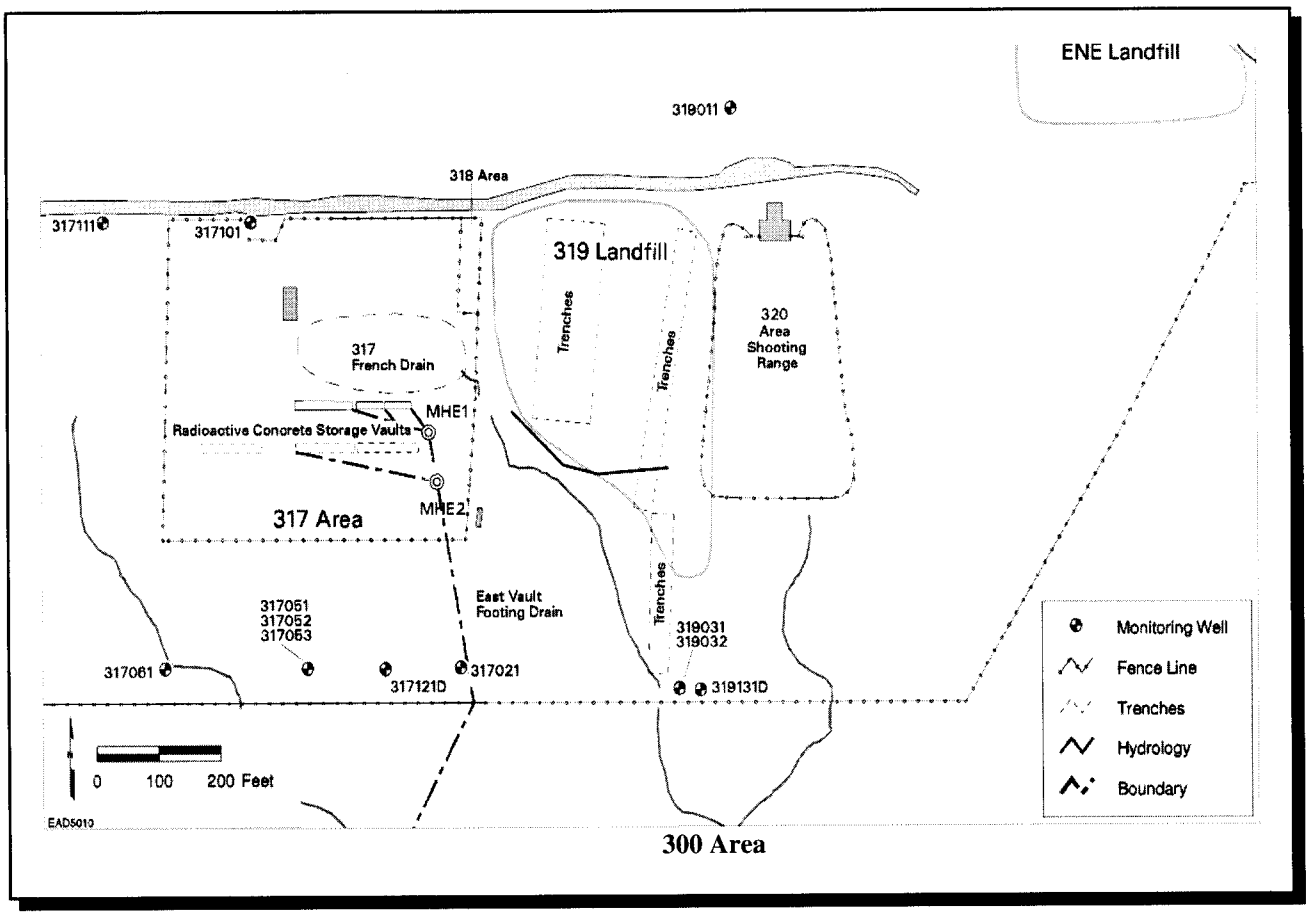
300 AREA HIGHLIGHTS

Major Long-Term Stewardship Activities - groundwater monitoring; surveillance and maintenance of engineered units; annual tree maintenance/ replacement (if required) for phytoremediation system
Portion Size - 10 hectares (25 acres)
Estimated Volume of Residual Contaminants - soil 688,100 cubic meters (900,000 cubic yards); engineered units 191,100 cubic meters (50,000 cubic yards); groundwater 76,450 cubic meters (100,000 cubic yards)
Long-Term Stewardship Start-End Years - 2004-2033
Average Annual Long-Term Stewardship Costs FY 2004-2006 - $310,000

solvents. The 319 Area includes an inactive landfill and waste trench that were used during the 1960s to dispose of solid waste, including some radioactive waste.

The 300 Area includes a perimeter fence and an interior fence around the 317 Area, which constitutes a major portion of the remediated area. In addition, deed restrictions are proposed on certain areas that contain residual contamination, such as the 318 Area gas cylinder disposal area. Some Solid Waste Management Units also have signage indicating that digging is not permitted.

DOE is conducting remedial actions at the 300 Area in accordance with the requirements of the site RCRA Part B Permit and the RCRA Corrective Action Program, which requires corrective actions at all sites that have been used to process or dispose of waste materials at any time in the past. The Solid Waste Management Units in the 300 Area have been characterized and data reported to the Illinois Environmental Protection Agency in the 1996 RCRA Facility Assessment Report. Most of the Solid Waste Management Units in the 300 Area have Illinois Environmental Protection Agency-approved work plans, which identify the selected remediation activities and endpoints. These work plans are presently being executed, and requests for No Further Action are being submitted to the Illinois Environmental Protection Agency as work is completed.



3.1.1 Soil

Soil contamination exists in approximately 2.8 hectares (seven acres) of land, primarily under the 317 Area French Drain, the 319 Area French Drain, and the 319 Area Landfill. The geology of the 300 Area is characterized by approximately 24 meters (80 feet) of glacial drift on top of dolomite bedrock. A significant body of analytical data has been acquired so that the contaminant identity and concentrations in the 300 Area are

well known. The monitoring and characterization data indicates that the various contaminant plumes have merged and contaminated 2.8 hectares (seven acres) of the 300 Area soil with mainly tritium and volatile organic compounds. Other contaminants include metals, semi-volatile organic compounds, and other radionuclides. There are two major volumes of contamination (primarily, tritium and volatile organic compounds) in the subsurface soil — one under the 317 Area French Drain and one under the 319 Area Landfill and French Drain. However, the exact sources of contamination cannot be easily segregated due to the close proximity of the various Solid Waste Management Units and the commingling of the soil and groundwater contamination.

Soil cleanup activities have been underway in the 300 Area since the late 1980s and include treatment of contaminated soil in the 317 Area. In 1995, soil monitoring was conducted as part of a RCRA Facility Investigation, and the Illinois Environmental Protection Agency accepted the data in 1996 and approved soil remediation work plans for each Solid Waste Management Unit in the 300 Area. The remediation plans are being executed, and the 317 Area Soil Treatment Project was completed in 1998. It is anticipated that the soil contaminant concentrations will be significantly reduced by remediation and the total estimated volume of contaminated soil will be 688,099 cubic meters (900,000 cubic yards) after remediation. The remediation activities to be completed by the end of 2003 include capping the landfills; soil mixing and venting; phytoremediation; surface soils metals removal; and in-place burial of subsurface concrete structures. Contaminant concentrations have been significantly reduced since completion of the 317 Area Soil Treatment Project.

Soil Long-Term Stewardship Activities

Long-term stewardship activities for the 300 Area include maintenance of the perimeter fence and an interior fence around the 317 Area, a major portion of the remediated area. In addition, DOE is proposing deed restrictions for certain areas that contain residual contamination, such as the 318 Area gas cylinder disposal area. Some Solid Waste Management Units in the 300 Area also have signage indicating that digging is not permitted. Long-term stewardship for the 317 Area French Drain is expected to be completed by the end of 2014, but the other 300 Area units may require monitoring until 2033.

3.1.2 Engineered Units

There are two engineered units in the 300 Area — the 319 Area Landfill and the East-Northeast Landfill. Both consist of unlined trenches that cover 2.8 hectares (seven acres) of land. The 319 Area Landfill was excavated from the top three meters (ten feet) of the glacial drift and consists of unlined trenches filled with solid waste (e.g, general rubbish, demolition debris, discarded equipment, empty drums, and air filters) and covered by an engineered barrier. Incomplete records indicate that various liquid chemical compounds, including radionuclides, were discarded into the 319 Area Landfill during its operational life of 1956 to 1968. The volume of waste disposed of in the 319 Area Landfill is estimated to be less than 152,900 cubic meters (200,000 cubic yards).

The East-Northeast Landfill contains waste deposited on the ground surface that was pushed down the side of a steep ravine and covered with soil. The waste disposed of in the East-Northeast Landfill during 1951 to 1956 primarily included construction debris, along with pipes, ductwork, machine shop turnings, and demolition debris. Therefore, the 319 Area Landfill contains hazardous and mixed waste, while the East-Northeast Landfill contains only hazardous waste. The volume of waste disposed of in the East-Northeast Landfill is estimated to be less than 38,200 cubic meters (50,000 cubic yards). Engineered barriers/controls include subsurface barrier walls downgradient of the 319 Area to prevent contaminated groundwater migration, and groundwater extraction wells downgradient of both the 319 Area Landfill and the 317 Area to remove accumulated groundwater that is piped to the ANL-E wastewater treatment plant. These controls are augmented with a phytoremediation project in both the 317 and 319 Areas, which removes volatile organic compounds and tritium from the groundwater. DOE evaluates the effectiveness of these controls by a groundwater monitoring program.

DOE has acquired a significant body of analytical data and, therefore, the contaminant identity and concentrations are well known. The units are well characterized in the 1995 RCRA Facility Investigation report that was accepted by the Illinois Environmental Protection Agency. DOE has remediated the 319 Area landfill with a leachate collection system, which consists of a slurry wall and wells to remove the contaminated groundwater. The covers on the 319 Area landfill and East-Northeast Landfill use impermeable membranes sandwiched between clay. Although there are no liners under the buried materials, clay material into which the waste was placed, is frequently used to construct landfill covers.

Engineered Unit Long-Term Stewardship Activities

Long-term stewardship activities for engineered units in the 300 Area include surveillance and maintenance of the landfill caps on the 319 Area Landfill and East-Northeast Landfill and surveillance and maintenance of the 319 Area Landfill slurry wall and groundwater barrier system.

3.1.3 Groundwater

Groundwater contamination exists in the vicinity of the 317 Area and 319 Area French Drains and 319 Area Landfill. The physical proximity of the Solid Waste Management Units in this site portion allows the same remediation strategy to be applied to several of the units concurrently. These cleanup strategies, which have been underway in the 300 Area since the late 1980s, include operation of a leachate and groundwater collection system for the 319 Area Landfill and operation of groundwater extraction wells south of the 317 Area. Prior to issuance of the RCRA Part B permit in September 1997, ANL-E had voluntarily undertaken several remedial actions in the 300 Area.

The hydrogeology of the 300 Area is characterized by 24 meters (80 feet) of glacial drift on top of dolomite bedrock. The depth to the saturated zone is about eight meters (25 feet) below the ground surface. However, useable quantities of water cannot be obtained from this glacial drift. Groundwater flow direction in the dolomite is generally to the south-southeast, under the Forest Preserve and towards the Des Plaines River. The major groundwater contaminants are tritium and volatile organic compounds, with smaller amounts of metals, semi-volatile organic compounds, and other radionuclides. There are two major subsurface plumes of groundwater contamination that merge as they move south. The total estimated volume of the combined subsurface plumes of groundwater is about 76,450 cubic meters (100,000 cubic yards), primarily in the upper fractures of the dolomite. There are 2.8 hectares (seven acres) of contaminated groundwater area in the 300 Area.

Significant analytical data have been compiled since 1985, when groundwater monitoring of the 300 Area began, and the contaminant identities and concentrations are well known. Monitoring and characterization data indicate that various groundwater plumes have merged, and a groundwater management zone has been proposed for monitoring groundwater in the portion. The target cleanup levels are the State of Illinois Class I Ground Water Quality Standards (i.e., 20,000 pCi/L for tritium; 0.005 mg/L for trichloroethylene; 0.07 mg/L for cis-1,2-Dichloroethylene; and 0.005 mg/L for tetrachloroethylene). DOE expects to achieve these cleanup target levels by 2033.

Groundwater Long-Term Stewardship Activities

Groundwater monitoring of the entire area has been conducted since 1985. Groundwater monitoring is conducted for volatile organic compounds and tritium (317 Area French Drain), for volatile organic compounds and selected radionuclides (319 Area French Drain), and for metals and selected radionuclides (319 Area Landfill). Long-term stewardship activities include groundwater monitoring and continued operation of the leachate collection and groundwater extraction system. Long-term stewardship activities for the 317 Area French Drain are expected to be completed by the end of 2014, but the 319 Area French Drain and 319 Area Landfill may require

groundwater monitoring until 2033.

3.1.4 Estimated Long-Term Stewardship Costs for the 300 Area

Long-term stewardship costs for the 300 Area portion are derived from baseline estimated costs of such activities as cap maintenance, leachate collection, and monitoring. There are no costs for the 317 French Drain after FY 2014 because DOE assumes phytoremediation will be successful. Annual costs are $310,000 per year through FY 2010.

Long-Term Stewardship Costs (Constant Year 2000 Dollars)							
FY 2000 - FY 2010	***FY 2011 - FY 2020***	***FY 2021 - FY 2030***	***FY 2031 - FY 2040***	***FY 2041 - FY 2050***	***FY 2051 - FY 2060***	***FY 2061 - FY 2070***	***Estimated Total***
$2,170,000	$2,128,000	$1,480,000	$444,000	$0	$0	$0	$6,222,000

3.2 800 Area

The 800 Area is a 22-hectare (55-acre) geographically contiguous and distinct area that has residual contamination located mainly in the 800 Area Landfill. The 800 Area portion is completely fenced; in addition, the 800 Area Landfill is separately fenced with controlled access and has deed restrictions due to the burial of asbestos. The 800 Area Landfill was used for the disposal of demolition debris, general refuse, boiler-house ash, asbestos, and other nonradioactive waste. Between 1969 and 1978, organic and inorganic liquids were disposed of in a French Drain (dry well) located in the northeast corner of the landfill. The contaminants of concern at the 800 Area Landfill are volatile organic compounds and metals. Other solid waste management units in the area involved the use of waste oil, scrap metal, and polychlorinated biphenyls.

800 AREA HIGHLIGHTS

Major Long-Term Stewardship Activities - groundwater monitoring; surveillance and maintenance of engineered units
Portion Size - 22 hectares (55 acres)
Estimated Volume of Residual Contaminants - groundwater 764,555 cubic meters (1 million cubic yards); engineered unit 764,555 cubic meters (1 million cubic yards)
Long-Term Stewardship Start-End Years - 2004-2033
Average Annual Long-Term Stewardship Costs FY 2004-2006 - $39,000

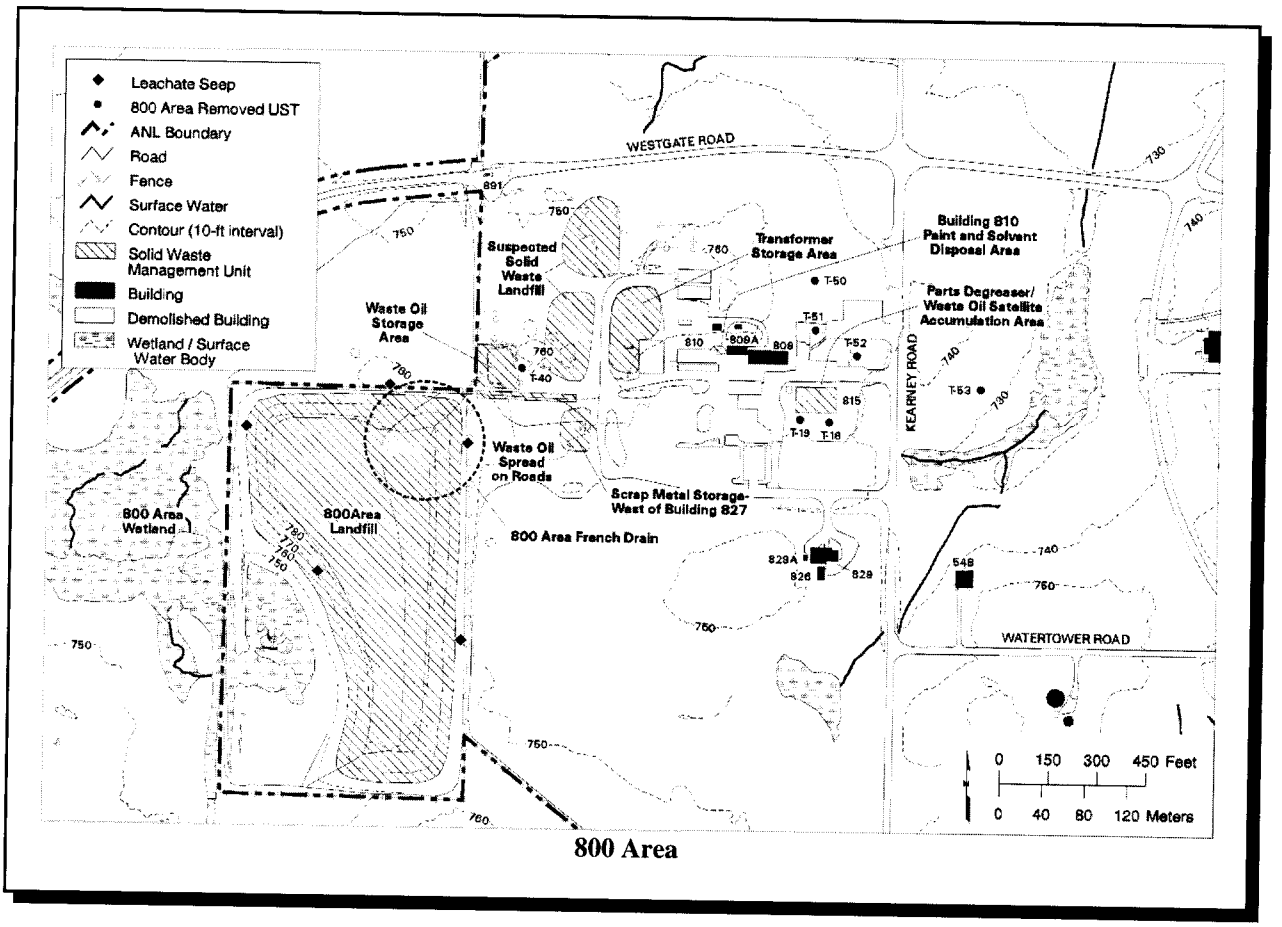
All of the Solid Waste Management Units within this portion are limited to chemical constituents with no radionuclides and are well characterized in the1996 RCRA Feasibility Investigation that was accepted by the Illinois Environmental Protection Agency. Groundwater monitoring of this portion has been conducted since 1989 and has resulted in well-characterized contaminants and known concentrations.

DOE closed the 800 Area Landfill by applying an engineered barrier (cap) and also covered other remediated areas after removing the contaminant(s). An ongoing groundwater and surface water monitoring program is being conducted at the 800 Area Landfill as part of the closure process. DOE will remediate the remaining Solid Waste Management Units in the 800 Area, primarily by soil removal, to concentrations appropriate for unrestricted use.

Long-term stewardship of this portion is expected to start in 2004 and continue through 2033. DOE will conduct long-term stewardship activities at the 800 Area Landfill in accordance with the permit for the landfill issued by the Illinois Environmental Protection Agency, which contains requirements for landfill post-closure care, and in accordance with the Corrective Action requirements of the site RCRA Part B permit. The original construction and operating permit for the sanitary waste landfill was issued by the Illinois Environmental Protection Agency

(pursuant to 35 Illinois Annotated Code Part 807).

The Illinois Environmental Protection Agency issued a supplemental permit for the closure of the sanitary landfill in 1992 and a supplemental permit for groundwater monitoring in 1998. DOE characterized the 800 Area Landfill in 1992 as part of the landfill closure activities. The landfill and other Solid Waste Management Units also are characterized in the 1996 800 Area RCRA Feasibility Investigation report. DOE prepared and submitted the report to the Illinois Environmental Protection Agency, which approved the report. The 800 Area Landfill is not subject to regulatory requirements for municipal solid waste landfills because the unit does not meet the regulatory definition of a municipal solid waste landfill.



800 Area

3.2.1 Groundwater

The hydrogeology of the 800 Area is characterized by 43 meters (140 feet) of glacial drift on top of dolomite bedrock. Although the glacial drift has a hydraulic conductivity of about 0.0000001 centimeter per second, it does contain some intermittent sand and gravel lenses. The depth to the saturated zone is about eight meters (25 feet); however, the glacial drift does not yield sufficient water to be used as a source for domestic use. The groundwater flow direction is to the south-southeast, and any contamination would be under the ANL-E site or the Forest Preserve. Much of the nine-hectare (22-acre) groundwater contamination is attributable to the 800 Area Landfill. The other Solid Waste Management Units contribute a very small volume to the total contamination and, thus, will not require any long-term monitoring. The total estimated volume of the contaminated groundwater is 764,555 cubic meters (one million cubic yards). DOE has compiled significant analytical data since 1989, when groundwater monitoring was initiated.

Groundwater Long-Term Stewardship Activities

Groundwater monitoring at the 800 Area Landfill for long-term stewardship is anticipated to be conducted until 2033, and will continue as required by the Illinois Environmental Protection Agency permit for closure of the landfill and the RCRA Part B permit. According to monitoring data, groundwater in the 800 Area contains levels of chloride, lead, iron, manganese, and total dissolved solids in excess of groundwater protection standards; however, DOE expects to achieve the cleanup target levels by 2033. The target cleanup levels are the State of Illinois Class I Ground Water Quality Standards (e.g., 1,200 mg/L for total dissolved solids; 5 mg/L for iron; 0.0075 mg/L for lead; and 200 mg/L for chloride).

3.2.2 Engineered Unit

The 800 Area Landfill - the only engineered unit in the 800 Area - comprises a single cell with buried waste that occupies eight hectares (22 acres) of land. DOE placed the 800 Area Landfill waste on the natural grade to eventually create an 11-meter (35-foot) mound. The landfill operated from 1966 to 1992 and was used for the disposal of general refuse, demolition debris, boiler-house ash, asbestos, and other nonradioactive waste. Between 1969 and 1978, organic and inorganic liquids were disposed of in a French Drain (dry well) located in the northeast corner of the landfill. In addition to sanitary waste in the 800 Area Landfill, analytical data has also indicated the presence of hazardous waste and polychlorinated biphenyls in the landfill. The volume of the disposed material is estimated to be approximately 764,555 cubic meters (one million cubic yards). The waste is covered with an engineered barrier, which includes an impervious membrane sandwiched by clay. Although there is no liner under the buried waste, the clay in which the material is buried is frequently used for landfill cap covers.

Engineered Unit Long-Term Stewardship Activities

Long-term stewardship activities for the 800 Area Landfill engineered unit is anticipated to include surveillance and maintenance of the landfill cover and landfill gas monitoring. DOE is planning quarterly inspections for this unit, and any erosion damage or other maintenance that may be required will be addressed at that time.

3.2.3 Estimated Long-Term Stewardship Costs for the 800 Area

DOE based costs for the 800 Area on quarterly inspections and routine maintenance.

Long-Term Stewardship Costs (Constant Year 2000 Dollars)							
FY 2000 - FY 2010	*FY 2011 - FY 2020*	*FY 2021 - FY 2030*	*FY 2031 - FY 2040*	*FY 2041 - FY 2050*	*FY 2051 - FY 2060*	*FY 2061 - FY 2070*	*Estimated Total*
$308,000	$440,000	$440,000	$132,000	$0	$0	$0	$1,320,000

3.3 Rest of Site

The Rest of Site portion of the ANL-E site is comprised of all of the remaining Solid Waste Management Units (28 in total) identified in the RCRA Part B permit that are not included in the 300 Area or 800 Area portions. These Solid Waste Management Units are less complex than those in the 300 and 800 areas and can, therefore, be remediated with traditional engineering approaches. The 12-hectare (30-acre) portion size is the sum of the area of all of the individual Solid Waste Management Units that make up this portion and which are scattered throughout the entire ANL-E site. All the Solid Waste Management Units in this portion are within the ANL-E site perimeter fence. A significant body of analytical data, obtained as part of the RCRA Feasibility

Investigation, was collected to effectively characterize the constituents and contaminant levels of the Solid Waste Management Units.

Twenty-six of the Solid Waste Management Units will be cleaned to below the State of Illinois Tiered Approach to Cleanup Objectives (TACO) standards, which will allow a determination of No Further Action. The remaining two Solid Waste Management Units in the Rest of Site portion are the 570 Pond (SWMU 133), which will require an engineered cover, groundwater monitoring, and institutional controls; and the 003C Outfall (SWMU 179), which will be treated by phytoremediation and will require monitoring to determine the rate of removal of the contaminants. Remedial actions for these Solid Waste Management Units, and long-term stewardship for the two units that are not remediated to the standards set forth in TACO, are being conducted in compliance with the site's RCRA Part B permit and the RCRA Corrective Action Program.

REST OF SITE HIGHLIGHTS

Major Long-Term Stewardship Activities - quarterly inspections of paved asphalt engineered barriers; annual resealing; annual sampling
Portion Size - 12 hectares (30 acres)
Estimated Volume of Residual Contaminants - soil 15,290 cubic meters (20,000 cubic yards); groundwater 765 cubic meters (1,000 cubic yards); surface water/sediment 7 cubic meters (10 cubic yards)
Long-Term Stewardship Start-End Years - 2004-2033
Average Annual Long-Term Stewardship Costs FY 2004-2006 - $39,000

3.3.1 Soil

The geology of the Rest of Site portion is glacial drift that varies in depth from 24 to 46 meters (80 to 150 feet) on top of dolomite bedrock. Although the glacial drift has a hydraulic conductivity of about 0.0000001 centimeters per second, it does contain intermittent sand and gravel lenses. A significant body of analytical data has been collected to effectively characterize the constituents and contaminant levels of the Solid Waste Management Units based on information generated for the site RCRA feasibility investigation.

A total of two hectares (five acres) of soil in the Rest of Site portion is contaminated. The typical contaminants in the Solid Waste Management Units are industrial materials associated with prior ANL-E operations, i.e., mostly metals, with some semi-volatile organic compounds and volatile organic compounds.

Most of the Solid Waste Management Units will be remediated by soil removal, with disposal at an offsite special waste landfill. DOE expects to clean these units to below Tiered Approach to Cleanup Objectives (TACO) limits. The two Solid Waste Management Units (Outfall 003C and 570 Pond) that have residual radionuclide contamination will be addressed on a case-specific basis in accordance with the Corrective Action Program. (The 570 Pond will be covered and require groundwater monitoring for metals and radionuclides, and Outfall 003C will be cleaned by phytoremediation.)

Soil Long-Term Stewardship Activities

During long-term stewardship of the site, expected to begin in 2004 and end in 2033, all residual hazard locations will become part of the ANL-E institutional record, and signage will be placed as needed. Solid Waste Management Units in the Rest of Site portion that are not remediated to below Illinois TACO standards will require long-term monitoring. After remediation is completed in 2003, DOE estimates that less than 15,290 cubic meters (20,000 cubic yards) of contaminated soil in the rest of site area will remain and require long-term monitoring. DOE will place an engineered cover over the 570 Pond and will monitor the Outfall 003C.

3.3.2 Groundwater

The hydrogeology of the Rest of Site portion is glacial drift that varies in depth from 24 to 46 meters (80 to 150 feet) on top of dolomite bedrock. The dolomite bedrock is about 23 meters (75 feet) below the surface at the 570 Pond Solid Waste Management Unit, where tritium has been identified in a monitoring well at about 200 to 300 pCi/L, which is below drinking water standards (20,000 pCi/L). Approximately two hectares (five acres) of groundwater are contaminated. The typical contaminants in the Solid Waste Management Units that make up the Rest of Site portion are industrial materials associated with prior ANL-E operations, i.e., mostly metals, with some semi-volatile organic compounds and volatile organic compounds. Only the 570 Pond Solid Waste Management Unit contains low levels of tritium in the groundwater.

The Rest of Site portion Solid Waste Management Units were characterized as part of a RCRA Feasibility Investigation. DOE is currently executing Illinois Environmental Protection Agency work plans to remediate the Solid Waste Management Units. Much of the Rest of Site portion is expected to be cleaned to below State of Illinois Class 1 Ground Water Quality Standards. The only identified contaminant is tritium at levels of 200 to 300 pCi/L.

Groundwater Long-Term Stewardship Activities

After remediation is completed in 2003, DOE estimates that the volume of contaminated dolomite bedrock and groundwater will be less than 765 cubic meters (1,000 cubic yards), with tritium concentrations well below the Class 1 Ground Water Quality Standards (i.e., below 20,000 pCi/L). The one Solid Waste Management Unit that has residual radionuclide contamination in groundwater will be addressed by capping the area and conducting groundwater monitoring for radionuclides. Long-term stewardship activities for the Rest of Site portion will include groundwater monitoring for the 570 Pond and Outfall 003C.

3.3.3 Surface Water/ Sediments

DOE has identified the substantial contaminants and their concentrations for the Rest of Site portion. The only Solid Waste Management Unit in the Rest of Site portion that has surface water/sediment contamination is NPEDS Outfall 003C, which is located in a small surface drainage stream that drains part of the center of the site. The volume of contaminated sediment is estimated to be about seven cubic meters (ten cubic yards) for the less than 30 meters (100 feet) long Solid Waste Management Unit (Outfall 003C). The impacted area is about 46.5 square meters (500 square feet.) The underlying geology of the Outfall 003C Solid Waste Management Unit is glacial drift. Outfall 003C contaminants of concern are lead and semi-volatile organic compounds, such as benzo(a)anthracene, benzo(b)fluoranthene, and benzo(a)pyrene. For this area, DOE intends to conduct Tiered Approach to Cleanup Objectives (TACO) sampling and analysis. This approach focuses on soil standards and presents a staged framework under which cleanup levels may be determined.

Surface Water/Sediments Long-Term Stewardship Activities

Long-term stewardship activities for surface water and sediment for Outfall 003C include monitoring of surface water and sediment concentrations for the semi-volatile organic compounds.

3.3.4 Estimated Long-Term Stewardship Costs for the Rest of Site

Costs for this portion are based on quarterly inspections and monitoring at about $39,000 per year.

Long-Term Stewardship Costs (Constant Year 2000 Dollars)							
FY 2000 - FY 2010	*FY 2011 - FY 2020*	*FY 2021 - FY 2030*	*FY 2031 - FY 2040*	*FY 2041 - FY 2050*	*FY 2051 - FY 2060*	*FY 2061 - FY 2070*	*Estimated Total*
$273,000	$390,000	$390,000	$117,000	$0	$0	$0	$1,170,000

3.4 CP-5 Reactor Facility

The CP-5 Reactor Facility (Building 330) is a two-hectare (five-acre), completely fenced entity currently undergoing decontamination and decommissioning, which is expected make it accessible for unrestricted use by the end of 2000. The CP-5 Reactor and its associated support facilities constitute a single purpose entity. The reactor was a heavy-water cooled and moderated research reactor that operated between 1954 and 1979.

CP-5 REACTOR FACILITY HIGHLIGHTS

Major Long-Term Stewardship Activities - groundwater monitoring of tritium in soil water
Portion Size - 2 hectares (5 acres)
Estimated Volume of Residual Contaminants - groundwater unknown; facilities 2,900 square meters (3,793 cubic yards)
Long-Term Stewardship Start-End Years - 2001-2033
Average Annual Long-Term Stewardship Costs FY 2001-2006 - $20,000

3.4.1 Groundwater

Groundwater in the vicinity of the CP-5 reactor facility is monitored quarterly from four groundwater wells for radionuclides, metals, volatile organic compounds, semi-volatile organic compounds, polychlorinated biphenyls, pesticides, and herbicides. Some environmental contamination by tritium occurred both from normal reactor operations and from reactor incidents. DOE has detected tritium at all four wells at the CP-5 Reactor Facility. Tritium is in groundwater and soil water below the building. ("Soil water" is water incorporated in the soil matrix that is removed and analyzed for various constituents. Typically "soil water" is collected above the saturated zone; not in a monitoring well.) Soil water tritium concentrations average about 1,000 picocuries per liter (pCi/L) and have been measured at concentrations up to 18,000 pCi/L. These concentrations are below the State of Illinois Class 1 Ground Water Quality Standards for tritium (20,000 pCi/L).

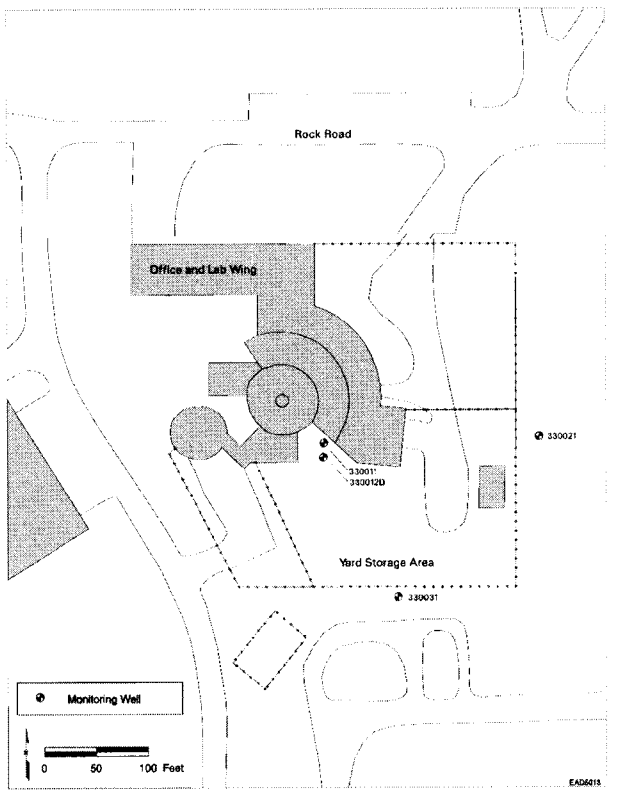
DOE also has detected strontium-90 and cesium-137 in groundwater in concentrations less than 2 pCi/l. Concentrations of metals, including manganese and nickel, exceeded State water quality standards (0.15 mg/L, 0.10 mg/L) in 1998. Manganese concentrations ranged up to 0.6 mg/L.

Groundwater Long-Term Stewardship Activities

DOE will document the amount of the residual radioactive material in the CP-5 Reactor Facility area in the ANL-E institutional record and update it as needed. The institutional record will reflect all restrictions, such as requiring a dig permit for all subsurface activities. Residual radionuclides that may remain within the subsurface structures and soil would be monitored by a groundwater monitoring program. The presence of the building serves as a barrier to the infiltration of precipitation into the subsurface soil under the reactor building and, thereby, limits the migration of any contaminants. If the building is removed, a parking lot will be installed that will serve the same protective purpose.

Long-term stewardship activities are expected to begin in 2001 and continue through 2033. The primary activity will be the groundwater monitoring of tritium. DOE estimates an annual cost of $20,000 will be incurred from such monitoring activities. Groundwater monitoring for long-term stewardship for the CP-5 Reactor Facility is being conducted to demonstrate compliance with DOE Order 5400.1 and to demonstrate compliance with Illinois Environmental Protection Agency Groundwater Quality Standards (under 35 Illinois Annotated Code Subtitle

F Part 620). The CP-5 Reactor Facility environmental monitoring program is being conducted in accordance with DOE Order 5400.1, and the radioactive waste management environmental monitoring and surveillance program is being conducted in accordance with DOE Order 435.1, *Radioactive Waste Management.*



CP-5 Reactor

3.4.2 Facilities

The CP-5 reactor is contained in a single building that has approximately 38 meters (125 feet) of underlying glacial till on top of dolomite bedrock. The tritium is contained in the top 15 meters (50 feet) of the glacial drift. The depth to the saturated zone is about six meters (20 feet) in this area. Concentrations of tritium in the soil water have been less than the State of Illinois Class 1 Ground Water Quality Standard for tritium, i.e., less than 20,000 pCi/L. Typical measured levels of tritium have been less than 1,000 pCi/L.

The building occupies approximately 2,900 square meters (32,000 square feet or about 1/10 of an acre) of the portion. The CP-5 reactor and associated support facilities constitute a single purpose entity. The reactor was a heavy-water cooled and moderated research reactor that operated from 1954 to 1979. The tritium contamination in the soil below the building (as tritiated water) is the most widespread and occupies about 38,228 cubic meters (50,000 cubic yards) beneath the building. Soil water concentrations have been measured at up to 18,000 pCi/L of tritium. Several other radionuclides (Sr-90 and Cs-137) have been measured at less than 2.0 pCi/L. Some volatile organic compounds are present in the soil water, in addition to low concentrations of a few metals in the surface soil adjacent to the building.

Facilities Long-Term Stewardship Activities

The decontamination and decommissioning of the CP-5 Reactor Facility is expected to remove all accessible radioactive contamination to release-for-reuse levels by the end of CY 2000. However, ANL-E has no planned future use for the structure. Approximately $1,500,000 in funding is being sought to demolish the building. As long as the building remains, approximately $75,000 will be required annually for operating costs, including utilities (heating, ventilation, electricity) and building maintenance. ANL-E considers these costs to be surveillance and maintenance costs, not long-term stewardship costs. The long-term stewardship activities for the CP-5 Reactor Facility include soil water monitoring of tritium.

3.4.3 Estimated Long-Term Stewardship Costs for the CP-5 Reactor

Long-term stewardship costs for the CP-5 Reactor Facility are based on soil water monitoring of tritium at $20,000 per year. The $75,000 annual costs for surveillance and maintenance of the CP-5 Reactor Facility are not considered by ANL-E to be long-term stewardship costs and are not included in the long-term stewardship cost estimate for the facility.

Long-Term Stewardship Costs (Constant Year 2000 Dollars)							
FY 2000 - FY 2010	*FY 2011 - FY 2020*	*FY 2021 - FY 2030*	*FY 2031 - FY 2040*	*FY 2041 - FY 2050*	*FY 2051 - FY 2060*	*FY 2061 - FY 2070*	*Estimated Total*
$200,000	$200,000	$200,000	$60,000	$0	$0	$0	$660,000

4.0 FUTURE USES

DOE assumes that the site's future land use will remain "industrial with restricted access," in accordance with the DOE Office of Science's ongoing mission for the site. However, after all DOE missions are complete, DOE anticipates the ultimate land use for this site would range from "residential" to "controlled access" use.

For additional information about the Argonne National Laboratory - East site, please contact:

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FERMI NATIONAL ACCELERATOR LABORATORY

1.0 SITE SUMMARY

1.1 Site Description and Mission

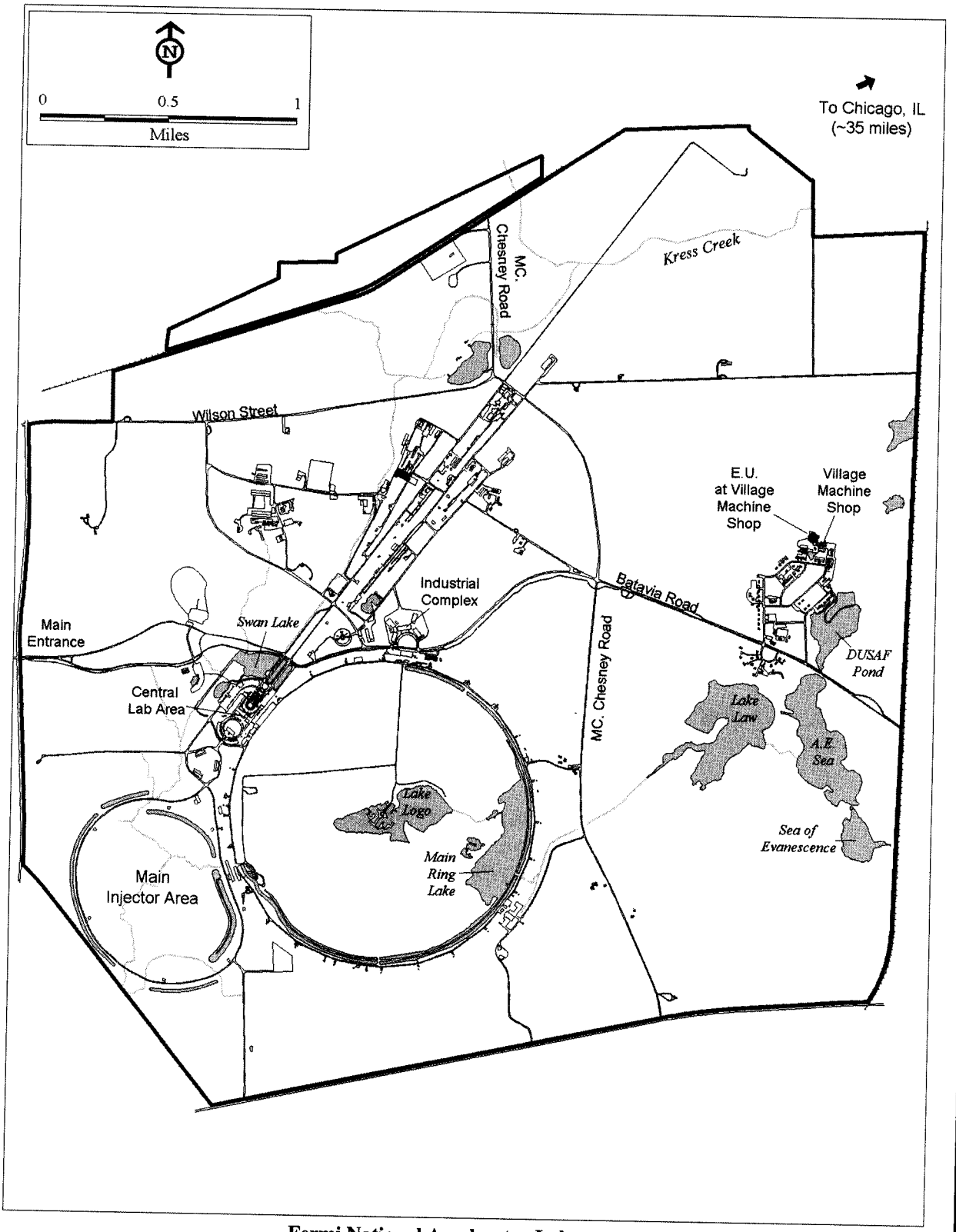
> ***LONG-TERM STEWARDSHIP HIGHLIGHTS***
>
> *Major Long-Term Stewardship Activities* - routine surveillance and monitoring
> *Total Site Area* - 2,720 hectares (6,720 acres)
> *Estimated Volume of Residual Contaminants* - engineered units unknown
> *Long-Term Stewardship Start-End Years* - engineered units 1999-in perpetuity; groundwater - 2000-2013
> *Average Annual Long-Term Stewardship Cost FY 2000-2006* - $150,000
> *Landlord* - U.S. Department of Energy, Office of Science

The Fermi National Accelerator Laboratory, also referred to as Fermilab, is located on a 2,720 hectare (6,720 acre) tract in Batavia, Illinois, approximately 48 kilometers (30 miles) west of downtown Chicago. About half of this acreage contains the Tevatron (the world's highest energy particle accelerator), Fermilab Main Injector, Fixed Target Area, and various technical and support areas. The Fermi National Accelerator Laboratory began as a single-program research and development facility for the U.S. Atomic Energy Commission (a predecessor agency to the U.S. Department of Energy) in 1967, when the first accelerator at the laboratory began operations. The Laboratory's exclusive mission was to explore the fundamental nature of matter, using high-energy proton beams to probe subatomic structure at the smallest scale, and this continues to be the Laboratory's mission.

The Laboratory is operated by Universities Research Association, Inc. under contract with the U.S. Department of Energy (DOE). The Laboratory's ongoing mission is to conduct research in physics under the direction of DOE's Office of Science. The Laboratory conducts basic research in the area of high energy physics and related disciplines. More than 2,200 scientists from 34 States and 25 countries use the Laboratory's facilities to carry out particle physics research, which involves acceleration and collision of subatomic particles and examining the products of these interactions. The information gained from these studies contributes to understanding the basic nature of matter and forces.

The Laboratory's experiments continue to generate low-level radioactive waste, hazardous, and other special wastes, which are shipped offsite for appropriate treatment and disposal. As long as Fermi National Accelerator Laboratory is in operation, waste management will be a necessary function of the Laboratory's research activities.

The Laboratory has a *Resource Conservation and Recovery Act* (RCRA) permit, which allows operation of a greater-than-90-day onsite hazardous waste storage facility. The permit was approved and issued by the Illinois Environmental Protection Agency (Illinois EPA) and the U.S. Environmental Protection Agency (EPA) in 1991. The Laboratory manages all RCRA hazardous waste onsite in satellite accumulation areas and the hazardous waste storage facility according to permit provisions prior to treatment and disposal at appropriate offsite commercial facilities.



Fermi National Accelerator Laboratory

1.2 Site Cleanup and Accomplishments

DOE has completed most site remediation activities from past laboratory operations. A RCRA Facility Investigation, initiated as a condition of the Laboratory's Part B permit, resulted initially in 21 solid waste management units. Illinois EPA has determined that 16 of the 21 units require no further action. The remaining five units, with soil contamination only, are: CUB Tile Field (contaminants of concern include chloride and chromate); Meson Hill (unknown construction debris disposal); Meson-Neutrino Area (the contaminants of concern include radionuclides from soil activation); Railhead Storage Area (the contaminant of concern is lead), and Village Machine Shop (the contaminant of concern is trichloroethene (TCE). Remediation at all five sites is complete and Fermilab is awaiting approval from Illinois EPA of cleanup efforts.

Quarterly groundwater monitoring will continue for the CUB Tile Field, Meson Hill, and Meson-Neutrino Area, as required by Illinois EPA for the contaminants of concern. A concrete cap was placed in 1999 over the contaminated soil located to the west of the Village Machine Shop. Because of the isolated nature of this contamination, the reduced infiltration caused by the concrete pad, and because the clay beneath the contaminated soil prevents water saturation, DOE expects limited migration of the contaminants. Inhalation of dispersed soil contaminants does not appear likely unless the pad is removed and the soils are excavated.

In addition, relatively small quantities of soil contamination occurred from leaking transformers and other electrical equipment, whose oil contained toxic substances such as polychlorinated biphenyls (PCBs). The site expects to complete remediation of PCB-contaminated soil near electrical transformers by 2004. Removal of PCB-contaminated soil at transformer service buildings distributed around the 6.4-kilometer (four-mile) circle of the Tevatron is scheduled for completion in 2002 or 2003. Fermilab plans to clean the soils to the one part per million regulatory level. If one part per million proves to be infeasible in some locations, then a cap and deed restrictions may impact future land use. Current sampling, however, indicates that this level will be met.

SITE ACCOMPLISHMENTS

- 16 of 21 solid waste management units determined to require no further action
- Remaining 5 units remediated in 1998
- 15,000 cubic meters (20,000 cubic yards) of soil treated
- 20 hectares (50 acres) released for unrestricted use

ANTICIPATED SITE ACCOMPLISHMENTS AS OF 2006

- Complete remediation of PCB-contaminated soil near electrical transformers by 2004
- Dispose of an additional 10,000 cubic meters (13,000 cubic yards) of soil offsite
- Release five acres for unrestricted use

As a result of its ongoing research activities, the Fermi National Accelerator Laboratory continues to generate and manage hazardous waste and small amounts of low-level and low-level mixed waste. The laboratory is estimated to generate approximately seven cubic meters (nine cubic yards) of low-level mixed waste through 2002 and 3,561 cubic meters (4,658 cubic yards) of low-level radioactive waste through 2070. In 1995, the Laboratory generated approximately 132 cubic meters (173 cubic yards) of hazardous waste. At that time, DOE also assumed Laboratory activities would generate approximately 6,444 cubic meters (8,428 cubic yards) of hazardous waste through 2070. DOE continues to manage these wastes under the RCRA Part B permit. Current expected annual waste generation levels, based on averages over the past five years, are 40 cubic meters of low-level radioactive waste and 50 cubic meters for regulated chemical wastes, such as, waste managed under RCRA, TSCA, or defined by Illinois Special Waste.

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

> ***LONG-TERM STEWARDSHIP GOALS***
>
> Post-closure monitoring and routine surveillance to ensure human health and environment continues to be protected, and compliance levels continue to be met.

The only long-term stewardship activities that will be required at the Fermi National Accelerator Laboratory are post-closure monitoring, including routine groundwater monitoring and environmental surveillance. The site will maintain institutional controls in the form of deed restrictions on any excavation of the remaining five solid waste management units, and will continue quarterly groundwater monitoring as required by Illinois EPA. Groundwater monitoring results and records are maintained at the site and are also provided to the regulators and to the public. The solid waste management units are inspected annually.

Fermilab has not detected contaminants in the groundwater aquifer. The CUB Tile Field, Meson Hill, and Meson-Neutrino Area will be subject to groundwater monitoring until 2013, as required by Illinois EPA. At the Meson and Neutrino Activated Area, DOE monitors the groundwater for low levels of radiological constituents (sodium-22 and tritium), which resulted from past accelerator operations at the laboratory, in the dolomite aquifer. The glacial till overlying the aquifer has low-levels of sodium-22 and tritium contamination in the soil. These contaminants are below the compliance standards established in DOE Order 5400.5, *Radiological Protection of the Environment*, and pose no hazard to human health. No new tritium source exists at these areas at Fermilab.

> ***STAKEHOLDER INVOLVEMENT***
>
> All groundwater monitoring quarterly reports provided to the State of Illinois, as required under the RCRA Part B permit, are made available to the public.

DOE plans to monitor the groundwater for these radiological constituents until 2013. Illinois EPA classifies this aquifer as a "class I" groundwater source because it is a source of drinking water and, therefore, subject to drinking water standards (which limit the amount of tritium to 20 picocuries per milliliter). These standards require monitoring for "class I" groundwater for radiological constituents. There is no standard for sodium-22. The tritium levels in the soil (0.2 to 0.3 picocuries per milliter) are at levels below the standard.

2.2 Specific Long-Term Stewardship Activities

Engineered Units

The concrete cap over contaminated soil near the Village Machine Shop will be maintained as a constructed barrier to prevent inhalation or ingestion of soil contaminants and to prevent any excavation of the soil. However, it is not intended to prevent the infiltration of groundwater. A deed restriction on any site soil excavation for this area is recorded with the County of DuPage. The cap, about six meters by 12 meters (20 feet by 40 feet), was placed only over soils where contamination was discovered at about 2.4 meters (eight feet) below the surface.

DOE does not anticipate that any new engineered units will be required for long-term stewardship. Removal of PCB-contaminated soil at transformer service buildings distributed around the 6.4-kilometer (four-mile) circle of the Tevatron is scheduled for completion in 2002 or 2003. Fermilab plans to clean the soils to the one part per million regulatory level. However, possible cap and deed restrictions may be required if soil cannot be

remediated to the one part per million level.

2.3 Regulatory Regime

Long-term surveillance activities of the Fermi National Accelerator Laboratory are governed by the RCRA Part B permit issued by the State of Illinois.

2.4 Assumptions and Uncertainties

The long-term surveillance and monitoring of the groundwater is assumed to consist of quarterly monitoring until 2013. No further actions will be required, and no further caps or deed restrictions will be imposed at the site, assuming no more contaminants are found in the groundwater.

3.0 ESTIMATED LONG-TERM STEWARDSHIP COSTS

Cost estimates are based current expenditure for quarterly groundwater monitoring requirements. These costs include operation and maintenance of 15 wells, as well as sampling and analytical costs. Total costs for the project have been borne by the DOE Office of Science since FY 98, when Fermilab participated in the first group of pilots to make the transition from programs funded by DOE's Office of Environmental Management (EM). DOE's Office of Science will continue to fund long-term stewardship costs.

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	*Amount*	*Year(s)*	*Amount*	*Year(s)*	*Amount*
FY 2000	$150,000	**FY 2008**	$150,000	**FY 2036-2040**	$0
FY 2001	$150,000	**FY 2009**	$150,000	**FY 2041-2045**	$0
FY 2002	$150,000	**FY 2010**	$150,000	**FY 2046-2050**	$0
FY 2003	$150,000	**FY 2011-2015**	$450,000	**FY 2051-2055**	$0
FY 2004	$150,000	**FY 2016-2020**	$0	**FY 2056-2060**	$0
FY 2005	$150,000	**FY 2021-2025**	$0	**FY 2061-2065**	$0
FY 2006	$150,000	**FY 2026-2030**	$0	**FY 2066-2070**	$0
FY 2007	$150,000	**FY 2031-2035**	$0		

4.0 FUTURE USES

The Fermi National Accelerator will continue to operate as a national high energy physics accelerator laboratory under the direction of DOE's Office of Science. Future use of the facility will remain industrial, with restricted access. At the completion of a DOE mission, it is anticipated that land use at the site will be a combination of open space, industrial, agricultural and residential with open space making up the majority of the site.

For additional information about Fermi National Accelerator Laboratory site, please contact:

Sally Arnold
U.S. Department of Energy, Fermi National Accelerator Laboratory Group
P.O. Box 2000
Batavia, Illinois, 60510
Phone: 630-840-2239
or visit the Internet website at http://www.fnal.gov.

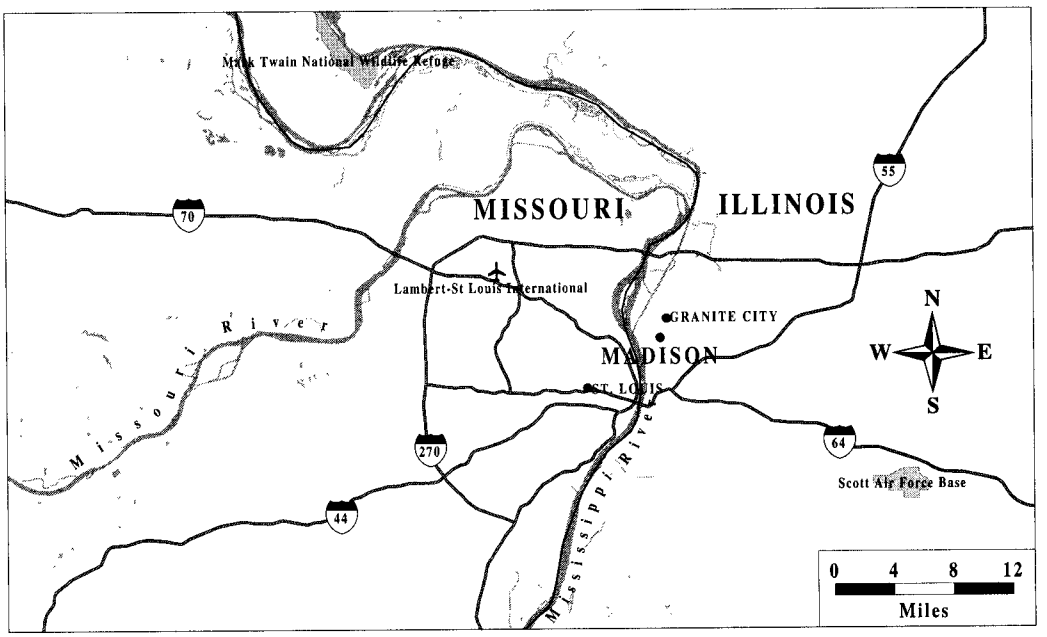
MADISON SITE [1]

SITE SUMMARY

The Madison Site (formerly known as the Dow Chemical Company Plant) performed fuel and target fabrication work for the Atomic Energy Commission (AEC), a predecessor agency to the U.S. Department of Energy, in the late 1950s and early 1960s. The Madison Site is located at an active industrial site in Madison, Illinois, across the Mississippi River from St. Louis, Missouri. The site consists of a large, multi-sectional complex of ten interconnecting buildings.

Dow Chemical Company operated the Madison Site under subcontract to Mallinckrodt Chemical Company, an AEC prime contractor. In the late 1950s, Dow Chemical Company performed research and development work at the site, which focused on gamma phase extrusion of uranium metal, and straightened Mallinckrodt-supplied uranium rods. In the late 1980s, a radiological survey indicated elevated concentrations of uranium and thorium in Buildings 4 and 6 (where the uranium extrusion and rod straightening work took place).

In the 1990s, the site was designated for cleanup under the Formerly Utilized Sites Remedial Action Program (FUSRAP). The Corps' remedial action for the Madison Site is not yet complete and, therefore, the extent of long-term stewardship required, if any, is not yet known.



Madison Site

[1] The Madison Site is one of the 21 Formerly Utilized Sites Remedial Action Program (FUSRAP) sites where cleanup responsibility was transferred to the U.S. Army Corps of Engineers (Corps) in accordance with the Energy and Water Development Appropriations Act for FY 1998. At these 21 sites, the Corps is responsible for remediation and DOE is responsible for long-term stewardship activities, if any are deemed necessary. The cleanup decisions for these sites are not yet final and, therefore, the extent of long-term stewardship required for these sites, if any, is not yet known.

For additional information about the Madison Site, please contact:

FUSRAP Project Office
St. Louis District
U.S. Army Corps of Engineers
8945 Latty Avenue
Berkeley, MO 63134
Phone: 314-260-3905
or visit the Internet website at: http://www.mvs.usace.army.mil/engr/fusrap/home2.htm

PALOS FOREST (SITE A/PLOT M) PRESERVE

1.0 SITE SUMMARY

1.1 Site Description and Mission

> ***LONG-TERM STEWARDSHIP HIGHLIGHTS***
>
> *Major Long-Term Stewardship Activities* - disposal cell monitoring; groundwater monitoring
> *Total Site Area* - 16 hectares (40 acres)
> *Volume of Residual Contaminants* - groundwater unknown; disposal cell 5,000 cubic meters (6,000 cubic yards)
> *Long-Term Stewardship Start-End Years* - 1997-in perpetuity
> *Average Annual Long-Term Stewardship Cost FY 2000-2006* - $170,000
> *Landlord* - Palos Forest Preserve District of Cook County, Illinois

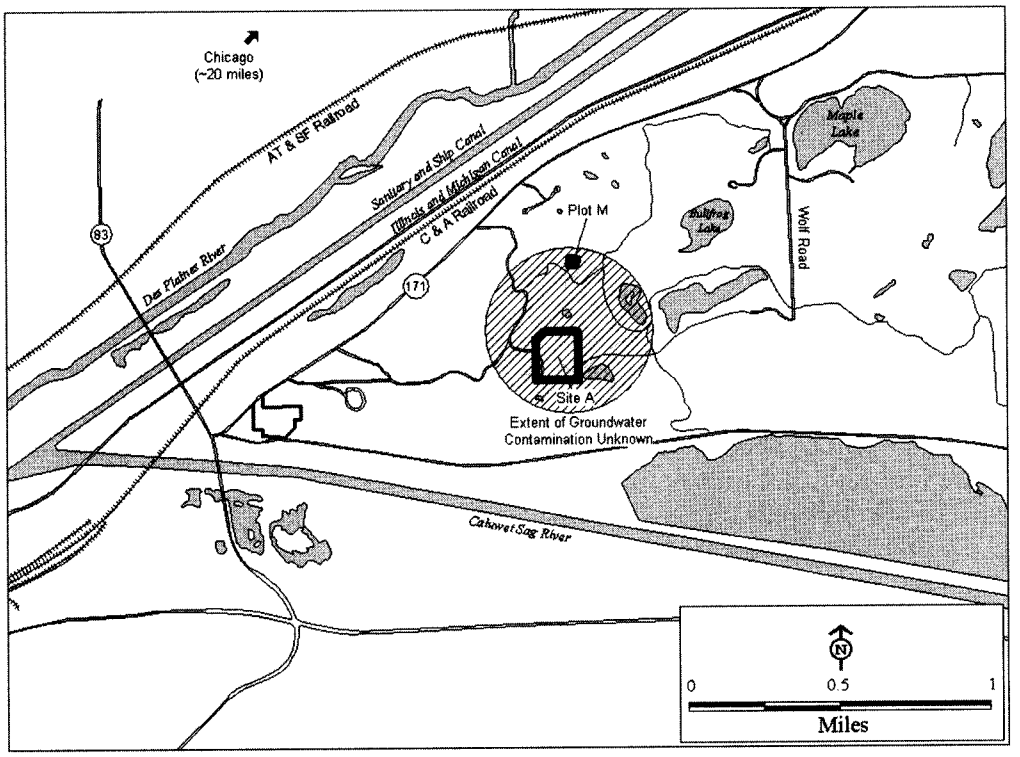
Palos Forest (Site A/Plot M) Preserve is situated on the former grounds of Argonne National Laboratory and its predecessor, the University of Chicago Metallurgical Laboratory. The site encompasses approximately 16 hectares (40 acres) within the Palos Forest Preserve in Cook County, Illinois. The region is densely forested and the site is accessible to the public by recreation trails. The site is located approximately 30 kilometers (20 miles) southwest of downtown Chicago. Site A is a 7.6-hectare (19-acre) area that contained early experimental laboratories and nuclear reactor facilities. Plot M is a nearly square-shaped area, measuring 46 meters (150 feet) by 43 meters (140 feet), located approximately 500 meters (1,600 feet) north of Site A. Plot M was used for burial of radioactive waste from experimental research conducted at Site A. The U.S. Department of Energy (DOE) completed surface remediation activities at Plot M in 1956, and at Site A in June 1997. Currently, Plot M contains a less than .4-hectare (one-acre) disposal cell with a concrete barrier and thick soil layer on top for erosion control. Site A currently contains buried contaminated building debris and the bioshields from the two nuclear reactors that formerly operated at the site.

The current mission of Palos Forest (Site A/Plot M) Preserve is performing long-term stewardship, including monitoring and maintaining the disposal cell and groundwater monitoring. DOE's Grand Junction Office conducts these activities. Palos Forest Preserve District of Cook County, Illinois owns the land, but DOE provides funding for long-term stewardship.

DOE leased Palos Forest (Site A/Plot M) Preserve from the owner, the Palos Forest Preserve District of Cook County, from 1942 to 1956. Site A contained two experimental reactors (i.e., the Chicago Pile CP-2 and CP-3 nuclear reactors) and associated research laboratories. Operations of both reactors at Site A ceased in 1954, and the reactors were defueled in 1955. Between 1944 and 1949, radioactive waste and contaminated laboratory equipment from these operations were buried in Plot M. Waste was buried in 2-meter (6-foot) deep trenches and was covered with soil until 1948, after which it was placed in steel bins and buried. The bins were relocated in 1949 to the Oak Ridge Reservation in Tennessee. Both Site A and Plot M were decommissioned in 1956 and later were returned to the Palos Forest Preserve District.

1.2 Site Cleanup and Accomplishments

As a result of past missions, both surface and subsurface (groundwater) contamination occurred at Site A. Surface soils at Site A contained residual radiological and heavy metal contamination. An area approximately 30 meters (100 feet) across and 15 meters (50 feet) deep was excavated between the two reactors and used for the disposal of contaminated building debris and the biological shield for the nuclear reactors (CP-2 and CP-3).



Palos Forest (SiteA/Plot M) Preserve

The area was then backfilled, leveled, and landscaped. Approximately 280 cubic meters (360 cubic yards) of soil containing contaminant concentrations above background levels was removed and disposed offsite at the U.S. Ecology Site in the State of Washington. The excavated areas were backfilled with low-permeability materials, covered with topsoil, and revegetated.

Disposal of radioactive waste also contaminated the groundwater beneath the burial area in Site A. The exact area of contamination is unknown; however, the groundwater plume has not migrated significantly. The primary contaminant consists of low concentrations of tritium. Therefore, groundwater monitoring is necessary to ensure that harmful levels of contamination are not migrating offsite. At this time, no plans exist for further remediation.

In June 1997, final remedial actions were completed, and an agreement was executed between DOE and the Palos Forest Preserve District to return Site A to the District. Site A was returned to the Forest Preserve District in June 1997 for unimproved recreational use by the public, with restrictions on building and digging.

Plot M was a series of burial trenches that received miscellaneous, radioactively contaminated laboratory wastes. Since the wastes were not well characterized, in-place encapsulation was considered the prudent approach. The buried wastes and contaminated soils were stabilized and isolated by backfilling and encasing the sides and top of the burial zone with concrete. The disposal area was surrounded by concrete walls 2.4 meters (8 feet) deep and 0.45 meters (1.5 feet) thick. In 1956, a 0.3-meter (one-foot) thick concrete cap was placed over the top of the entire disposal area. The concrete was covered with 0.6 meters (two feet) of soil and seeded with grass.

Groundwater below the Plot M disposal cell is contaminated with residual radiological and heavy metals. The

primary contaminant is tritium, and the highest levels of contamination exist directly beneath the buried waste as contaminated perched water zones. Although the perched water does not migrate significantly, tritium has been detected in the alluvial aquifer. Therefore, groundwater monitoring is necessary to ensure that harmful levels of contamination are not migrating offsite. At this time, no plans exist for further remediation.

In 1956, final remedial actions were completed and Plot M was returned to the Forest Preserve for unimproved recreational use by the public, with restrictions on building and digging.

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

Long-term stewardship activities include surveillance and maintenance of the disposal cell and monitoring the groundwater. New monitoring wells were completed at Site A and are now included in the long-term surveillance and monitoring program. DOE monitors the groundwater, surface water, soil, and air to ensure that there is no significant spread of contamination. The need to continue surveillance and maintenance activities will be evaluated in 2005. DOE's Grand Junction Office is responsible for long-term stewardship at the Palos Forest (Site A/Plot M) Preserve.

DOE maintains and updates specific records and reports required to document long-term stewardship activities at Palos Forest (Site A/Plot M) Preserve. Site records are kept in permanent storage at the DOE Grand Junction Office in Colorado. Types of records maintained include site characterization data, remedial action design information, the site completion report, long-term monitoring plans, annual inspection reports, and current and historic monitoring data. A report is submitted annually to the stakeholders.

2.2 Specific Long-Term Stewardship Activities

Groundwater

Groundwater is contaminated from the disposal of radioactive waste at both Site A and Plot M. Groundwater and surface water at both Site A and Plot M are currently being monitored and will continue to undergo annual monitoring until at least 2005.

STAKEHOLDER INVOLVEMENT

Community interaction has been minimal in recent years. Copies of the annual inspection report for Palos Forest (Site A/Plot M) Preserve and other sites are distributed to the local library and to any stakeholders requesting them. The report is also published on the DOE Grand Junction Office website at www.doegjpo.com.

Engineered Units

Site A contains buried contaminated building debris and the bioshields from the two nuclear reactors. Plot M contains one disposal cell encased in concrete with an inscribed granite marker on top. The purpose of the concrete barrier is to prevent people from digging into the waste and to impede the flow of water through the buried radioactive materials. Long-term stewardship activities include maintenance of sampling wells, evaluation of erosion, changes in vegetation, changes in local land use, evidence of subsidence, and other environmental parameters that may have an impact on site integrity.

2.3 Regulatory Regime

The primary standard governing long-term stewardship activities at Site A/Plot M is DOE Order 5400.5, "*Radiation Protection of the Public and the Environment,*" which establishes dose limits and radiological protection standards for workers and the public.

2.4 Assumptions and Uncertainties

Because the site has been monitored since 1997, long-term stewardship activities at the site are well known and are not expected to change dramatically. Sound scope and cost estimates for the long-term stewardship activities at the site have been developed. Groundwater monitoring will continue indefinitely or until cleanup levels are achieved and the disposal cell demonstrates infiltration control. In addition, the disposal cell cover is not expected to be replaced for a minimum of 200 years.

3.0 ESTIMATED LONG-TERM STEWARDSHIP COSTS

Estimated costs for long-term stewardship of the Palos Forest (Site A/Site M) are identified in the table below. The cost estimates are based on the actual cost of long-term stewardship activities at this site, including historic costs incurred while conducting actual surveillance and maintenance activities. Cost estimates also reflect the current site agreements and monitoring frequencies. Contingency costs, such as cap replacement, have not been incorporated into the cost estimates. Although costs are only estimated to fiscal year (FY) 2070, it is anticipated that long-term stewardship activities will be required in perpetuity.

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	***Amount***	***Year(s)***	***Amount***	***Year(s)***	***Amount***
FY 2000	$170,000	**FY 2008**	$170,000	**FY 2036-2040**	$850,000
FY 2001	$170,000	**FY 2009**	$170,000	**FY 2041-2045**	$850,000
FY 2002	$170,000	**FY 2010**	$170,000	**FY 2046-2050**	$850,000
FY 2003	$170,000	**FY 2011-2015**	$850,000	**FY 2051-2055**	$850,000
FY 2004	$170,000	**FY 2016-2020**	$850,000	**FY 2056-2060**	$850,000
FY 2005	$170,000	**FY 2021-2025**	$850,000	**FY 2061-2065**	$850,000
FY 2006	$170,000	**FY 2026-2030**	$850,000	**FY 2066-2070**	$850,000
FY 2007	$170,000	**FY 2031-2035**	$850,000		

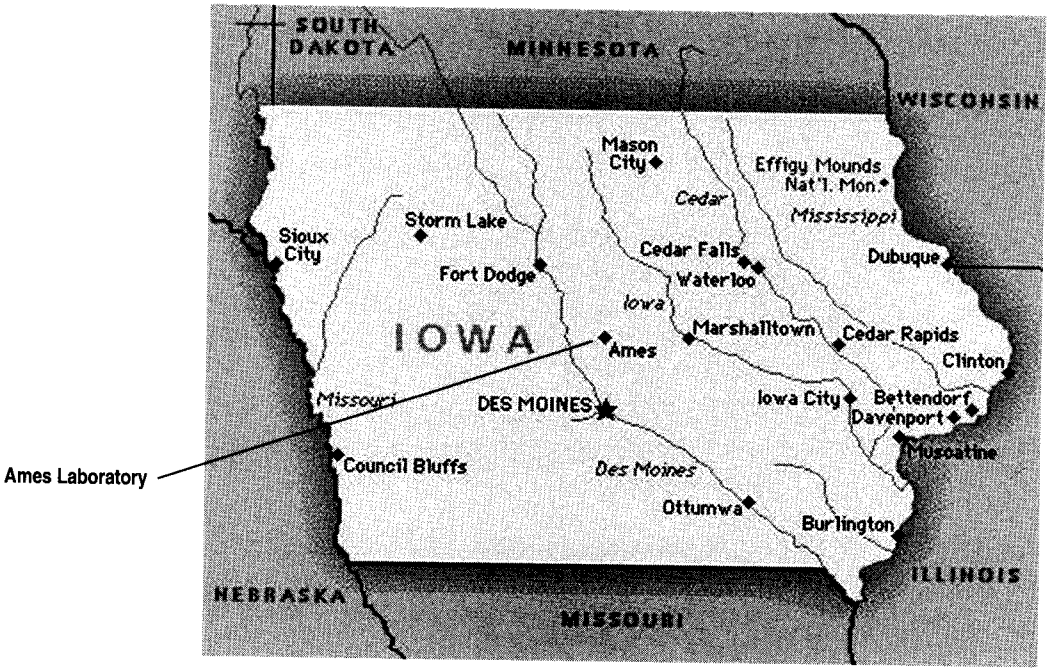
4.0 FUTURE USES

DOE's responsibility for this site will end when it is determined that no further surveillance and monitoring is needed. Unimproved recreational land use (i.e., no building or digging allowed) is expected to continue indefinitely.

For more information about the Palos Forest (Site A/ Plot M) Preserve, please contact:

Art Kleinrath, Long-Term Surveillance and Maintenance Program Manager
U.S. Department of Energy, Grand Junction Office
2597 B3/4 Road, Grand Junction, CO 81503
Phone: 970-248-6037
or visit the Internet website at http://www.doegjpo.com

Iowa



Site Highlights

Ames Laboratory (page 3)

Site Size - 4 hectares (10 acres)
Current Landlord - U.S. Department of Energy, Office of Science
Expected Future Landlord - U.S. Department of Energy, Office of Science

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Ames Laboratory 3

AMES LABORATORY[1]

1.0 SITE SUMMARY

1.1 Site Description and Mission

> ***LONG-TERM STEWARDSHIP HIGHLIGHTS***
>
> *Total Site Area* - 4 hectares (10 acres)
> *Current Landlord* - U.S. Department of Energy, Office of Science
> *Expected Future Landlord* - U.S. Department of Energy, Office of Science
> *Reason Not Subject to NDAA* - No long-term stewardship activities are anticipated for this site

Ames Laboratory is one of the 12 dedicated laboratories within the DOE complex. The Laboratory is located on the Iowa State University Campus in the town of Ames, Iowa. Iowa State University manages and operates the laboratory under a five-year contract to DOE, and leases this land to DOE. Iowa State University owns the land, and DOE owns the Ames Laboratory buildings. The four-hectare (ten-acre) site includes several research facilities, including a metallurgy research building, a records storage facility, a laboratory research building, a metals development building, an administrative building, and several small auxiliary buildings. The laboratory, at one time, maintained a dedicated Chemical Disposal Site (which was about 7,440-square meters (80,000 square feet) in size and located north of Ontario Street, off of Scholl Road, and east of the Ames Applied Sciences Complex). This disposal site has since been remediated and approved for unrestricted use.

Ames Laboratory was founded in 1947, following work to produce purified uranium for the Manhattan Project. Researchers at Iowa State University perfected a magnesium reduction process, producing pure uranium metal that quickly became the industry-wide standard for production of uranium metal in large quantities. Other universities and private companies participated in the research; however, Iowa State University was one of the first organizations to supply metallic uranium, used as "fuel" for the first self-sustaining chain reaction, to Enrico Fermi and his colleagues at the University of Chicago. The laboratory continues to provide basic and applied research to the U.S. Government.

Currently, DOE has an ongoing research mission at Ames Laboratory, and the site landlord is the DOE Office of Science. The laboratory's mission is to conduct fundamental research in the physical, chemical, materials, and mathematical sciences and engineering. Ames Laboratory also pursues broader research priorities in the areas of energy resources, high-performance computing, environmental technology development, and the synthesis and study of new materials. The laboratory and many of its staff continue to stay involved in the academic programs at Iowa State University.

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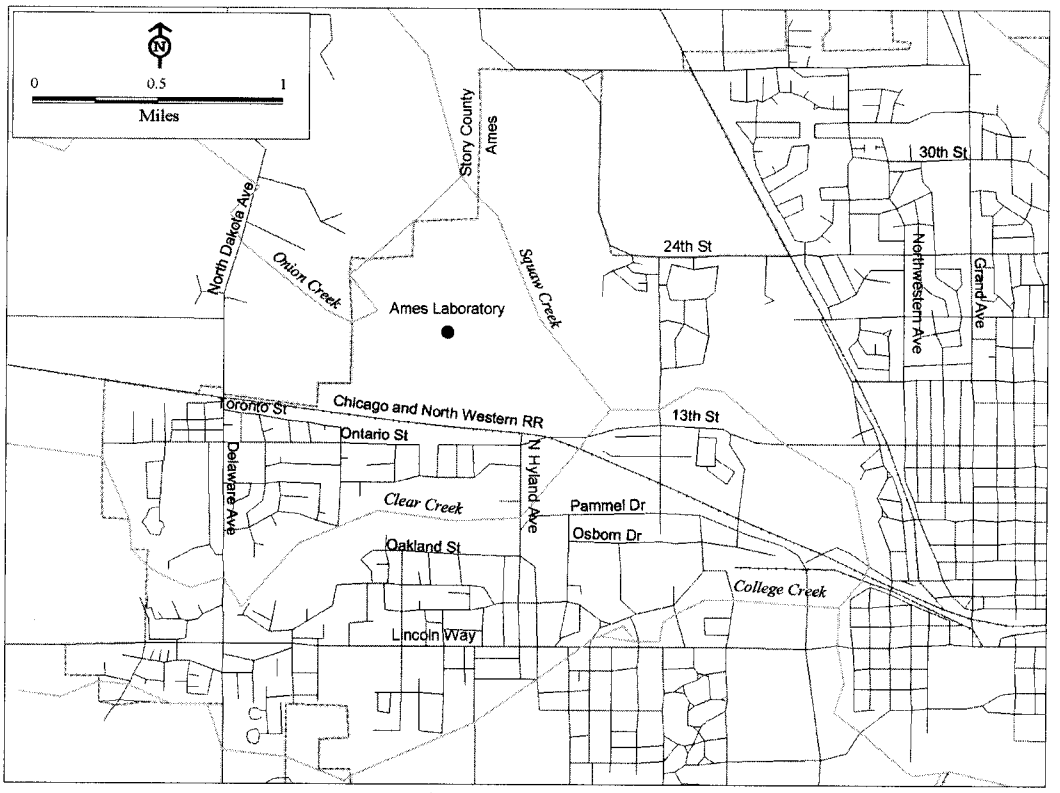
[1]This report is developed in response to a Congressional request in the Fiscal Year (FY) 2000 National Defense Authorization Act (NDAA). As requested by the Act, this report addresses current and anticipated long-term stewardship activities at each site or portion of a site by the end of calendar year 2006 ("Conference Report on S.1059, National Defense Authorization Act for Fiscal Year 2000," *Congressional Record,* August 5, 1999).

Based on current planning, all currently identified and planned remediation activities at the Ames Laboratory will be completed before 2006, and the site will not require long-term stewardship activities other than record-keeping activities. For this reason, the site is not the primary focus of this report. This summary of the site is included because the Department of Energy (DOE) has an ongoing mission at the site, has funded remediation activities in the past, and is responsible for completing remediation from previous laboratory activities.



Ames Laboratory

1.2 Site Cleanup and Accomplishments

DOE completed all currently identified remediation activities at Ames Laboratory in 1999. Past operations at Ames Laboratory, principally as a result of waste disposal practices, led to contamination of soils and groundwater. Contaminants of concern included uranium, thorium, tritium, mercury, thallium, potassium, lithium, and kerosene. Between 1958 and 1966, radiological and chemical wastes were buried in nine unlined pits at the Chemical Disposal Site (located at the southeast corner of the site). This disposal method met the regulatory standards at that time. The bulk of the disposed wastes was metal slags from the research and development of the processes for separating and purifying specific metals. Small quantities of reactive or unstable materials from routine chemical laboratory research, such as mercury, salts, potassium, and sodium, were also buried at the site. Waste was reportedly buried in steel pails, drums, glass containers, and plywood boxes.

In 1994, DOE spent $4 million to clean up the site, completing soil and groundwater assessment activities, and removing approximately 1,530 cubic meters (2,000 cubic yards) of contaminated soil and debris, which were sent to a commercial disposal site in Utah. In

SITE ACCOMPLISHMENTS

- Investigated nine inactive waste sites; those requiring remediation were completed
- Remediated former Chemical Disposal Site
- Sampled Old Iowa State College Dump and determined contamination was below action levels

ANTICIPATED SITE ACCOMPLISHMENTS AS OF 2006

- Complete groundwater monitoring at former Chemical Disposal Site
- Dispose of Iowa State University Fire Training site soils offsite

1998, the Iowa Department of Public Health approved the site for unrestricted use. Groundwater monitoring of the site, however, will continue through 2002, as approved in a monitoring plan agreed to by DOE, the U.S. Environmental Protection Agency, and Iowa State University. DOE provided a lump-sum payment of $50,000 for Iowa State University to conduct post-remediation monitoring at the former Chemical Disposal Site and complete closeout activities.

DOE has treated and disposed offsite all newly-generated waste at the Ames Laboratory. Regarding the Ames Laboratory facilities, DOE assumes that the DOE Office of Science will be responsible for any future decontamination, environmental remediation, land use issues, and long-term stewardship activities that may be identified in the future. However, there are no long-term stewardship activities identified for the actions currently planned to be completed by the end of 2006.

In addition to the cleanup work on the former Chemical Disposal Site, nine other waste sites were investigated, and those requiring remediation were completed in FY 1995 and FY 1996. One underground storage tank action was also completed at that time. The intent of these investigations was to determine if any of the nine sites had been impacted by previous Ames Laboratory activities. Although the concentrations at some of the inactive waste sites are slightly above background levels, information collected to date indicates that the sites do not pose a significant health risk in their present land uses. No further activities are currently envisioned for any of these waste sites. The nine inactive waste sites are: Old Sewage Treatment Plant; Ames Airport; Ames Municipal Cemetery; Grand Avenue Underpass; Annex I; Annex II; Little Ankeny Debris Site; Applied Science Complex; and Blockhouse.

Four of the nine waste sites (Old Sewage Treatment Plant, Ames Airport, Grand Avenue Underpass, and Ames Municipal Cemetery) were characterized due to higher than expected releases of material to the Old Sewage Treatment Plant (formerly City of Ames Water Pollution Control Plant) in 1951 and 1952. The Old Sewage Treatment Plant received effluent containing low levels of mesothorium, a daughter product of thorium decay. The effluent was treated as routine sanitary sewage, i.e., the plant discharged the liquid effluent and produced a dry sludge which was used for fertilizer. As a result of the treatment process, the mesothorium was concentrated primarily in the dry sludge. The dry sludge produced during this period is known to have been stored at the Old Sewage Treatment Plant and spread at the Ames Airport. The Grand Avenue Underpass and Ames Municipal Cemetery also had permits to spread this material. DOE does not know if any of the impacted sludge was spread in these areas.

The Old Sewage Treatment Plant is inactive and much of the plant has been demolished. Several kinds of sampling and surveying (soil sampling, surface gamma surveying, and aerial gamma surveying) have been performed since 1976. In 1988, soil was removed from some contaminated areas at this site and disposed of offsite. Subsequent sampling and surveying in 1993 indicated soil and groundwater activity levels slightly above background but below acceptable DOE (soil) and Iowa Administrative Code (groundwater) levels. Additional sampling and analysis was performed by the Oak Ridge Institute for Science in 1994, in response to stakeholder concerns, with similar results. Remedial activities were performed by the City of Ames, under the guidance of the Iowa Department of Public Health, in the fall of 1994.

Sampling and surveying performed at the Ames Airport in 1976 indicated readings above background in some areas. Subsequent surveying and groundwater sampling (in 1992 and 1993) showed soils at background radiation levels and groundwater below isotope detection limits. Extensive construction activities have occurred at this location, which probably spread and diluted any contaminated soil. Available data indicate that the site does not pose a threat to public health or the environment in its current land use.

Sampling and surveying at the Ames Cemetery and Grand Avenue Underpass indicated readings within the range of naturally-occurring levels.

Three of the inactive waste sites (Annex I, Annex II, and Little Ankeny Debris Site) were related to the production of uranium as part of the Manhattan Project. All three sites are on Iowa State University property. Annex I and Annex II were buildings that subsequently were razed. Little Ankeny Debris Site is the location where debris from Annex I was burned after its demolition in 1953. The Annex I site now is largely covered by vegetation, and a portion of the site is occupied by the Iowa State University Food Technology Laboratory. The Annex II site is paved over and is used as a parking lot for the Iowa State University Physical Plant Building. The ash from the Little Ankeny Debris Site, which was placed in a depression in the ground and covered with soil, was removed from the site in 1987 and shipped to DOE's Hanford site for disposal. Surveys and sampling in 1976, 1977 and 1993 indicated background levels for the Annex II site and the presence of some residual contamination at the Annex I and Little Ankeny Debris Site. However, data collected to date indicate that none of the sites poses a significant health risk in its present land use.

The Applied Science Complex, plus its auxiliary structures for radioactive waste management, its cooling towers, and its liquid waste treatment and discharge systems, was the former site of the Ames Laboratory Research Reactor, which operated from 1965 until 1977. Decommissioning was conducted from 1978 to 1980, with dismantlement and removal of all reactor equipment and materials. The leased property subsequently was transferred back to Iowa State University. Subsequent sampling, analysis, and surveying in 1987 indicated the need for a few areas to be cleaned in the reactor building basement and for shielding and marking of abandoned drain lines. The radioactive waste disposal building and warehouse building are still in use by Iowa State University. The available data indicate that there is no public health threat under current land use.

The Blockhouse site was a 22 square meter (240-square-foot) concrete block building that was used from the mid-1960s to the early 1980s for handling of radioactive wastes. The site is owned by Iowa State University. The building (except for the concrete floor slab) was demolished around 1988. The concrete floor slab predated the rest of the building. Residual radioactive contamination was removed from the pad, as well as some soils contaminated by a heating oil spill. Surveys and analyses in 1993 resulted in offsite disposal of an old cinder block. The available data indicate that there is no public health threat under current land use.

The two-hectare (five-acre) tract of land at 13th Street and Stange Road in Ames was another area of concern. In the early 1940s, wastes from the Laboratory and the Manhattan Project were disposed there. In 1946, the U.S. Atomic Energy Commission (the predecessor agency to DOE) removed 226.8 metric tons (250 tons) of uranium extraction wastes from the site for processing. In response to stakeholder concerns at a public meeting in 1995, DOE agreed that the radiological portion of the site should be sampled to determine if a threat to human health and the environment existed. In August 1995, DOE completed the sampling, which showed that contamination levels were below "action levels" for thorium, uranium, and their decay products and, therefore, posed no threat to human health or the environment. DOE then sent the sampling results to the Iowa Department of Public Health in September 1995. DOE considered the radiological investigation closed. The Iowa Department of Public Health did not formally respond to the sampling report; however, the Department did forward the document to Iowa State University. In a November 2, 1995 cover letter, the Iowa Department of Public Health indicated that it was waiting for Iowa State University, as the licensee, to review the sampling data and issue a written synopsis of its conclusions. Once it received the University's conclusions, the Iowa Department of Public Health would then write a site status determination. In 1999, no discussions between DOE, the Iowa Department of Public Health, or Iowa State University occurred concerning this area. DOE assumes, based on the sampling results and on the absence of a follow-on response from the University, that no further activities are required for this area.

Two remaining cleanup activities are the characterization and decontamination of Ames Laboratory Wilhelm Hall and the remediation of the Iowa State University Fire Service Training Institute Site. During the late 1940's and early 1950's, research activities on thorium-232 were conducted in Wilhelm Hall. Although these activities ceased long ago, legacy contamination has been identified. DOE has controlled the contamination, which is limited to remote sealed areas of the building. Initial characterization indicates that the contamination does not pose a health hazard to current occupants of the building. At this time, Wilhelm Hall is an active facility. There are no known plans or known available funding to conduct additional characterization activities and decontamination of Wilhelm Hall prior to FY 2006.

The Iowa State University Fire Service Training Institute Site has a non-continuous layer of calcified soil, of variable thickness, that is contaminated with areas of thorium decay products. The contaminated materials were under a thin layer of topsoil. Iowa State University has undertaken action to characterize and remediate the site by excavation of material. DOE has agreed to provide assistance with disposal of the contaminated soil. Iowa State University's immediate plans are to continue to use the area as a training facility for fire fighters. The excavated soils are expected to be removed in fiscal year (FY) 2000 or FY 2001, with no continuing monitoring planned.

2.0 POTENTIAL LONG-TERM STEWARDSHIP ACTIVITIES

DOE assumes there will be no long-term stewardship activities for the actions currently planned to be completed by the end of 2006, nor for the site areas remediated after their active use comes to an end.

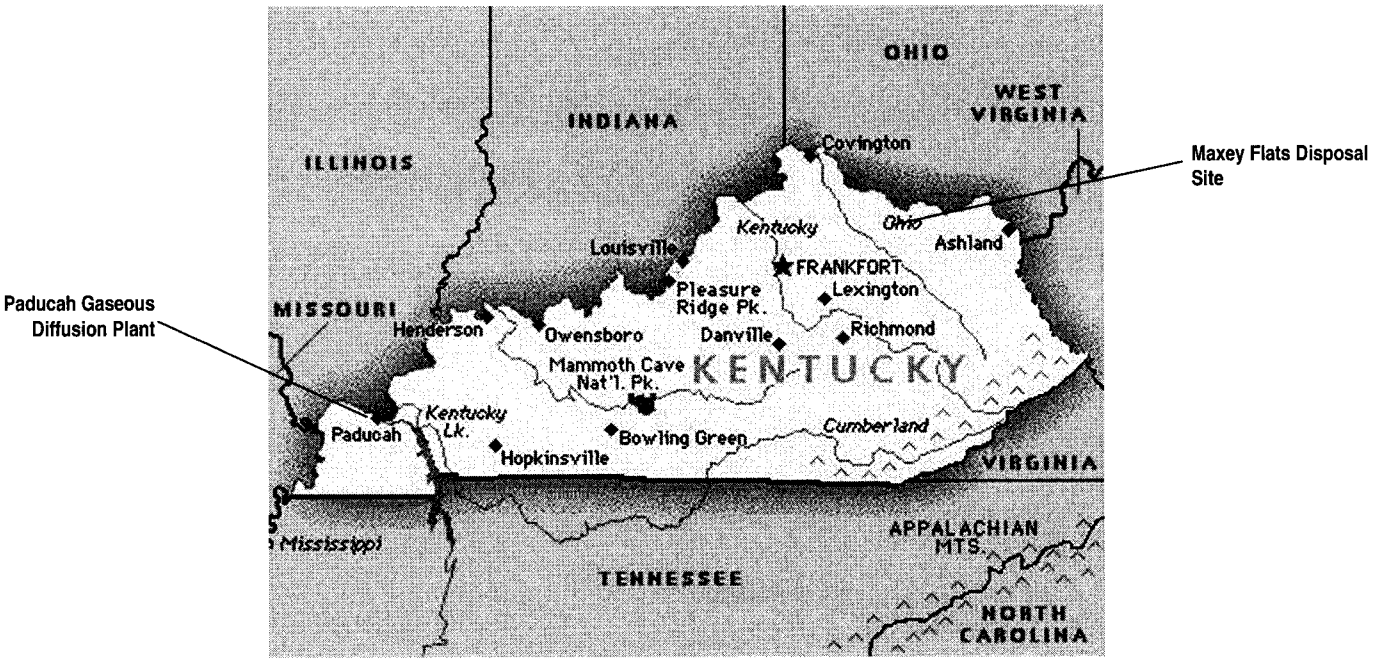
3.0 EXPECTED FUTURE USES AND SITE RESPONSIBILITY

When DOE's lease expires, the land will revert to Iowa State University, for unrestricted use (unless Iowa State University requests an alternate arrangement).

For additional information about the Ames Laboratory, please contact:

James Buchar
DOE Group Manager, Ames Group
9800 South Cass Avenue
Argonne, IL 60430
Phone: 630-282-2402
or visit the Internet website at: http://www.external.ameslab.gov

Kentucky



Long-Term Stewardship Site Highlights

Maxey Flats Disposal Site (page 3)

Site Size - 364 hectares (900 acres)
Current Landlord - Commonwealth of Kentucky
Expected Start Year - 2003
Expected Future Landlord - Commonwealth of Kentucky

Paducah Gaseous Diffusion Plant (page 7)

Major Activities - engineered caps, groundwater, and surface water monitoring; maintenance; institutional control enforcement
Site Size - 1,385 hectares (3,423 acres)
Start/End Years - 2000/in perpetuity
Estimated Average Annual Cost FY 2000-2006 - $6,495,000

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Paducah Gaseous Diffusion Plant 7

MAXEY FLATS DISPOSAL SITE[1]

1.0 SITE SUMMARY

1.1 Site Description and Mission

The Maxey Flats Disposal Site accepted low-level radioactive waste for disposal from government and private entities from across the United States (research laboratories, electric utilities, government and private health-care facilities, manufacturing companies, and nuclear powerplants). The disposal site is located approximately 14 kilometers (9 miles) northwest of Morehead, Kentucky, and 104 kilometers (65 miles) northeast of Lexington, Kentucky. The Commonwealth of Kentucky owns the 364-hectare (900-acre) site. The site was opened under a lease arrangement between the Commonwealth of Kentucky and the Nuclear Engineering Company (now U.S. Ecology, Inc.) of Louisville, Kentucky, in January 1963.

SITE HIGHLIGHTS

Total Site Area - 364 hectares (900 acres)
Estimated Volume of Residual Contaminants - disposal cell 142,000 cubic meters (186,000 cubic yards)
Current Landlord - Commonwealth of Kentucky
Expected Long-Term Stewardship Start Year - 2003
Expected Future Landlord - Commonwealth of Kentucky
Reason Not Subject to NDAA Requirements - DOE is not expected to be responsible for long-term stewardship at the site

Low-level radioactive waste was buried in 51 trenches measuring up to 198 meters (650 feet) long, 21 meters (70 feet) wide, and 9 meters (30 feet) deep. By the time disposal operations ended in 1977, Maxey Flats had accepted a total of approximately 142,500 cubic meters (186,675 cubic yards) of low-level radioactive waste.

Currently, the site is undergoing remedial action, which is expected to be complete by 2003. At that time, the Commonwealth of Kentucky will assume all responsibility for long-term stewardship needs, such as monitoring, surveillance, and maintenance.

1.2 Site Cleanup and Accomplishments

The waste disposed at the site consisted of approximately 242 metric tons (533,000 pounds) of source material (consisting of uranium and thorium or ores), 2.5 megacuries of byproduct materials, and 0.43 metric tons (950 pounds) of special nuclear material (plutonium and enriched uranium). During the operation of the facility, workers capped each disposal trench with a layer of soil after it was filled, but the earth eventually collapsed into the ditches. Water collected in the trenches, leaching radionuclides into the surrounding environment.

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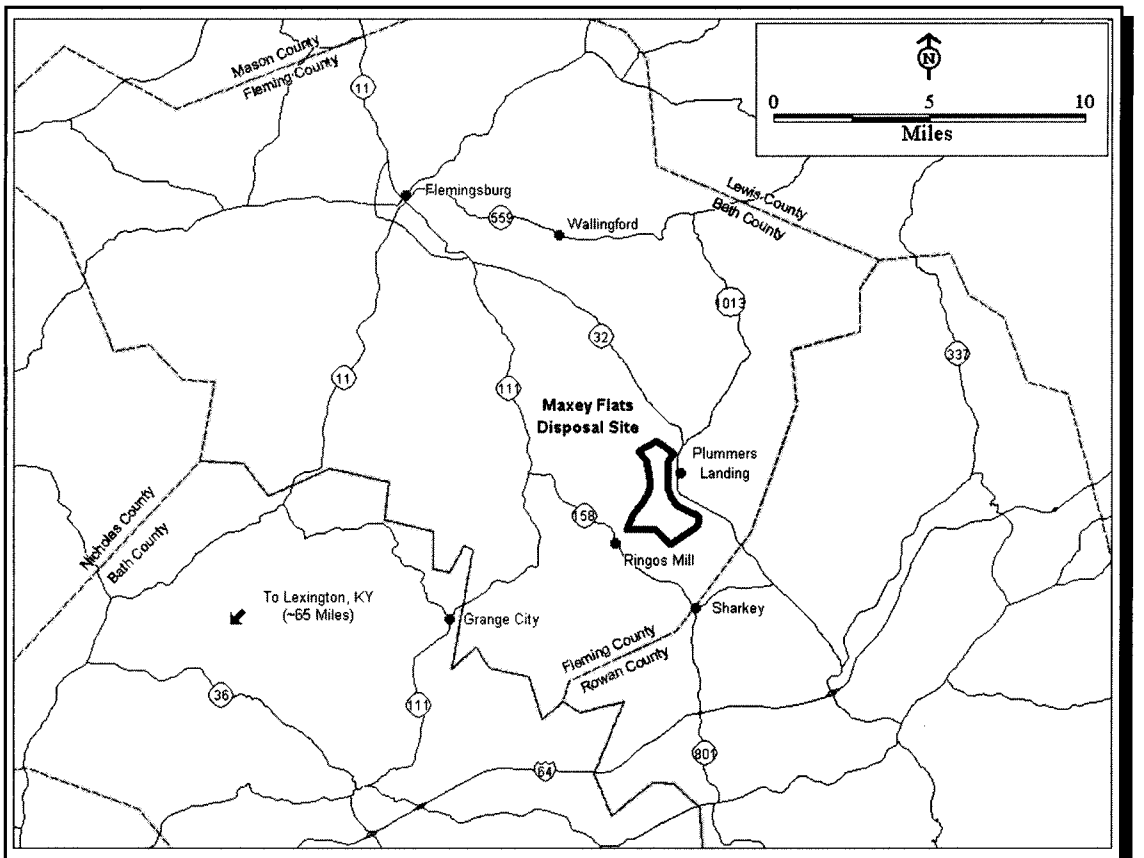
[1]This report is developed in response to a Congressional request in the Fiscal Year (FY) 2000 National Defense Authorization Act (NDAA). As requested by the Act, this report addresses current and anticipated long-term stewardship activities at each site or portion of a site by the end of calendar year 2006 ("Conference Report on S.1059, National Defense Authorization Act for Fiscal Year 2000," *Congressional Record,* August 5, 1999).

Based on current planning, the U.S. Department of Energy is not expected to be responsible for the long-term stewardship activities at the Maxey Flats Disposal Site. However, since DOE sent waste to the disposal site and was identified as a potentially responsible party, a description of the site and possible long-term stewardship responsibilities are included. (See Section 2.1.2 of Volume I).



Maxey Flats Disposal Site

In 1986, the U.S. Environmental Protection Agency (EPA) notified 832 potentially responsible parties, including DOE, that the EPA had placed the Maxey Flats Disposal Site on the National Priorities List. Other potentially responsible parties include other federal agencies, federal contractors, medical facilities, physicians, clinics, industry, state agencies, transporters, broker/haulers, and the land owner. In accordance with the *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA) Record of Decision, cleanup levels will be achieved through natural stabilization, with low-level waste remaining on site in the subsurface and in above-ground vaults.

The selected remedy includes extraction, solidification, and onsite disposal of approximately 3.8 million liters (1 million gallons) of radioactive trench leachate in the Earth Mounded Concrete Bunkers; construction of a temporary cap (intended to last 100 years) composed of a synthetic liner; and construction of a final cap once the waste is stabilized. The final cap will cover both the trenches and the Earth Mounded Concrete Bunkers. The stabilized waste will remain in the above-ground bunkers (i.e., Earth Mounded Concrete Bunkers). All site structures will be demolished and the site will be regraded.

ACCOMPLISHMENTS

- Earth Mounded Concrete Bunkers have been constructed for onsite waste disposal
- The majority of trench leachate material has been extracted, solidified, and disposed

BY 2006 MAXEY FLATS DISPOSAL SITE WILL HAVE:

- Completed trench leachate extraction, solidification, and disposal
- Regraded the site and extended the synthetic liner

Primary contaminants of concern in the ground and surface water include radionuclides, primarily tritium. Surface water control systems have been installed to limit infiltration and to control surface water runoff. Water monitoring equipment, as part of an Infiltration Monitoring System, will be installed in trenches and within wells, to detect potential accumulation of leachate in trenches.

As a potentially responsible party, DOE is responsible for approximately forty percent of the remediation costs. This responsibility will cease when the interim cap is in place and the initial closure construction support activities are complete. DOE assumes that these activities will be complete by 2003. DOE anticipates no further liability once it has made the final payment, currently scheduled for 2003.

2.0 POTENTIAL LONG-TERM STEWARDSHIP ACTIVITIES

The Commonwealth of Kentucky is responsible for long-term stewardship, including surveillance, maintenance, and monitoring of stabilized waste, as stated in the Consent Decree developed between the potentially responsible parties. Currently, the Maxey Flats Disposal Site is fenced to control access. As part of long-term stewardship, the Commonwealth of Kentucky will continue to maintain and repair the fence, as needed. The Commonwealth of Kentucky will also be responsible for maintaining and updating site records. Types of records include site characterization data, remedial action design information, the site completion report, long-term monitoring plans, annual inspection reports, and current and historic monitoring data.

The interim cap will cover approximately 26 hectares (65 acres) of the site. Upon completion of the interim cap, intensive monitoring will be conducted for two five-year periods to evaluate the need for additional remedial action. Erosion and runoff controls will be improved. A final cap will be placed over the site after disposal trenches have subsided and waste has had sufficient time to stabilize. In accordance with CERCLA, five-year reviews will be required, as well as cap maintenance and inspection.

Ground and surface water will be monitored in trenches and within wells to detect potential accumulation of leachate. Radionuclide testing of groundwater and surface water will be performed, as appropriate, on a routine basis.

3.0 EXPECTED FUTURE USES AND SITE RESPONSIBILITY

Maxey Flats will remain a permanent low-level waste disposal site under controlled access. The site is currently managed by the landlord, Commonwealth of Kentucky. DOE has no control or management responsibility. As of 2003, DOE anticipates no further liability because it will have fulfilled its responsibilities as a potentially responsible party.

For additional information about the Maxey Flats Disposal Site, please contact:

Fazi Sherkat, Manager
Superfund Branch
Kentucky Division of Waste Management
14 Reilly Road
Frankfort, KY 40601
Phone: 502-564-6716

Paul Beam
U.S. Department of Energy
Office of Technical Program Integration
EM-22, Room 2151
Germantown, MD 20874
Phone: 301-903-8133

or visit the Internet website at http://www.nr.state.ky.us/nrepc/dep/waste/dwmhome.htm

PADUCAH GASEOUS DIFFUSION PLANT

1.0 SITE SUMMARY

1.1 Site Description and Mission

The Paducah Gaseous Diffusion Plant enriches uranium for use in commercial nuclear facilities (formerly for the U.S. Department of Energy (DOE) and its predecessor agencies). The plant is located on a 1,385-hectare (3,423-acre) reservation owned by DOE, approximately eight kilometers (five miles) west of the City of Paducah, Kentucky. The gaseous diffusion plant itself is located within an industrialized, security-controlled area that comprises 304 hectares (750 acres), roughly in the center of the reservation. The plant began operating in 1952, supplying enriched uranium through a gaseous diffusion process for both government and commercial nuclear fuel needs. In 1992, Congress passed the *Energy Policy Act* and, under its provisions, DOE leased the uranium enrichment operations at Paducah to the United States Enrichment Corporation (USEC). However, the Act required DOE to retain responsibility for remedial action of environmental releases and for decontamination and decommissioning of facilities. Uranium enrichment operations and related waste disposal activities at Paducah resulted in both onsite and offsite contamination of the environment with radiological and chemical substances. Investigation of offsite contamination was initiated in 1988. DOE is currently conducting remediation activities and anticipates completion by 2010.

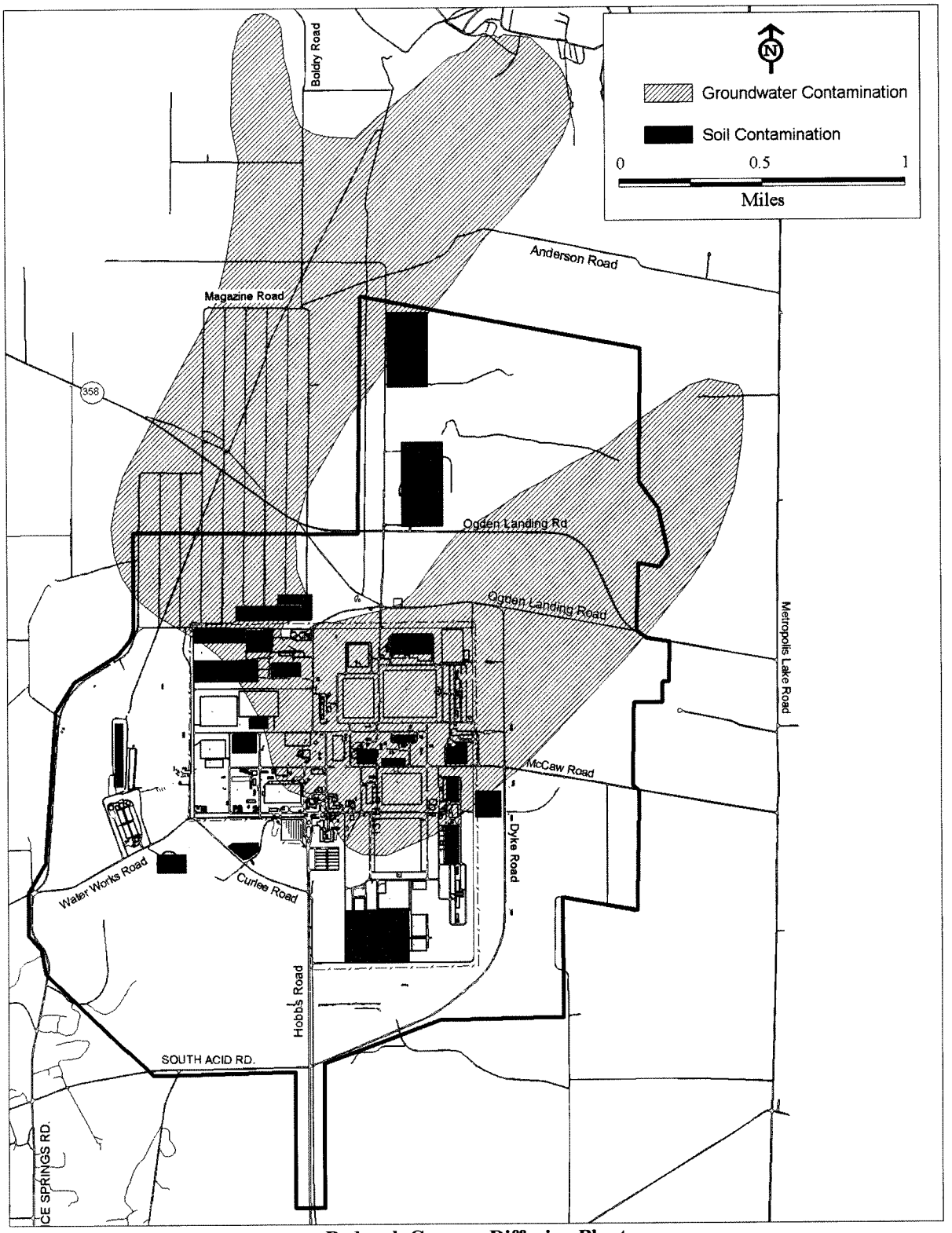
LONG-TERM STEWARDSHIP HIGHLIGHTS

Major Long-Term Stewardship Activities - engineered cap, groundwater, and surface water monitoring; maintenance; institutional control enforcement
Total Site Area - 1,385 hectares (3,423 acres)
**Estimated Volume of Residual Contaminants* - soil 1.2 million cubic meters (1.6 million cubic yards); groundwater 23,000 cubic meters (30,000 cubic yards); engineered units unknown; facilities unknown; surface water/sediments unknown
Long-Term Stewardship Start-End Years - 2000-in perpetuity
Average Annual Long-Term Stewardship Cost FY 2000-2006 - $6,495,000
Landlord - U.S. Department of Energy, Office of Nuclear Energy (Uranium enrichment facilities leased to United States Enrichment Corporation)
*The estimated volume indicates only the known amounts of residual contaminants. For certain portions discussed for this site, exact volume is not known at this point. For specific discussions, please see Section 2.2.

Presently, the site supports three missions: (1) continued enrichment of uranium by USEC for use in commercial nuclear facilities; (2) ongoing environmental restoration and related waste management activities by DOE's Office of Environmental Management; and (3) continued interim storage of depleted uranium hexaflouride until a conversion facility is constructed. Current long-term stewardship activities include monitoring surface water, groundwater, and capped landfills. Once remediation is complete, the long-term stewardship activities will also include monitoring and maintaining engineered controls and enforcing institutional controls.

1.2 Site Cleanup and Accomplishments

In May 1994, the U.S. Environmental Protection Agency (EPA) placed the Paducah site on its National Priorities List, thereby establishing it as a high priority for cleanup under the *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA). Currently, DOE is conducting cleanup activities under the conditions established in a Federal Facility Agreement signed by DOE, EPA, and the Commonwealth of Kentucky. The Federal Facility Agreement coordinates cleanup activities conducted at the site under both the *Resource Conservation and Recovery Act of 1976* (RCRA) and CERCLA regulations.



Paducah Gaseous Diffusion Plant

The cleanup strategy at Paducah consists of a multi-phase process:

1) Mitigate immediate risks, both onsite and offsite;
2) Reduce further migration of offsite contamination;
3) Address onsite sources of offsite contamination;
4) Address the remaining areas of onsite contamination; and
5) Complete decontamination and decommissioning of the DOE facilities.

Site-wide, DOE has made significant progress in characterizing site problems and implementing interim actions to address immediate threats and reduce further migration of offsite contamination (e.g., supplied alternate drinking water to affected residents, construction and operation of two offsite groundwater extraction and treatment systems). Now that those initial threats are under control, the focus of the cleanup program is shifting to the onsite source areas. As the first step, DOE completed an extensive investigation effort to identify and characterize the primary sources of groundwater contamination in 2000.

Another significant action currently underway includes removal of a pile of contaminated scrap metal (crushed drums), known as Drum Mountain, in 2000 and disposal of the packaged waste in early 2001. This area has been identified as a potential source of offsite contamination and geographically overlies several burial grounds that are of high priority. The primary field work at Drum Mountain was completed in September 2000. Removal of Drum Mountain will represent about 10 percent of the total contaminated scrap metal stored at the site. DOE and the regulatory agencies have established a baseline schedule for removing the remaining scrap metal by 2004.

During past operations, RCRA hazardous wastes, hazardous constituents, and hazardous substances were released into the environment in areas such as burial grounds, spill sites, landfarms, surface impoundments, and underground storage tanks. Releases from some source areas have migrated into the surrounding soils, underlying groundwater, and adjacent surface water and sediments.

The primary contaminants of concern in soils at Paducah include trichloroethylene (TCE), polychlorinated biphenyl (PCBs), and radionuclides. Since characterization of the soils has not been completed, the total volume of contaminated soils has yet to be determined. However, analyses to date indicate that approximately 80 hectares (200 acres) of soils are impacted by residual contamination. Cleanup of the surface soils focuses on addressing risks to onsite industrial workers and offsite receptors potentially exposed through contaminant migration. DOE will remediate areas within the security fence and the buffer zone to industrial cleanup levels and areas outside of the fence to recreational levels. Soil contamination is planned for excavation. In accordance with EPA's *Toxic Substances Control Act* cleanup level regulations, DOE's current assumption is to cleanup PCBs to 10-25 parts per million (for industrialized areas for human health risk) and remediate radionuclides to 15-25 millirem per year. However, the Commonwealth of Kentucky has suggested PCB cleanup levels as low as one part per million for human health. This issue is unresolved, and the outcome could have a significant impact on the amount of residual contamination remaining in place. The primary goal is to conduct cleanup or stabilization activities that

ACCOMPLISHMENTS

- Eliminated imminent threats by providing residents alternate drinking water
- Reduced further migration of offsite groundwater contamination through installation of pump and treat systems
- Completed remedial investigations for the major Dense Non-Aqueous Phase Liquid (DNAPL) sources of offsite contamination

BY 2006 PADUCAH WILL HAVE:

- Completed removal of 65,000 tons of scrap metal
- Completed remedial construction for cleanup of groundwater sources
- Completed remediation activities of contamination of the North-South Diversion Ditch

will reduce contamination to levels allowing maximum reuse of the industrialized area with minimal institutional controls.

Due to past operations at Paducah, groundwater contamination from dense non-aqueous phase liquids (DNAPLs) consisting of TCE is a long-term source of concern. The groundwater plumes extend over 930 hectares (2,300 acres), both on and off the site, affecting approximately 23,000 cubic meters (30,000 cubic yards) of groundwater. The offsite contamination has spread into a residential use area, where DOE has provided an alternative, public water supply. DOE is currently mitigating the high-concentration portions of the offsite plumes through pump-and-treat operations and monitoring of the groundwater plumes, both onsite and offsite. DOE is conducting a feasibility study to identify and evaluate groundwater treatment alternatives, including treatment of groundwater contamination sources. The final remediation strategy for this contamination has not been selected; however, offsite groundwater will be remediated to residential cleanup levels. The target cleanup levels for the contaminants of concern, TCE and technetium-99 (Tc-99), are five parts per billion and four millirem per year, respectively. Onsite groundwater pumping, treating, and monitoring will continue. The response action for this contamination will likely include containment of source areas, mass removal of high-concentration areas, and natural attenuation of the lower concentration, dissolved-phase plume.

Surface water and sediments covering 26 hectares (65 acres) in the Big and Little Bayou watersheds (both on and off the site) are contaminated with PCBs, radionuclides, and metals. DOE's strategy is to protect both the ecosystem and recreational users of the Big and Little Bayou watersheds. DOE has not completed the remedial investigation of the surface water and sediment contamination. Consequently, neither a detailed description of the nature and extent of contamination nor any estimate of the expected remedial strategy and levels of residual contamination are available at this time. In addition, DOE and the Commonwealth of Kentucky have not agreed upon a cleanup standard for PCBs, which will significantly affect the amount of contamination remaining after cleanup activities are complete. The Commonwealth of Kentucky has suggested levels significantly below (in comparison to the levels proposed for surface soils posing human health risks) one part per million for PCBs in sediments posing ecological risks. In the meantime, surface waters are monitored, and postings (e.g., instructional signs stating what one can and cannot do), fences, and deed restrictions currently protect against improper use of surface water. There are also fish advisories posted in Little Bayou Creek, which runs through the Western Kentucky Wildlife Management Area.

Engineered units at Paducah include three closed industrial/solid waste landfills, one currently operational industrial/solid waste landfill, and one proposed onsite disposal cell. The three closed landfills are capped and monitored in accordance with the state RCRA regulations. The active landfill is assumed to continue operations until 2005, at which time it will be closed in accordance with state RCRA regulations. The proposed onsite disposal cell is a very preliminary remedial action strategy that has not been formally approved by DOE, regulators, or other affected parties. This onsite disposal cell would contain approximately 1.1 million cubic meters (1.5 million cubic yards) of decontamination and decommissioning and other material generated by Paducah cleanup projects. Formal closure of this onsite disposal cell would be managed under CERCLA.

Most of the uranium processing facilities at the Paducah site remain operational; only two have been transferred to DOE's Environmental Management program for cleanup. These two facilities, known as "C-410 and C-340," comprise 26,000 square meters (280,000 square feet) and have not undergone detailed characterization. However, the buildings and subsurface soils are likely to be radioactively contaminated due to uranium trioxide conversion and uranium hexafluoride reduction operations. The goal for cleaning up these facilities is to decontaminate and demolish them and maximize industrial reuse of the remaining land, with minimal institutional controls, by 2010.

There are four active diffusion cascade buildings (more than 186,000 square meters (2 million square feet)),

portions of which are potentially contaminated with radionuclides, PCBs, VOCs, and metals. While it is unclear when USEC will cease uranium processing operations at Paducah, the cleanup and final disposition of those facilities may significantly affect the nature of residual contamination at the site. DOE assumes that buildings that are unsuitable for reuse or pose an unacceptable risk will be placed under long-term surveillance and maintenance pending final decontamination and decommissioning.

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

The primary steward for the Paducah Gaseous Diffusion Plant site will be DOE. The long-term stewardship activities will include monitoring the surface and groundwater, maintaining engineered controls (e.g., landfill cap/covers, etc.), enforcing access restrictions, and maintaining institutional controls. Long-term stewardship activities are expected to continue in perpetuity; however the duration will be adjusted as requirements are better defined.

LONG-TERM STEWARDSHIP GOALS

- Apply deed restrictions to prohibit groundwater use and residential development
- Implement institutional controls to identify areas of buried waste and warn the public of its presence
- Provide long-term monitoring to ensure that engineered controls continue to contain hazardous and radiological contamination

Institutional controls will include deed restrictions prohibiting the use of onsite groundwater and residential development on DOE property. DOE will maintain a permit program that will control excavation, penetration, or other use of residually contaminated areas. Notices, deed restrictions, and other information (e.g., location and risk) associated with the presence of residual contaminants remaining onsite will be filed with appropriate city and county offices.

The Paducah industrial complex site is currently surrounded by a security fence, with access controlled by security guards. DOE will maintain access control to protect classified information. Entrance and perimeter signs clearly identify the Paducah site as a DOE-owned facility with access restrictions. Further, contaminated areas outside the fenced complex are posted as such and restricted, consistent with applicable requirements.

Currently, DOE is responsible for long-term record-keeping associated with environmental contamination at the site. DOE plans to maintain the existing administrative record for CERCLA actions and utilize it as a long-term repository for records in accordance with CERCLA, DOE Orders, and the Land Use Control Assurance Plans. Site records are kept in permanent storage at the Paducah site and real property records are retained at the DOE Oak Ridge Office. Types of records maintained include site characterization data, remedial action design information, monitoring plans, monitoring results, and action completion reports. Of particular importance are the Land Use Control Assurance Plan and the corresponding Land Use Control Implementation Plans that will be developed for each cleanup area. The Land Use Control Implementation Plans will contain notification and reporting requirements. Information collection systems need to be reviewed to determine a way to flag information relevant for long-term stewardship and to store the information in retrievable form for the long term.

STAKEHOLDER INVOLVEMENT

DOE has established a site-specific advisory board and the Paducah Area Community Reuse Organization to facilitate community involvement in cleanup decisions and long-term reuse initiatives for the site. In addition, DOE has developed and is implementing a Community Relations Plan that incorporates the public participation requirements of RCRA and CERCLA.

2.2 Specific Long-Term Stewardship Activities

Soil

DOE will monitor conditions at all release sites to ensure regulatory compliance. CERCLA five-year reviews will be conducted following remediation in areas where contamination or waste is left in place. Approximately 303 hectares (748 acres) of soils at Paducah are impacted by residual contamination. Long-term monitoring and restrictions prohibiting intrusive activities and residential development will control future use of these areas, consistent with the Records of Decision.

The Paducah site contains twelve unlined burial grounds (nine non-regulated and three permitted) which were used to dispose of radioactive and nonradioactive trash, equipment, and scrap metal. Consequently, the nature of the residual contamination found in the burial grounds consists of radionuclides, metals, PCBs, volatile organic compounds (VOCs), and other contaminants. The burial grounds occupy approximately 43 hectares (107 acres) within the DOE property boundary. The primary goal is to conduct cleanup or stabilization activities that will reduce contamination to levels allowing maximum reuse of the industrialized area with minimal institutional controls. As a result, DOE has divided the burial grounds into "principal threat" and "low-to-moderate threat" categories. The former category will be excavated to eliminate the sources of contamination, while the latter will be capped in place with a multi-layer cap. This cap will cover an estimated 1.2 million cubic meters (1.6 million cubic yards) of residual contamination.

Groundwater

Groundwater monitoring activities have begun under an interim Record of Decision. However, the degree of monitoring should decrease over time as remediation goals are verified. A network of wells monitor the migration of groundwater plumes and groundwater discharges to surface water. The Commonwealth of Kentucky requires a 30-year, post-closure groundwater monitoring and care period; however, due to the presence of DNAPLs, monitoring will likely be required for a longer period. DOE will continue to provide an alternate public water supply to affected residents as long as offsite DNAPL concentrations in groundwater are above maximum contaminant levels. Institutional controls, such as deed restrictions, are also planned, consistent with the site Land Use Control Assurance Plan and executed Records of Decision, to prevent improper use of contaminated groundwater onsite.

Surface Water/ Sediment

Surface water monitoring activities are ongoing, consistent with the *Clean Water Act*. However, the degree of monitoring may decrease over time with decreased industrial activity. In addition, institutional controls are in place including of postings, fences, and deed restrictions to protect against the improper use of surface water. For example, fish advisories are posted in Little Bayou Creek which runs through the Western Kentucky Wildlife Management Area.

Engineered Units

Capped landfills will require long-term monitoring, institutional controls, and ongoing maintenance. The closed landfills will require DOE monitoring for the foreseeable future. Institutional controls will be put in place to warn of contamination presence and prevent any subsurface disturbance of the areas. These caps will be maintained, monitored, and replaced in accordance with operation and maintenance schedules. Since contamination is left in place, institutional controls will be implemented, consistent with the site Land Use

Control Assurance Plan, and CERCLA five-year reviews will be required. Warning signs, fences, and deed restrictions will remain in those areas containing landfills.

Facilities

Depending on sampling results after the final decontamination and decommissioning of the facilities, minimal institutional controls may be necessary. Deed restrictions or use limitations may be placed on areas with residual contamination. These restrictions will be consistent with the Land Use Control Assurance Plan and applicable Records of Decision.

2.3 Regulatory Regime

The site was placed on the National Priorities List in 1994, and the current environmental restoration program incorporates both RCRA and CERCLA requirements in a Federal Facilities Agreement. A Land Use Control Assurance Plan has been executed for the site, and the Records of Decision include a Land Use Control Implementation Plan. Waste management operations are conducted under RCRA, and waters discharged to the State are permitted under the *Clean Water Act*. In addition, all radiological operations are conducted consistent with DOE Orders.

2.4 Long-Term Stewardship Technology Development and Deployment

The problems at Paducah are very complex and will require deployment of the best science and technology available. A number of innovative technologies have been reviewed and utilized as part of the environmental restoration program, especially with regard to remediation of groundwater and DNAPL sources. An Innovative Treatment Remediation Demonstration program has been utilized to enhance the site groundwater feasibility study in addressing groundwater contamination. The Innovative Treatment Remediation Demonstration is in the initial stages of application to surface water contamination. Specific technologies include characterization of DNAPLs in groundwater through the use of innovative cone penetrometers and DNAPL sensors, in-situ groundwater remediation, and innovative air stripping.

One example of a new technology for in-situ groundwater remediation is the Permeable Treatment Zone. The Permeable Treatment Zone will be installed to treat contaminated groundwater in the southwest plume. This technology will involve construction of a subsurface wall through the injection of reactive treatment media. The system design is currently underway, with construction scheduled to start in the summer of 2000. If this demonstration is successful, its use, in conjunction with other source treatment technologies currently under evaluation, may prove to be considerably more efficient and effective than the existing groundwater pump-and-treat systems. In general, discovering and applying better and more efficient technologies will improve the efficiency and/or reduce the need for long-term stewardship activities.

2.5 Assumptions and Uncertainties

Most of the estimates of the extent of environmental contamination at the Paducah site are preliminary in nature. DOE has completed a remedial investigation of only one (groundwater) of the six areas (operable units) defining Paducah's environmental contamination. Consequently, estimates of the extent of soil, surface water, burial ground, facility, and site-wide cumulative contamination were developed with limited information. The majority of cleanup activities at the site will take place in the future, and current DOE estimates include a final completion date of 2010 for environmental remediation and limited facility decommissioning. The Commonwealth of Kentucky has expressed concern about the proposed PCB cleanup levels for surface soil and sediments. This issue is unresolved, and the outcome could have a significant impact on the amount of residual contamination

remaining in place. In addition, DOE completed an environmental health evaluation at Paducah in 1999 that highlighted the need for accelerating cleanup activities at the site. Finally, the disposition of contaminated facilities that are currently being used is unclear and will affect the amount and type of contamination or other hazards remaining on the site after cleanup is complete, as well as the costs for conducting long-term stewardship.

3.0 ESTIMATED LONG-TERM STEWARDSHIP COSTS

Estimated costs for long-term stewardship activities for the Paducah Gaseous Diffusion Plant are identified in the table below. The long-term stewardship costs represent monitoring surface water, groundwater, and capped landfills, as well as monitoring and maintaining engineered controls and enforcing institutional controls. The significant changes in costs below reflect replacement costs and decreasing monitoring costs. Replacement costs include cap replacements, water treatment component replacements, etc. The largest one ($59 million in FY 2061-2065) includes cap replacement, but smaller ones occur on different schedules (monitoring wells, piping, etc.). Monitoring costs include ground and surface water, which decrease over time as site conditions stabilize and less data needs to be collected. Generally, annual costs decrease between 2015 and 2070; however, between 2036 and 2070 the decreased costs are hidden by the replacement costs. For purposes of this report, long-term stewardship costs are shown until FY 2070; however, it is anticipated that long-term stewardship activities will be required in perpetuity.

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	*Amount*	*Year(s)*	*Amount*	*Year(s)*	*Amount*
FY 2000	$6,599,000	**FY 2008**	$4,549,000	**FY 2036-2040**	$40,457,000
FY 2001	$6,599,000	**FY 2009**	$5,299,000	**FY 2041-2045**	$39,397,000
FY 2002	$6,599,000	**FY 2010**	$4,724,000	**FY 2046-2050**	$43,581,000
FY 2003	$6,958,000	**FY 2011-2015**	$21,879,000	**FY 2051-2055**	$48,181,000
FY 2004	$7,470,000	**FY 2016-2020**	$20,623,000	**FY 2056-2060**	$53,499,000
FY 2005	$6,482,000	**FY 2021-2025**	$17,986,000	**FY 2061-2065**	$59,312,000
FY 2006	$4,757,000	**FY 2026-2030**	$16,703,000	**FY 2066-2070**	$36,289,000
FY 2007	$4,657,000	**FY 2031-2035**	$16,703,000		

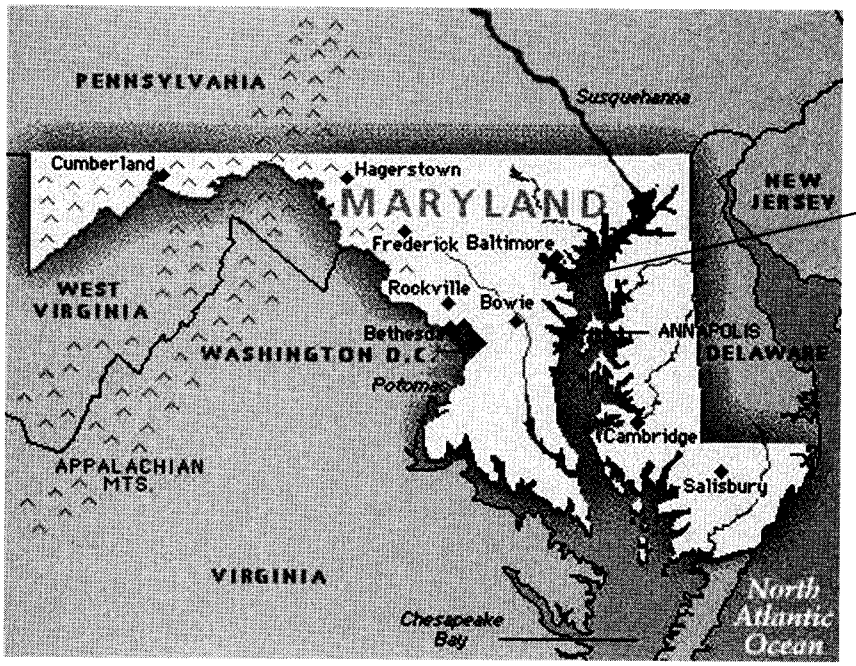
4.0 FUTURE USES

Future land use at the Paducah site will include a combination of controlled access on 43 hectares (107 acres), mixed industrial-recreational use on 299 hectares (740 acres), and open space and recreational use on 1,042 hectares (2,576 acres). Within the industrial area, USEC will continue to use existing facilities to conduct uranium enrichment operations according to its lease with DOE. Several other inactive DOE facilities within the industrial area will either be decommissioned or reused for other private or public industrial purposes. Outside the fenced industrial area, the Kentucky Department of Fish and Wildlife will continue to use certain areas onsite as part of the West Kentucky Wildlife Management Area, unless the site redesignates the future use of this area. The remainder of the site will serve as a buffer zone around the industrialized area.

For additional information about the Paducah Gaseous Diffusion Plant site, please contact:

John Sheppard
U.S. Department of Energy, Paducah Site Office
P.O. Box 1410
Paducah, KY 42001
Phone: 270-441-6804
or visit the Internet website at http://www.bechteljacobs.com/pad/report.htm

Maryland



W.R. Grace and Company

Long-Term Stewardship Site Highlights

W.R. Grace and Company (page 3)
unknown

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W.R. Grace and Company 3

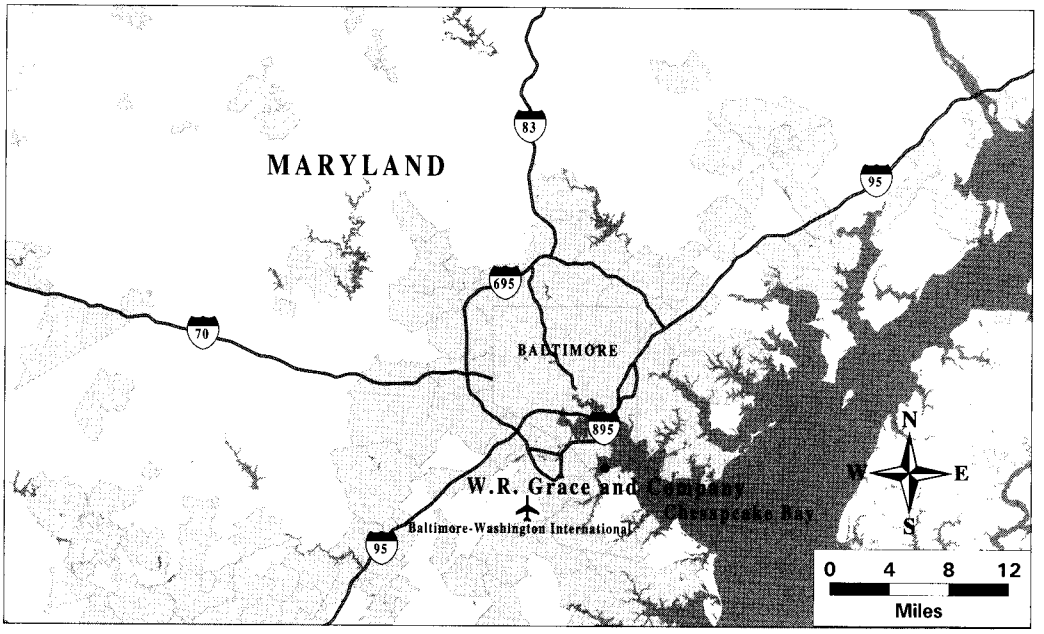
W.R. GRACE AND COMPANY SITE [1]

SITE SUMMARY

W.R. Grace and Company Site is on an industrialized peninsula in south Baltimore, Maryland. It is bordered on the north by Curtis Bay, on the west by Curtis Creek, on the east by the Patapsco River, and on the south by the Baltimore Municipal Landfill.

During the 1950s, W.R. Grace milled thorium for the Atomic Energy Commission (AEC), a predecessor agency of the U.S. Department of Energy (DOE). W.R. Grace began processing radioactive materials at the site in the mid-1950s, when Rare Earths, Inc. (W.R. Grace's predecessor) entered into a contract with AEC to extract thorium and rare earths from naturally-occurring monazite sands. Rare Earths' contract with AEC and its license to possess, transfer, and use radioactive thorium were transferred to W.R. Grace & Company. The facility where thorium processing took place (Building 23) operated until the late 1950s, when W.R. Grace and AEC agreed to terminate the contract. The wastes were buried in a landfill-type area.

Thorium processing at the W.R. Grace and Company Site, for U.S. Government and commercial entities, resulted in low-level radioactive waste that was buried on the property. Radiation surveys of the burial area and the surrounding area identified (1) randomly distributed contamination over the waste burial area; (2) elevated levels of radioactivity in several other locations on a waste management area surrounding the burial area; (3)



W.R. Grace and Company

[1] The W.R. Grace and Company Site is one of the 21 Formerly Utilized Sites Remedial Action Program (FUSRAP) sites where cleanup responsibility was transferred to the U.S. Army Corps of Engineers (Corps) in accordance with the Energy and Water Development Appropriations Act for FY 1998. At these 21 sites, the Corps is responsible for remediation and DOE is responsible for long-term stewardship activities, if any are deemed necessary. The cleanup decisions for these sites are not yet final and, therefore, the extent of long-term stewardship required for these sites, if any, is not yet known.

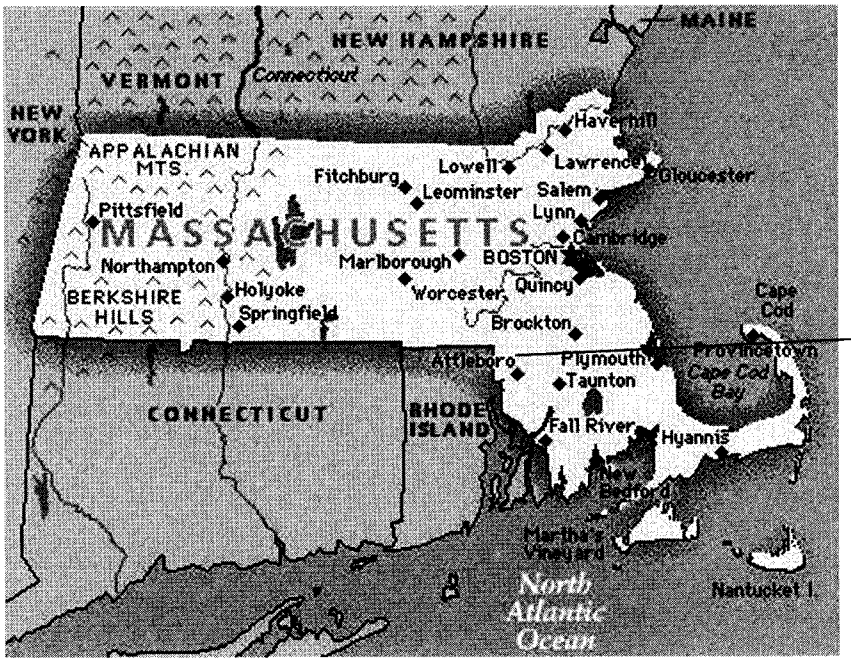
contaminated surfaces in Building 23 exceeding guidelines, especially around vats and hoppers; and (4) alpha-radiation surface contamination exceeding guidelines on all five levels of Building 23. The primary contaminant of concern is thorium-232.

The site was designated by DOE for remedial action under the Formerly Utilized Sites Remedial Action Program (FUSRAP) in 1984. The Corps' remedial action for this site is not yet complete and, therefore, the extent of long-term stewardship required, if any, is not yet known.

For additional information about the W.R. Grace and Company Site, please contact:

Baltimore District
U.S. Army Corps of Engineers
10 South Howard Street
Baltimore, MD 21201
Phone: 410-962-7608
or visit the Internet website at: http://www.nab.usace.army.mil/

Massachusetts



Shpack Landfill

Long-Term Stewardship Site Highlights

Shpack Landfill (page 3)
unknown

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Shpack Landfill 3

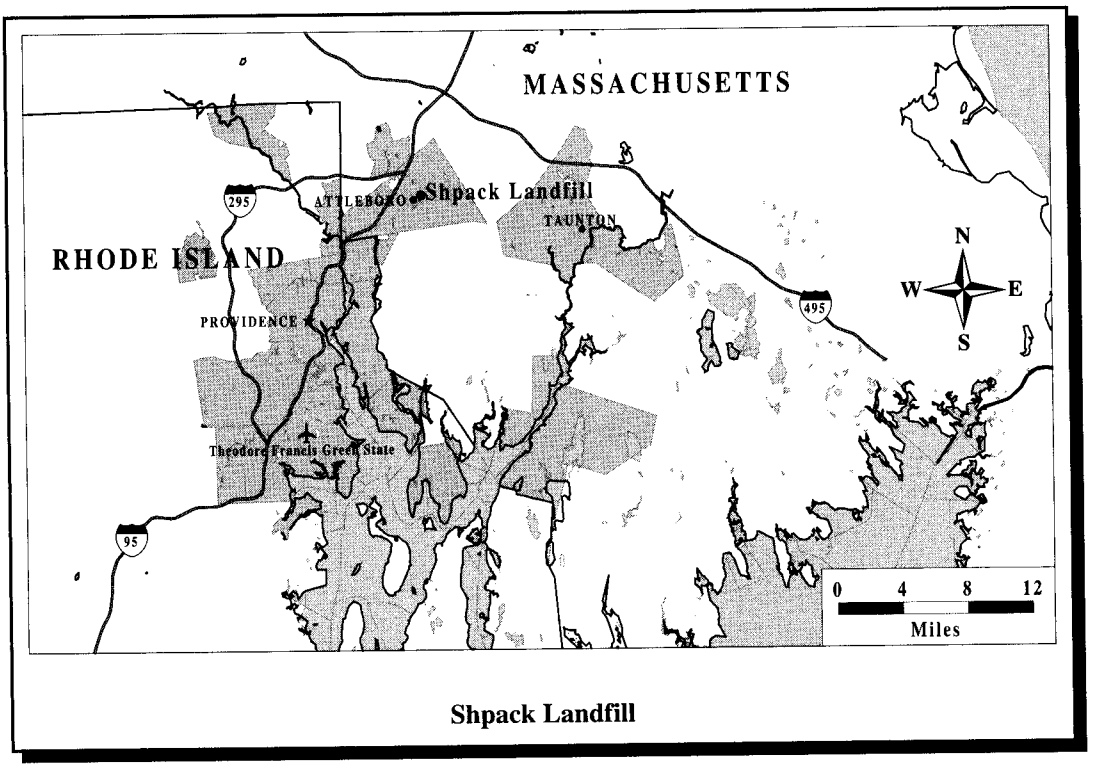
SHPACK LANDFILL[1]

SITE SUMMARY

The Shpack Landfill is located about 65 kilometers (40 miles) southwest of Boston in the towns of Norton and Attleboro, Massachusetts. The Shpack Landfill began operating as a private landfill in the early 1960s and received both industrial and domestic wastes. The landfill was closed in the mid-1960s under court order. In the late 1970s, a concerned citizen who had detected elevated radiation levels at the site contacted the U.S. Nuclear Regulatory Commission (NRC). The NRC investigated the site and confirmed the presence of radioactivity in excess of natural background levels for the area.

The landfill contains wastes that are contaminated with high-enriched uranium, low-enriched uranium, natural uranium, depleted uranium, radium, and various chemicals. Exactly when the contaminated materials were deposited at the site is not known. However, the NRC determined that the Texas Instruments plant (formerly M&C Nuclear, Inc.) in Attleboro had used the landfill to dispose of trash and other materials, some of which were generated from NRC-licensed activities at the plant. The NRC concluded that the contamination probably resulted primarily from these activities.

In the 1980s, personnel from the Oak Ridge National Laboratory conducted a radiological characterization of the site, confirmed the NRC findings, and defined the general areas of contamination. Macroscopic amounts of high-enriched uranium and other radioactive materials were also removed during the radiological characterization



Shpack Landfill

[1] The Shpack Landfill is one of the 21 Formerly Utilized Sites Remedial Action Program (FUSRAP) sites where cleanup responsibility was transferred to the U.S. Army Corps of Engineers (Corps) in accordance with the Energy and Water Development Appropriations Act for FY 1998. At these 21 sites, the Corps is responsible for remediation and DOE is responsible for long-term stewardship activities, if any are deemed necessary. The cleanup decisions for these sites are not yet final and, therefore, the extent of long-term stewardship required for these sites, if any, is not yet known.

survey. Based on the results of this survey, the former Shpack Landfill was designated for cleanup under the U.S. Department of Energy's Formerly Utilized Sites Remedial Action Program (FUSRAP). However, the Department determined that the Texas Instruments plant was excluded from FUSRAP because activities at the facility were licensed by the NRC.

The Town of Norton purchased the Shpack Landfill in the 1980s. The area is fenced and posted with "no trespassing" signs, and the Town of Norton and the New England Power Company control access to the site. In the late 1980s, Shpack was listed on the U.S. Environmental Protection Agency (EPA) National Priority List. The initial phase of the remedial investigation/feasibility study has been completed. Radioactive contamination at the site is believed to have come from private sources. EPA has identified potentially responsible parties for the site and the federal government was not identified.

In 1997, the site was transferred to the U.S. Army Corps of Engineers (Corps) for remediation. The remedial action for this site is not yet complete and, therefore, the extent of long-term stewardship required, if any, is not yet known.

For additional information about the Shpack Landfill, please contact:

Public Affairs Office
New England District
U.S. Army Corps of Engineers
696 Virginia Road
Concord, MA 01742-2751
Phone: 978-318-8264
or visit the Internet website at: http://www.nae.usace.army.mil/

Mississippi

Long-Term Stewardship Site Highlights

Salmon Site (page 3)
Major Activities - groundwater monitoring; enforcing restrictions for access to and use of the subsurface
Site Size - 595 hectares (1,470 acres)
Start/End Years - 2003/in perpetuity
Estimated Average Annual Cost FY 2000- 2006 - $60,000

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Salmon Site 3

SALMON SITE

1.0 SITE SUMMARY

1.1 Site Description and Mission

The Salmon Site covers approximately 595 hectares (1,470 acres) and is located 34 kilometers (21 miles) southwest of Hattiesburg, Mississippi. The U.S. Atomic Energy Commission (AEC), later known as the Department of Energy (DOE), used the site for two nuclear test detonations, Salmon and Sterling, to evaluate the seismic response of salt deposits to nuclear explosives. AEC conducted the first test, Salmon, at a depth of 828 meters (2,717 feet) in the Tatum Salt Dome in October 1964. AEC detonated the second test, known as Sterling, in the Salmon cavity in December 1966. The Salmon Site was also the location for two non-nuclear gas detonations used for seismic decoupling studies in the Vela Uniform Program. The non-nuclear gas detonations, Diode Tube in February 1969 and Humid Water in April 1970, consisted of two methane-oxygen explosions conducted in the Salmon/Sterling cavity. These two detonations did not result in additional contamination of the site.

LONG-TERM STEWARDSHIP HIGHLIGHTS

Major Long-Term Stewardship Activities - groundwater monitoring; enforcing restrictions for access to and use of the subsurface
Total Site Area - 595 hectares (1,470 acres)
Estimated Volume of Residual Contaminants - unknown
Long-Term Stewardship Start-End Years - 2003-in perpetuity
Average Annual Long-Term Stewardship Cost FY 2000-2006 - $60,000
Landlord - U.S. Department of Energy

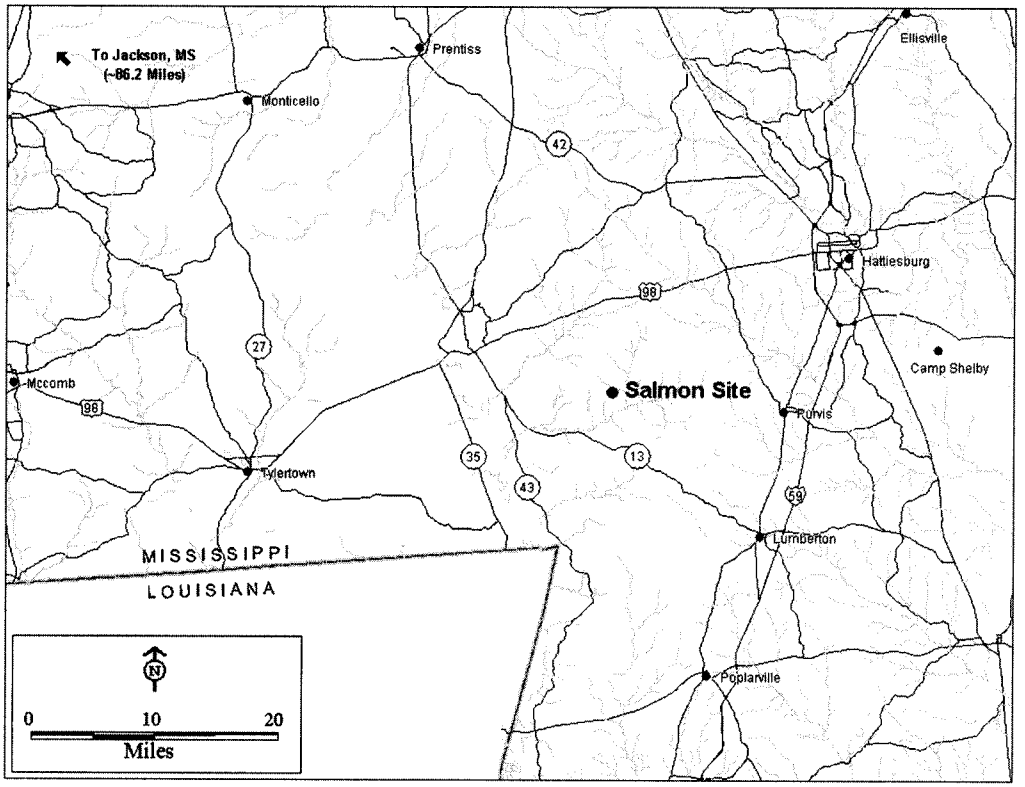
The Salmon Site is currently owned by DOE. DOE's mission at the site is to complete surface remediation and continue long-term stewardship activities of the residual subsurface contamination in the test cavity. DOE anticipates transferring the site surface to the State of Mississippi after final closure of the subsurface is completed in 2003. At that time, DOE anticipates that the surface area at the site will be established as a demonstration forest and wildlife refuge.

1.2 Site Cleanup and Accomplishments

DOE has developed site remediation plans and completed site characterization, modeling, and risk assessments for both the surface and subsurface areas. In October 1999, DOE initiated final site closure negotiations with the State of Mississippi. In addition, DOE has signed a Memorandum of Understanding with Lamar County that provides approximately $2 million to extend a drinking water system to residences in the vicinity of the site. This water system is expected to eliminate potential receptors for groundwater contamination. DOE expects to complete all remediation activities at the site by 2003.

AEC's underground detonations at the site resulted in contamination of subsurface areas and groundwater. The potential contaminants of concern for the subsurface are mixed fission products, including plutonium, uranium, and tritium. During cleanup activities conducted at the site in 1972, AEC injected radioactively contaminated soils and water into the test cavity. The injection wells were then sealed with concrete and bentonite when the site was decommissioned. DOE does not plan to remediate subsurface contamination because of the lack of feasible technologies for removing subsurface contamination. However, DOE will use characterization and modeling data to define the areas that will require institutional controls. Negotiations with the State of Mississippi on final site closure criteria were initiated in 1999, and DOE expects all subsurface closure work will be completed by 2003.

Potential surface contamination at the site resulted from drilling operations after the first test was conducted. Contaminants of concern include tritium and diesel fuel in abandoned mud pits, shallow disposal areas, and burn pits. In 1972, AEC initiated cleanup of surface contamination by excavating soils, decommissioning facilities, and disposing of wastes. In 1977, DOE conducted an additional sampling program, with more than 170 exploratory borings, and extensive soil and groundwater sampling. The results of the study showed that tritium contamination was left in the shallow mud pits during the 1972 site cleanup. As a result of this contamination, a plume of tritium extends northwest from the surface-ground-zero mud pits. DOE provided the site remedial investigation report to the State of Mississippi for review and State approval was received in May 2000. The State will make a decision on DOE's closure plans based on its review of the documentation. Assuming that the State accepts the current DOE plan, the surface contamination will be left in place to naturally decay to levels that will allow the site to be transferred to the State for use as a demonstration forest and wildlife refuge (approximately 10 years).



Salmon Site

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

DOE expects that the subsurface will be closed and that DOE activities at the site will consist solely of long-term stewardship activities beginning in 2003. DOE will not maintain an active presence at this site but will be responsible for monitoring and maintaining institutional controls over subsurface contamination. Final long-term stewardship requirements for the subsurface will be negotiated with the State of Mississippi. Periodic monitoring will be conducted to ensure that there is no contaminant migration from the test cavity to the groundwater. DOE does not anticipate that any long-term stewardship activities associated with the remediated surface

contamination will be necessary once the existing levels of contamination have either attenuated or decayed to agreed upon concentration levels, which is estimated to take approximately 10 years.

DOE maintains the project-specific records at the Nevada Operations Office in Las Vegas. These records include corrective action investigation work plans and reports; corrective action decision documents; health assessments; risk assessments; information submitted by the public; National Environmental Policy Act documents; and the Public Involvement Plan. The DOE Public Reading Facility and the Nevada Division of Environmental Protection Administrative Record are provided with copies of these documents. Upon the completion of the project, all DOE project files will be transferred to controlled storage at the Nevada Operations Office. Records are retained according to DOE records retention procedures.

2.2 Specific Long-Term Stewardship Activities

Groundwater

A monument has been placed at the site to mark the location of the test cavity. DOE will maintain institutional controls over the subsurface in perpetuity to prevent access to the test cavity, groundwater, and associated subsurface contamination. Institutional controls will include restricting surface intrusions on the site. DOE will continue to conduct annual groundwater monitoring at the site for at least 100 years after closure of the subsurface in 2003. DOE estimates that repair or replacement of groundwater monitoring wells will be required every 25 years. At the end of the post-closure groundwater monitoring period in 2103, assuming State regulatory agency approval, the monitoring wells will be plugged and abandoned in place in accordance with State regulations.

2.3 Regulatory Regime

In accordance with applicable regulatory drivers listed below, DOE is responsible for identifying the nature and extent of contamination, determining potential risk to the public and the environment, and performing the necessary corrective actions in compliance with guidelines and requirements under federal regulatory drivers, as well as the state-specific regulatory drivers associated with the site location. These responsibilities are delegated to the DOE Office of Environmental Management.

Resource Conservation and Recovery Act (RCRA): RCRA was the first comprehensive Federal effort to deal with solid and hazardous waste. RCRA regulates the generation, transportation, treatment, storage, and disposal of hazardous waste. At the Salmon Site, RCRA is enforced to protect human health and the environment; conserve energy and natural resources; reduce the amount of generated waste; and ensure that wastes are managed in an environmentally sound manner.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA): CERCLA supplies a system for identifying and providing corrective action to sites where hazardous substances have been released into any part of the air, water, groundwater, or land. Provisions of CERCLA include a National Contingency Plan, which establishes procedures for corrective action for hazardous substance releases. Salmon is not regulated under CERCLA; however, the regulations are useful as developmental guidelines.

In addition to federal regulations, DOE must comply with State regulatory requirements. In most cases, State of Mississippi requirements are based on federal guidelines; however, in specific cases they may be more detailed and stringent than federal regulations.

Nuclear Regulatory Commission (NRC): NRC regulations establish "free release" criteria. The State of Mississippi is not regulated under the NRC; however, the regulations are used as developmental guidelines.

2.4 Assumptions and Uncertainties

DOE assumes that the State of Mississippi will approve the proposed surface restoration plan. Current land use designations and subsurface intrusion restrictions will continue into the foreseeable future. DOE will reevaluate and modify the subsurface restrictions, as appropriate, as part of the assessment and/or corrective action activities.

DOE does not plan to remove subsurface contamination in and around the test cavities. However, DOE will develop subsurface models to define the contaminant boundary and refine the existing subsurface intrusion restrictions, if necessary. Post-closure monitoring will be conducted, as agreed upon in the site closure reports for the subsurface, in order to detect changes in the subsurface conditions. The schedule for groundwater monitoring after closure of the subsurface will be defined in the subsurface closure report. DOE assumes that groundwater monitoring will continue annually after subsurface closure is finalized in 2003 and that monitoring will be performed for 100 years (2003-2103).

3.0 Estimated Long-Term Stewardship Costs

The cost profile in the table below applies to the entire Salmon site. The major long-term stewardship costs are for monitoring activities, data analysis, and repair and replacement of monitoring wells. The spikes in cost are a result of costs associated with repairing or replacing monitoring wells, which are assumed to require maintenance every 25 years.

The long-term stewardship costs for the Salmon Site remain roughly constant at $40,000 annually through FY 2010. The higher costs in FY 2000 are associated with the new Real Estate Operations Permit (RE-OP) requirements. The cost increase in 2008 is the result of a periodic review and analysis of the data to evaluate and possibly refine the monitoring strategy. This review and analysis will occur every five years throughout the post-closure monitoring period (2003-2103). DOE projects that the total post-2070 (2071-2103) costs will be approximately $6.8 million dollars.

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	***Amount***	***Year(s)***	***Amount***	***Year(s)***	***Amount***
FY 2000	$180,000	**FY 2008**	$113,000	**FY 2036-2040**	$272,000
FY 2001	$40,000	**FY 2009**	$40,000	**FY 2041-2045**	$272,000
FY 2002	$40,000	**FY 2010**	$40,000	**FY 2046-2050**	$273,000
FY 2003	$40,000	**FY 2011-2015**	$272,000	**FY 2051-2055**	$2,772,000
FY 2004	$40,000	**FY 2016-2020**	$272,000	**FY 2056-2060**	$272,000
FY 2005	$40,000	**FY 2021-2025**	$272,000	**FY 2061-2065**	$272,000
FY 2006	$40,000	**FY 2026-2030**	$2,772,000	**FY 2066-2070**	$272,000
FY 2007	$40,000	**FY 2031-2035**	$272,000	**Post FY 2070**	$6,800,000

4.0 Future Uses

Public Law 104-201 (the *National Defense Authorization Act of Fiscal Year 1997*, Section 2851(b), September 1996) allows DOE to transfer the site to the State of Mississippi. It is anticipated that the Salmon Site will be

used as a demonstration forest and wildlife refuge. If the State accepts the property, agreements will be enacted for the transfer. The agreements will be completed prior to the completion of the closure activities and will be predicated on the final agreed upon surface closure criteria and future land use determinations. The anticipated end state for the Salmon Site will allow for future surface use at the site with an NRC designation of "no radiological restrictions." DOE will continue to restrict access to the test cavities, subsurface soil, and groundwater through the use of deed restrictions in perpetuity.

For additional information about the Salmon Site, please contact:

Monica Sanchez
U.S. Department of Energy, Nevada Operations Office
Environmental Restoration Division
232 Energy Way
North Las Vegas, NV 89030-4199
Phone: 702-295-0160
sanchezm@nv.doe.gov

Missouri

Long-Term Stewardship Site Highlights

Kansas City Plant (page 3)
Major Activities - groundwater and surface water monitoring; institutional controls for soil contamination
Site Size - 56.4 hectares (141 acres)
Start-End Years - 2005/in perpetuity
Estimated Average Annual Cost FY 2005-2006 - $1,334,000

Latty Avenue Properties (page 11)
unknown

St. Louis Airport Site (page 13)
unknown

St. Louis Airport Site Vicinity Properties (page 15)
unknown

St. Louis Downtown Site (page 17)
unknown

Weldon Spring Site Remedial Action Project (page 19)
Major Activities - surface water and groundwater monitoring; disposal cell maintenance and monitoring; institutional controls
Site Size - 91.4 hectares (226 acres)
Start-End Years - 2003/in perpetuity
Estimated Average Annual Cost FY 2003-2006 - $1,006,000

Westlake Disposal Site (page 29)
Site Size - 81 hectares (200 acres)

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St. Louis Downtown Site 17

Weldon Spring Site 19

Westlake Disposal Site 29

KANSAS CITY PLANT

1.0 SITE SUMMARY

1.1 Site Description and Mission

The Kansas City Plant is the U.S. Department of Energy's (DOE) main component fabrication plant, supporting multiple missions (defense, environmental, and others). The plant is part of the Bannister Federal Complex, a 120-hectare (300-acre) site approximately 19 kilometers (12 miles) south of downtown Kansas City, Missouri. DOE occupies about 56 hectares (141 acres) of this complex. The complex is zoned by local government for heavy industry. The surrounding area consists of single- and multiple-family residences, commercial establishments, industrial districts, and public-use lands.

LONG-TERM STEWARDSHIP HIGHLIGHTS

Major Long-Term Stewardship Activities - groundwater and surface water monitoring; institutional controls for soil contamination
Total Site Area - 56.4 hectares (141 acres)
Estimated Volume of Residual Contaminants - unknown
Long-Term Stewardship Start-End Years - 2005-in perpetuity
Average Annual Long-Term Stewardship Cost FY 2005-2006 - $1,334,000
Landlord - U.S. Department of Energy, Office of Defense Programs

The Kansas City Plant was built by the U.S. Navy during World War II to assemble engines for Navy fighter planes. Pratt-Whitney operated the plant from early 1943 until 1945. In 1947, Westinghouse began leasing the facility to the Fairfax Storage Company, which used part of the building as a warehouse for tires, raw rubber, sugar and lumber. Two years later in 1949, the Atomic Energy Commission (later known as the U.S. Department of Energy) asked the Bendix Corporation to take over part of the facility and begin building components for nuclear weapons. In 1993, DOE officially designated the Kansas City Plant as the consolidated site for all nonnuclear components for nuclear weapons. The plant, now under operation by Honeywell Federal Manufacturing & Technologies (FM&T), currently manufactures and procures electrical, electromechanical, mechanical, and plastic components.

1.2 Site Cleanup and Accomplishments

Various spills and leaks from previous production activities have contaminated the soil, groundwater, and surface water at the Kansas City Plant. Because the site produced only nonnuclear components for nuclear weapons, no radioactive contamination is present at the site.

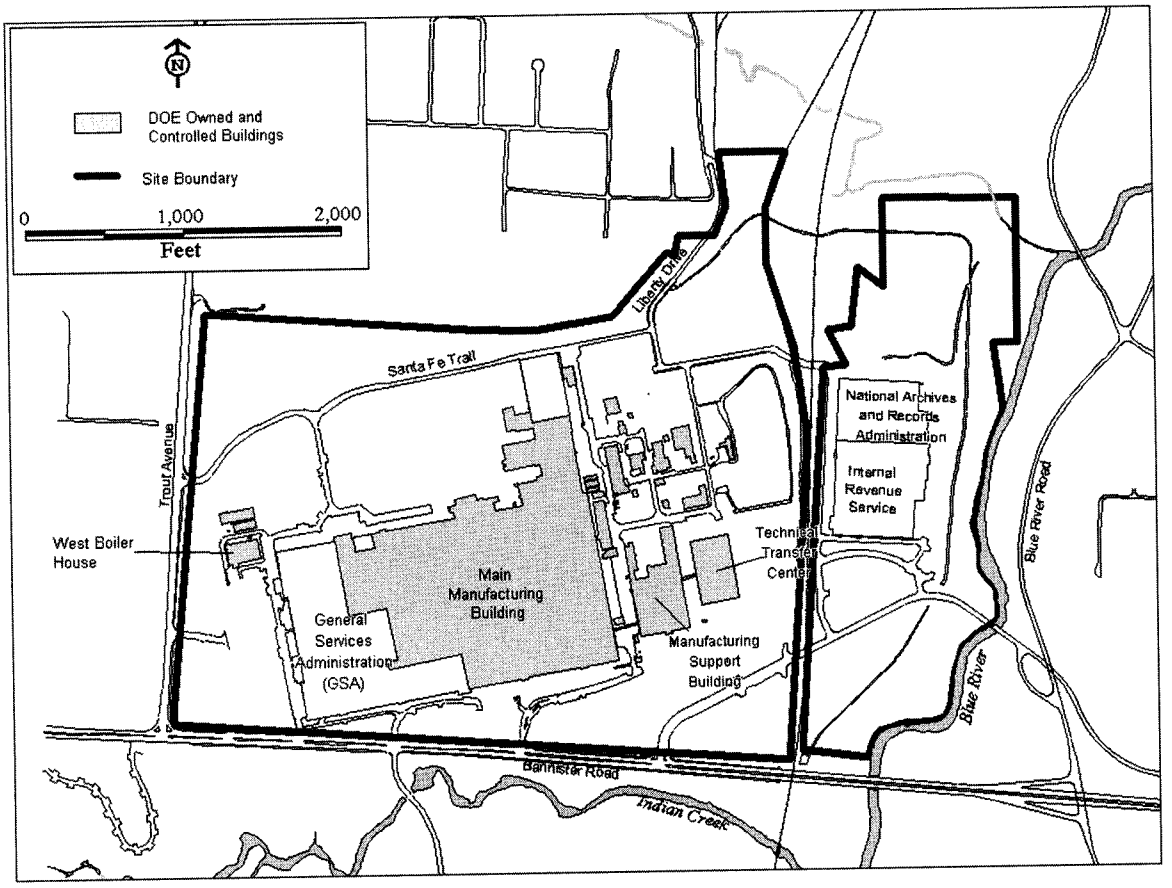
SITE ACCOMPLISHMENTS

- 42 of 43 release sites have been stabilized; and the Resource Conservation and Recovery Act (RCRA) Facility Investigation for the 43rd site (95th Terrace Site) is under Missouri Department of Natural Resources review

ANTICIPATED ACCOMPLISHMENTS BY 2006

- Complete the Corrective Measures Study to determine which cleanup method to use for the 95th Terrace Site
- Compete the Corrective Measures Implementation Design, which specifies construction details for cleanup of the 95th Terrace Site
- Continue groundwater treatment and monitoring activities, including well monitoring and maintenance, preparing regulatory reports, and ground water interceptor well design

The soil is contaminated with polychlorinated biphenyls (PCBs), volatile organics, and petroleum hydrocarbons. The volatile organic contamination covers much of the site, while the polychlorinated biphenyl contamination is most highly concentrated near the solid-waste management units. The petroleum hydrocarbon contamination occurs at various locations throughout the site. The soil contamination represented a surface area of approximately 70,000 square meters (84,000 square yards, or 17 acres) of subsurface soil.



Kansas City Plant

Surface remediation, including soil removal, has been ongoing under a Consent Order Agreement with the U.S. Environmental Protection Agency (EPA) since 1990 and is expected to be completed by fiscal year (FY) 2004. The Consent Order Agreement was transferred from EPA to the Missouri Department of Natural Resources as a post-closure permit in 1999.

The volume of residual soil contamination is unknown. DOE expects that institutional controls will be the selected remedy in areas where soil contamination poses a minimal risk. No additional capping of contaminated soil areas is planned, as the majority of contamination is located underneath the facility. Two former waste water treatment lagoons have caps, requiring monitoring and maintenance.

Approximately 24 hectares (58 acres) of groundwater is contaminated with volatile organics and petroleum hydrocarbons. Engineered controls are used to prevent further contamination of the groundwater. DOE will continue to extract and treat groundwater contaminated with trichloroethylene (TCE) and its degradation products, 1,2-dichloroethylene (1,2 DCE), and vinyl chloride until maximum concentration limits (MCLs) are no longer exceeded. However, currently, there is no known, viable, cost-effective treatment method that will remove volatile organics to MCLs for the contamination under the buildings (in a tight silty clay soil). Technologies will continue to be evaluated for applicability to volatile organic contamination. The groundwater contamination by petroleum hydrocarbons, which are dense non-aqueous phase liquids (DNAPLs), is being cleaned up primarily through the use of innovative technologies.

Final cleanup levels for groundwater have not yet been determined. DOE plans to continue groundwater treatment and monitoring until it can be demonstrated in three consecutive years that MCLs are not exceeded or until the regulators agree to an alternative. Approximately 80 million liters (21 million gallons) of groundwater per year are treated. With current technologies and cleanup standards, groundwater treatment could continue for hundreds of years in order to achieve maximum contaminant levels. There is currently no designated use for the contaminated aquifer and none is predicted, as the city uses surface water sources for its drinking supply. Current groundwater treatment is limiting discharge of contaminants to the surrounding surface water.

Contamination also spilled into the storm drains affecting the Indian Creek and Blue River surface water and sediments. The surface water concentrations have typically been in the parts-per-billion range, when detected. Sediment concentrations on areas of the site have been around two parts per million. The State of Missouri has recently notified DOE that the discharge limit will be lowered to 0.5 parts per billion in the near future, possibly resulting in future remediation work. The contamination consists of PCBs spilled into a storm drain and residual contamination in the storm sewer. Water collected in one exterior sump onsite is treated for PCBs prior to being discharged to the sanitary sewer system. Several projects to reduce the concentrations were completed in the last 15 years, including lining of laterals and excavations at different areas of the site. These projects include the following:

Date	Project
1984	Six manholes modified to decrease amount of PCBs entering storm sewer.
1985	K lateral lined with Insituform.
1987	PCB-containing heat transfer oil and PCB-contaminated piping were removed from the two heat transfer systems, one of which was responsible for the 95th Terrace spills.
1988	Four additional laterals were lined with Insituform; a corrugated metal pipe, which was coated with a PCB-containing material, was removed from part of the 002 system. Also in 1988, 1600 tons of 002 Raceway PCB-contaminated materials (soil, sediments, and concrete) were removed. This material had become contaminated as a result of a 1972 spill. Clean fill was used to return the area to grade, and a replacement concrete raceway from the outfall to Indian Creek was constructed.
1993	24,700 metric tons (27,210 tons) of PCB-contaminated material (up to 9,000 mg/kg) were removed for offsite disposal. PCBs at this location were primarily the result of the 1969 spill at the old 002 Outfall. Clean fill was used to restore the area to grade.

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

Because contamination remains in place, DOE must conduct long-term surveillance and monitoring. DOE's Office of Defense Programs (DP) will be responsible for institutional controls, continued groundwater remediation, and monitoring. DOE will conduct routine sampling and maintain institutional and procedural controls, including excavation restrictions, in order to protect workers from inadvertent exposure in areas where residual contamination is present. Corrective Action reports, completed as part of the Consent Order, are kept in a library in the Environmental Compliance Department onsite. Documents are also distributed to the DOE Kansas City Area Office, EPA Region 7, and the Missouri Department of Natural Resources.

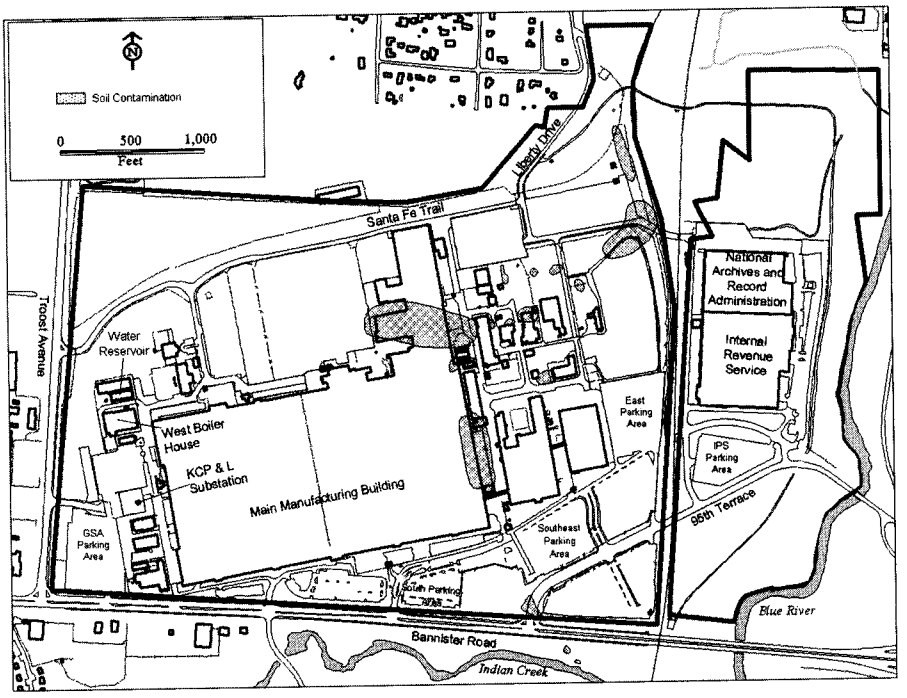
Currently, the site has institutional controls that include both procedural and proprietary controls. Procedural controls include: Hazardous Waste Operations and Emergency Response (HAZWOPER) determination,

preliminary hazard analysis, construction waste assessment, design review, construction safety plan, and an excavation permit. Proprietary controls include: land use restrictions and conditions, a land use restriction notice, a notice to potential transferees, a plan for continuation of institutional controls, and compliance with regulatory requirements. The engineered controls, in place at the site, include a groundwater pump and treat system and an iron wall to contain contaminated groundwater and prevent it from reaching Blue River and Indian Creek. Designs are underway to improve the efficiency and effectiveness of the engineered controls to provide containment and treatment of contaminated groundwater.

2.2 Specific Long-Term Stewardship Activities

Soil

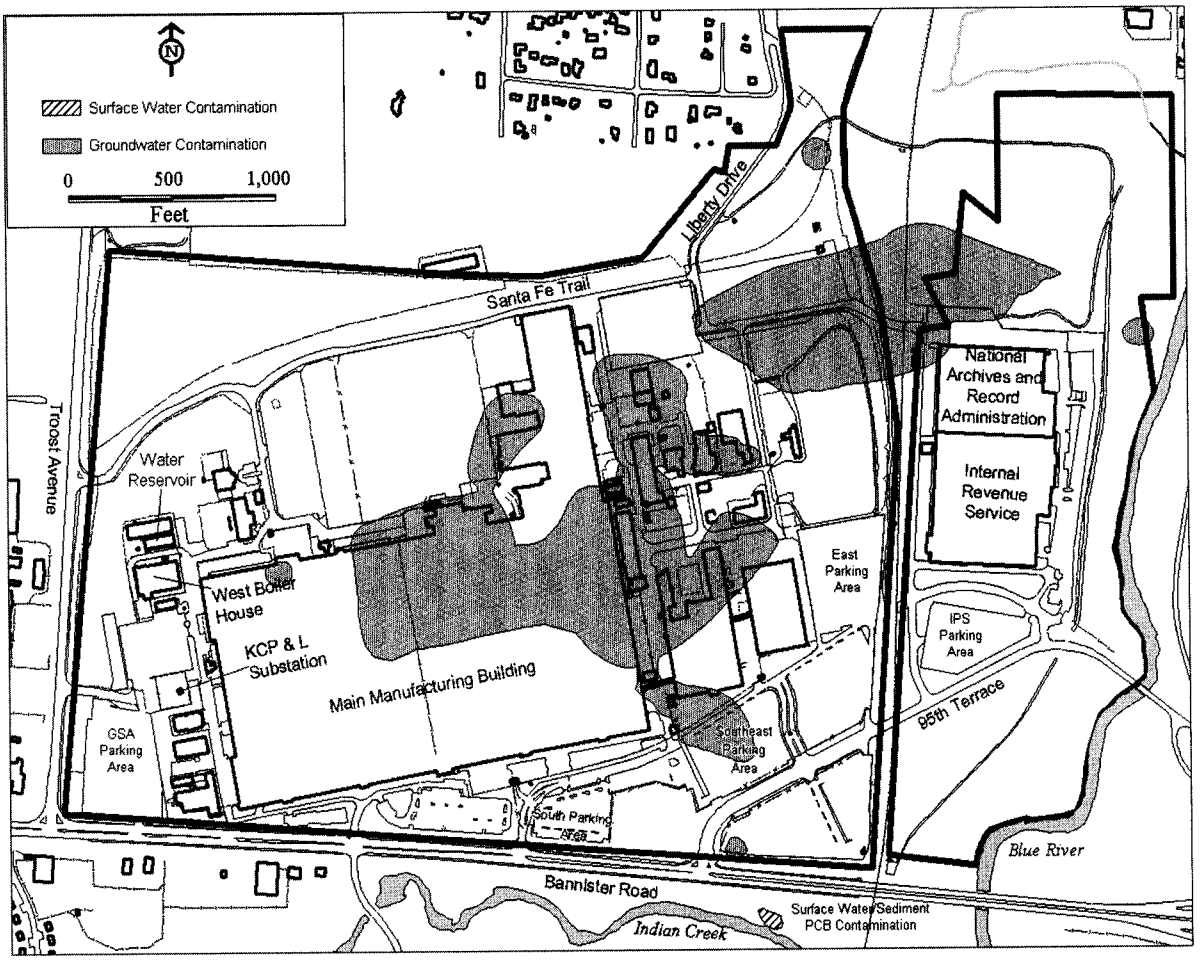
DOE will conduct routine sampling of the soil and maintain institutional and procedural controls, including excavation restrictions, to protect workers from inadvertent exposure in areas where residual contamination is present. Major areas of soil contamination lie near or under the Main Manufacturing Building, with additional areas of soil contamination located to the east and northeast of the main building. The exact volume of soil subject to long-term stewardship requirements is not known.



Kansas City Soil Contamination

Groundwater

Due to the presence of DNAPLs, the site expects that groundwater monitoring will be needed indefinitely. At the present remediation rate, additional treatment may be necessary to restore the alluvial aquifer. Currently, 188 wells are in place to monitor groundwater. Monitoring wells and groundwater treatment equipment will require surveillance and maintenance throughout this treatment period.



Kansas City Groundwater and Surface Water Contamination

Surface Water/Sediment

Due to the presence of PCBs in Indian Creek, DOE periodically monitors for PCBs. As previously mentioned, several projects have addressed PCB concentrations (see previous page). Also, future activities will be influenced by possible changes to the discharge limits for PCB contamination set by the State of Missouri.

2.3 Regulatory Regime

The Missouri Department of Natural Resources has authority over the Post Closure Permit and is the regulatory lead over all environmental restoration for the Kansas City Plant. Long-term stewardship activities at the Kansas City Plant are governed by several regulations, including the *Atomic Energy Act of 1954, as amended;* EPA groundwater protection standards in 40 *Code of Federal Regulations*; and the *National Environmental Policy Act of 1969*, the *Resource Conservation and Recovery Act*, and the *Comprehensive Environmental Response, Compensation, and Liability Act.*

2.4 Assumptions and Uncertainties

DOE assumes that the designated groundwater cleanup levels will be met. If they cannot be met, it may be possible to apply for alternative cleanup levels (ACLs) because of "technical impracticability," but this will need to be demonstrated. Although the cost estimates assume no additional remediation, the *Resource Conservation and Recovery Act* Post Closure Permit, issued by the Missouri Department of Natural Resources, requires periodic review of new technologies. If a new technology is determined feasible for this site, implementation would be required, which would possibly require increased funding.

3.0 ESTIMATED LONG-TERM STEWARDSHIP COSTS

Estimated costs for long-term stewardship activities for the Kansas City Plant are identified in the table below. Costs are based on monitoring, sampling of the groundwater, and well maintenance. Of the cost totals shown in the cost table, approximately 55% is for groundwater monitoring, 18% for groundwater treatment, and 27% for program management. As stated in Section 2.4, possible future groundwater remediation costs have not been factored into cost estimates as a contingency.

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	***Amount***	***Year(s)***	***Amount***	***Year(s)***	***Amount***
FY 2000	$0	**FY 2008**	$1,166,000	**FY 2036-2040**	$6,676,000
FY 2001	$0	**FY 2009**	$1,506,000	**FY 2041-2045**	$6,689,000
FY 2002	$0	**FY 2010**	$1,167,000	**FY 2046-2050**	$6,345,000
FY 2003	$0	**FY 2011-2015**	$6,691,000	**FY 2051-2055**	$6,679,000
FY 2004	$0	**FY 2016-2020**	$6,343,000	**FY 2056-2060**	$6,691,000
FY 2005	$1,164,000	**FY 2021-2025**	$6,677,000	**FY 2061-2065**	$6,345,000
FY 2006	$1,504,000	**FY 2026-2030**	$6,690,000	**FY 2066-2070**	$6,677,000
FY 2007	$1,165,000	**FY 2031-2035**	$6,345,000		

4.0 FUTURE USES

DOE's Office of Defense Programs (DP) has an ongoing mission and will use facilities and land for office space, warehousing, and light manufacturing. DP is expected to be the lead secretarial office and intends to use the site for the foreseeable future. In the event of a landowner change, a Notice to Potential Transferees will be issued, a plan for Continuation of Institutional Controls will be developed, and compliance with the *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA) Section 120(h) will be achieved.

For more information about the Kansas City Plant, please contact:

Tanya Snyder, Public Affairs Officer
2000 East 95th Street
P.O. Box 419159
Kansas City, MO 64141-6159
Phone: 816-997-5937
or visit the Internet website at http://www.os.kcp.com

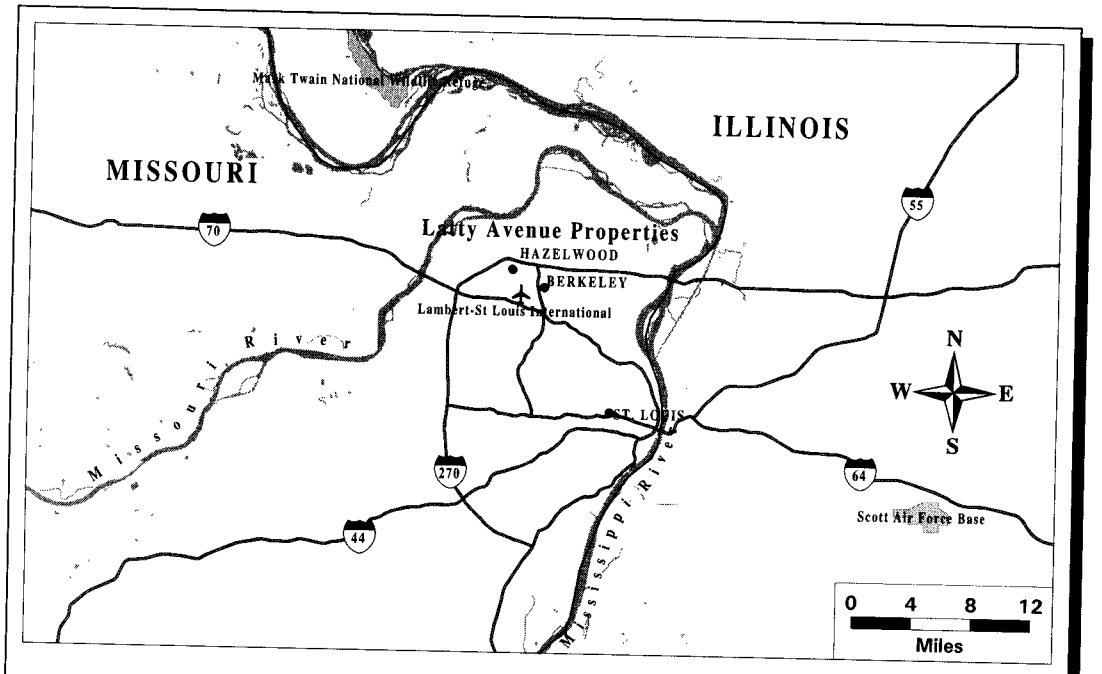
Phil Keary, Environmental Restoration Manager
Office of Technical Management
US Department of Energy, Kansas City Area Office
P.O. Box 410202
Kansas City, MO 64141-0202
Phone: 816-997-7288

LATTY AVENUE PROPERTIES [1]

SITE SUMMARY

The Latty Avenue Properties are located in an area approximately one kilometer (0.6 mile) north of the St. Louis Airport in the towns of Hazelwood and Berkeley, Missouri. The Latty Avenue Properties include: (1) the Hazelwood Interim Storage Site, which was used for interim storage of materials removed from St. Louis vicinity properties; (2) the Futura Coatings Site, which was a Futura Coatings, Inc.-leased property used for manufacturing plastic coatings; and (3) several vicinity properties on Latty Avenue.

During the 1940s and 1950s, the Mallinckrodt Chemical Company conducted uranium milling and refining operations under contracts with the Manhattan Engineer District and the Atomic Energy Commission (predecessor agencies to the U.S. Department of Energy) at the nearby St. Louis Downtown Site in Missouri. During the same period, Mallinckrodt transported process residues to the St. Louis Airport Site for storage. The process residues at the St. Louis Airport Site were sold to a commercial firm in the late 1960s, and the residues were transported to a property at 9200 Latty Avenue for storage and processing. This material was subsequently sold to the Cotter Corporation and shipped to its facilities in Cañon City, Colorado. By the early 1970s, the material had been removed from the Latty Avenue site, and the Cotter Corporation's Nuclear Regulatory Commission (NRC) license was terminated. However, soil analyses conducted by the NRC in 1976, and subsequent radiological assessments by others, indicated that there were residual uranium and thorium



Latty Avenue Properties

[1] The Latty Avenue Properties Site comprise one of the 21 Formerly Utilized Sites Remedial Action Program (FUSRAP) sites where cleanup responsibility was transferred to the U.S. Army Corps of Engineers (Corps) in accordance with the Energy and Water Development Appropriations Act for FY 1998. At these 21 sites, the Corps is responsible for remediation and DOE is responsible for long-term stewardship activities, if any are deemed necessary. The cleanup decisions for these sites are not yet final and, therefore, the extent of long-term stewardship required for these sites, if any, is not yet known.

concentrations above criteria for unrestricted land use.

In 1983, Congress authorized the cleanup of the Latty Avenue Properties as a reasearch and development contamination project under the Formerly Utilized Sites Remedial Action Program (FUSRAP).

Current radiological contamination present no significant health risks to workers or the public under the current site-use and land-use conditions. The Corps' remedial action for this site is not yet complete and, therefore, the extent of long-term stewardship required, if any, is not yet known.

For additional information about the Latty Avenue Properties, please contact:

FUSRAP Project Office
St. Louis District
U.S. Army Corps of Engineers
8945 Latty Avenue
Berkeley, MO 63134
Phone:314-260-3905
or visit the Internet website at: http://www.mvs.usace.army.mil/engr/fusrap/home2.htm

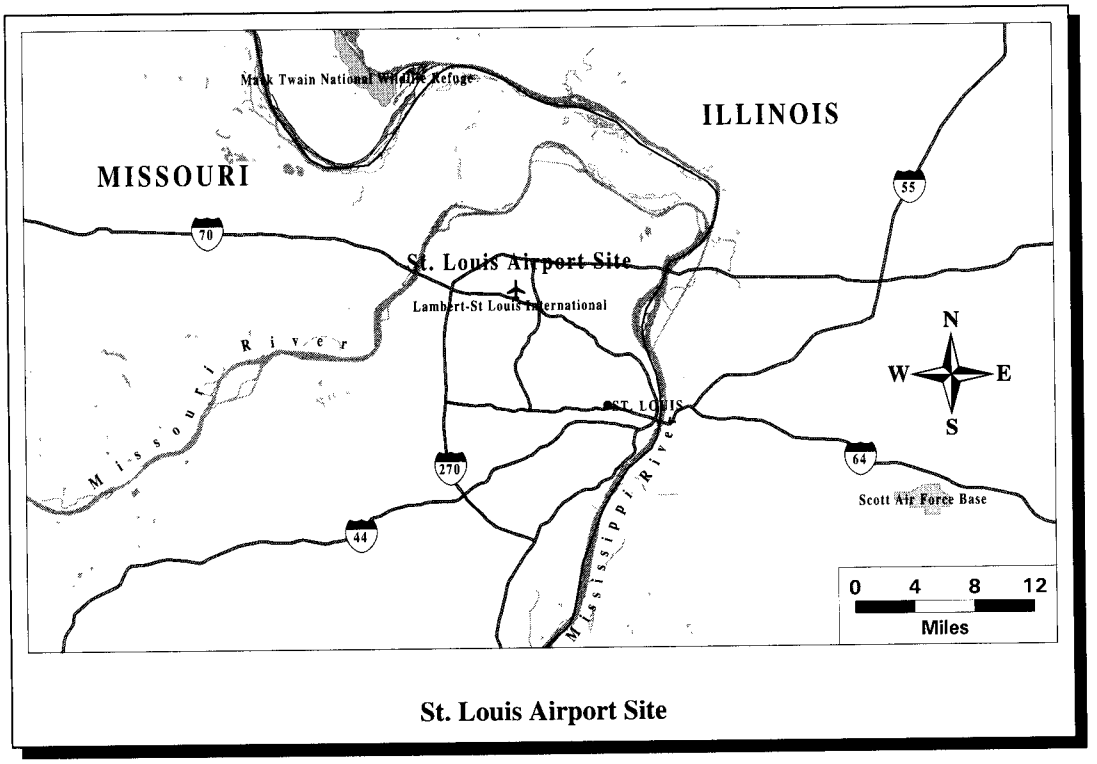
ST. LOUIS AIRPORT SITE [1]

SITE SUMMARY

The St. Louis Airport Site is adjacent to the northern boundary of the Lambert-St. Louis International Airport Authority in St. Louis County, Missouri. The site is approximately 25 kilometers (15 miles) northwest of downtown St. Louis. The site was used primarily to store process residues from the former Mallinckrodt Chemical Company plants in downtown St. Louis, currently known as the St. Louis Downtown Site.

The Manhattan Engineer District (MED), an early predecessor agency of the U.S. Department of Energy (DOE), acquired the St. Louis Airport Site in 1946. The site was operated by the Manhattan Engineer District and the Atomic Energy Commission (the successor agency to the MED and a predecessor agency of DOE) from 1946 to 1953 to store residues from the milling and refining of high-grade uranium ore conducted at the St. Louis Downtown Site. During the late 1960s, the stored process residues were sold and removed from the site. Also, in the late 1960s, title to the property was transferred to the Lambert-St. Louis Airport Authority. Ownership of the site was assumed by the city of St. Louis in the 1970s, with the Lambert-St. Louis Airport Authority being responsible for access to and maintenance of the site.

In the Energy and Water Development Appropriations Act for Fiscal Year 1985, Congress directed DOE to reacquire the site for use as a disposal facility for contaminated materials and wastes from the Latty Avenue Properties Site in Hazelwood, Missouri, as well as the St. Louis Airport Site Vicinity Properties. However,



St. Louis Airport Site

[1] The St. Louis Airport Site is one of the 21 Formerly Utilized Sites Remedial Action Program (FUSRAP) sites where cleanup responsibility was transferred to the U.S. Army Corps of Engineers (Corps) in accordance with the Energy and Water Development Appropriations Act for FY 1998. At these 21 sites, the Corps is responsible for remediation and DOE is responsible for long-term stewardship activities, if any are deemed necessary. The cleanup decisions for these sites are not yet final and, therefore, the extent of long-term stewardship required for these sites, if any, is not yet known.

absent an agreement and important decisions regarding final cleanup of the principal St. Louis sites, work was initiated to clean up designated vicinity properties and haul road contamination. An interim storage site on Latty Avenue in Hazelwood is being used to store radioactively contaminated soil from vicinity properties and haul roads.

Contaminants of concern from storage activities at the St. Louis Airport Site are uranium, thorium, metals, and organics.

The Corps' remedial action for this site is not yet complete and, therefore, the extent of long-term stewardship required, if any, is not yet known.

For additional information about the St. Louis Airport Site, please contact:

FUSRAP Project Office
St. Louis District
U.S. Army Corps of Engineers
8945 Latty Avenue
Berkeley, MO 63134
Phone:314-260-3905
or visit the Internet website at: http://www.mvs.usace.army.mil/engr/fusrap/home2.htm

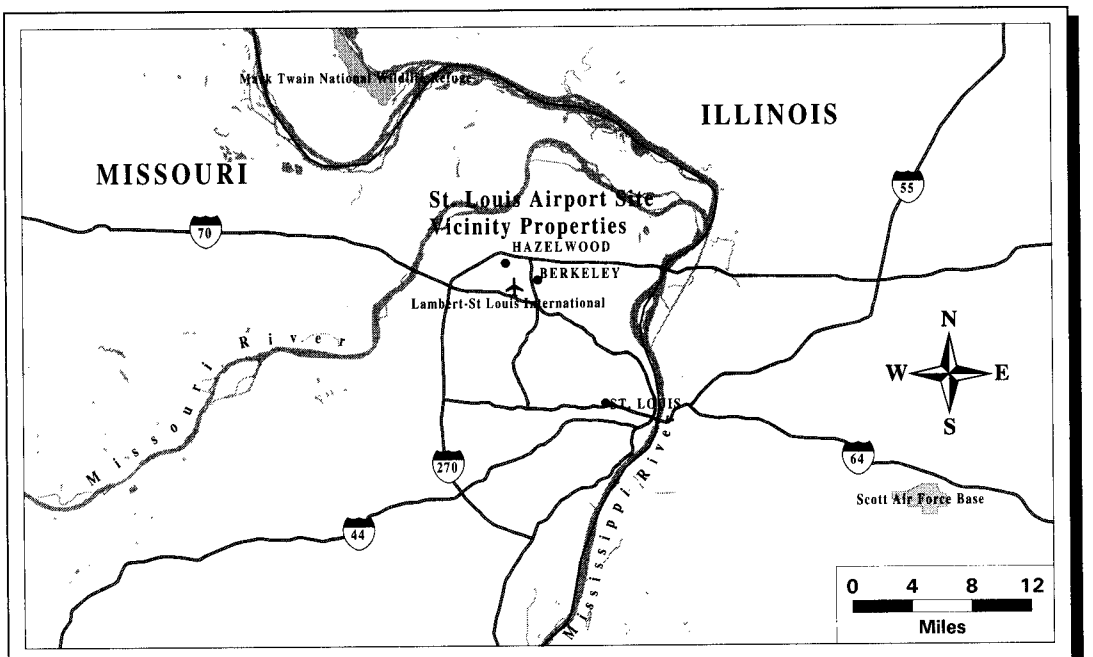
ST. LOUIS AIRPORT SITE VICINITY PROPERTIES[1]

SITE SUMMARY

The St. Louis Airport Site Vicinity Properties are located in the towns of Hazelwood and Berkeley, Missouri, approximately 25 kilometers (15 miles) northwest of downtown St. Louis. The properties are associated with both the St. Louis Airport Site and the Latty Avenue Properties.

The Manhattan Engineer District (MED), an early predecessor agency of the U.S. Department of Energy (DOE), acquired the St. Louis Airport Site in 1946. The site was operated by the Manhattan Engineer District and the Atomic Energy Commission (the successor agency to the MED and a predecessor agency of DOE) from 1946 to 1953 to store residues from uranium processing operations, primarily from the former Mallinckrodt Chemical Company Plants in St. Louis, at a location currently referred to as the St. Louis Downtown Site.

By the late 1960s, most of the residues were sold to Continental Mining and Milling Company and removed from the St. Louis Airport Site to their property on Latty Avenue, which is part of the Latty Avenue Vicinity Properties.



St. Louis Airport Site Vicinity Properties

[1] The St. Louis Airport Site Vicinity Properties comprise one of the 21 Formerly Utilized Sites Remedial Action Program (FUSRAP) sites where cleanup responsibility was transferred to the U.S. Army Corps of Engineers (Corps) in accordance with the Energy and Water Development Appropriations Act for FY 1998. At these 21 sites, the Corps is responsible for remediation and DOE is responsible for long-term stewardship activities, if any are deemed necessary. The cleanup decisions for these sites are not yet final and, therefore, the extent of long-term stewardship required for these sites, if any, is not yet known.

As a consequence of moving these residues from the St. Louis Airport Site to Latty Avenue, several vicinity properties and locations (right-of-ways) along the haul roads were contaminated with the radioactive constituents of the residues. Also, over time, natural migration by water and wind resulted in the transport of radioactive contamination to several properties contiguous to the St. Louis Airport Site and along Coldwater Creek. Radioactive contaminants have been removed from most of the properties and place in temporary storage at the Hazelwood Interim Storage Site.

The Corps' remedial action for the St. Louis Airport Vicinity Properties Site is not yet complete and, therefore, the extent of long-term stewardship required, if any, is not yet known.

For additional information about the St. Louis Airport Site Vicinity Properties, please contact:

FUSRAP Project Office
St. Louis District
U.S. Army Corps of Engineers
8945 Latty Avenue
Berkeley, MO 63134
Phone:314-260-3905
or visit the Internet website at: http://www.mvs.usace.army.mil/engr/fusrap/home2.htm

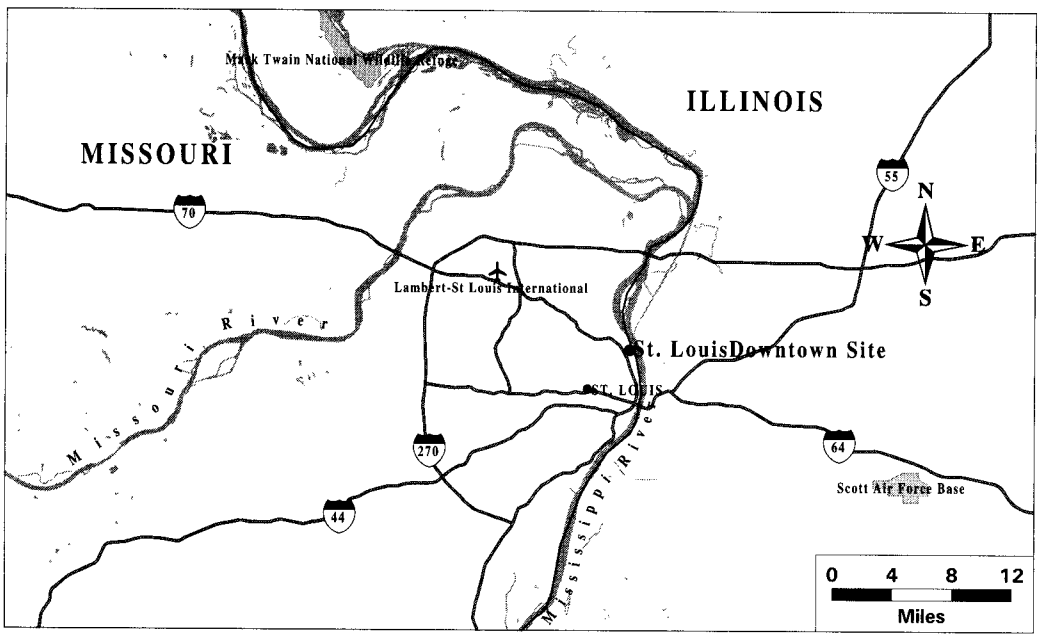
ST. LOUIS DOWNTOWN SITE [1]

SITE SUMMARY

The St. Louis Downtown Site is located in an industrial area on the eastern border of St. Louis, about 60 meters (200 feet) west of the Mississippi River. The St. Louis Downtown Site is an operating industrial facility owned by Mallinckrodt, Inc

From the 1940s to 1950s, Mallinckrodt Chemical Company conducted a variety of uranium processing and recovery operations at the site in support of the national defense program. During closeout of operations in the late 1950s, government-owned buildings were either dismantled or transferred to Mallinckrodt as part of a settlement agreement.

Contamination at the St. Louis Downtown Site originated from industrial-scale milling to recover uranium from high-grade uranium ore, among other processing activities (e.g., extraction and concentration of thorium-230 from pitchblende raffinate). The primary contaminants of concern at the site include uranium, thorium, and radium. Based on chemical characterization data, several metals (antimony, arsenic, beryllium, lead, nickel, and thallium) are also present at concentrations above background levels. The St. Louis Downtown Site was designated for cleanup by the U.S. Department of Energy (DOE) under the Formerly Utilized Sites Remedial Action Program (FUSRAP) in 1984. The final decision on a remedy for all St. Louis sites has not been made.



St. Louis Downtown Site

[1] The St. Louis Downtown Site is one of the 21 Formerly Utilized Sites Remedial Action Program (FUSRAP) sites where cleanup responsibility was transferred to the U.S. Army Corps of Engineers (Corps) in accordance with the Energy and Water Development Appropriations Act for FY 1998. At these 21 sites, the Corps is responsible for remediation and DOE is responsible for long-term stewardship activities, if any are deemed necessary. The cleanup decisions for these sites are not yet final and, therefore, the extent of long-term stewardship required for these sites, if any, is not yet known.

However, cleanup activities have been conducted in support of building construction and renovation operations by Mallinckrodt. Residual radioactive materials that were accumulated were place in interim storage on the site.

The potential for contaminant transport is limited. Impervious materials (e.g., buildings) cover most of the contaminated soils.

The Corps' remedial action for the site is not yet complete and, therefore, the extent of long-term stewardship required, if any, is not yet known.

For additional information about the St. Louis Downtown Site, please contact:

FUSRAP Project Office
St. Louis District
U.S. Army Corps of Engineers
8945 Latty Avenue
Berkeley, MO 63134
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WELDON SPRING SITE

1.0 SITE SUMMARY

1.1 Site Description and Mission

The Weldon Spring Site is located in southern St. Charles County, Missouri, approximately 48.2 kilometers (30 miles) west of St. Louis along Missouri State Route 94. The site consists of two main areas, the Weldon Spring Chemical Plant and the Weldon Spring Quarry.

The Weldon Spring Chemical Plant Site is an 87.8-hectare (217-acre) area initially used by the U.S. Army during the 1940s to produce the explosives trinitrotoluene (TNT) and dinitrotoluene (DNT), and later by the U.S. Atomic Energy Commission (AEC) [a predecessor agency to the U.S. Department of Energy (DOE)]to process uranium and thorium ore concentrates. Site features included 40 buildings, four raffinate pits, two ponds, and two former dump areas. The plant was operated by Mallinckrodt Chemical Company from 1957 until it was shut down in 1966.

LONG-TERM STEWARDSHIP HIGHLIGHTS

Major Long-Term Stewardship Activities - surface water and groundwater monitoring; disposal cell maintenance and monitoring; institutional controls; inspections
Total Site Area - 91.4 hectares (226 acres)
Estimated Volume of Residual Contaminants - engineered unit 1.13 million cubic meters (1.48 million cubic yards); groundwater 85,000 cubic meters (110,000 cubic yards)
Long-Term Stewardship Start-End Years - 2003-in perpetuity
Portions in Long-Term Stewardship as of 2006 - 2
Average Annual Long-Term Stewardship Cost FY 2003-2006 - $1,006,000
Landlord - U.S. Department of Energy, Grand Junction Office (beginning in 2003)

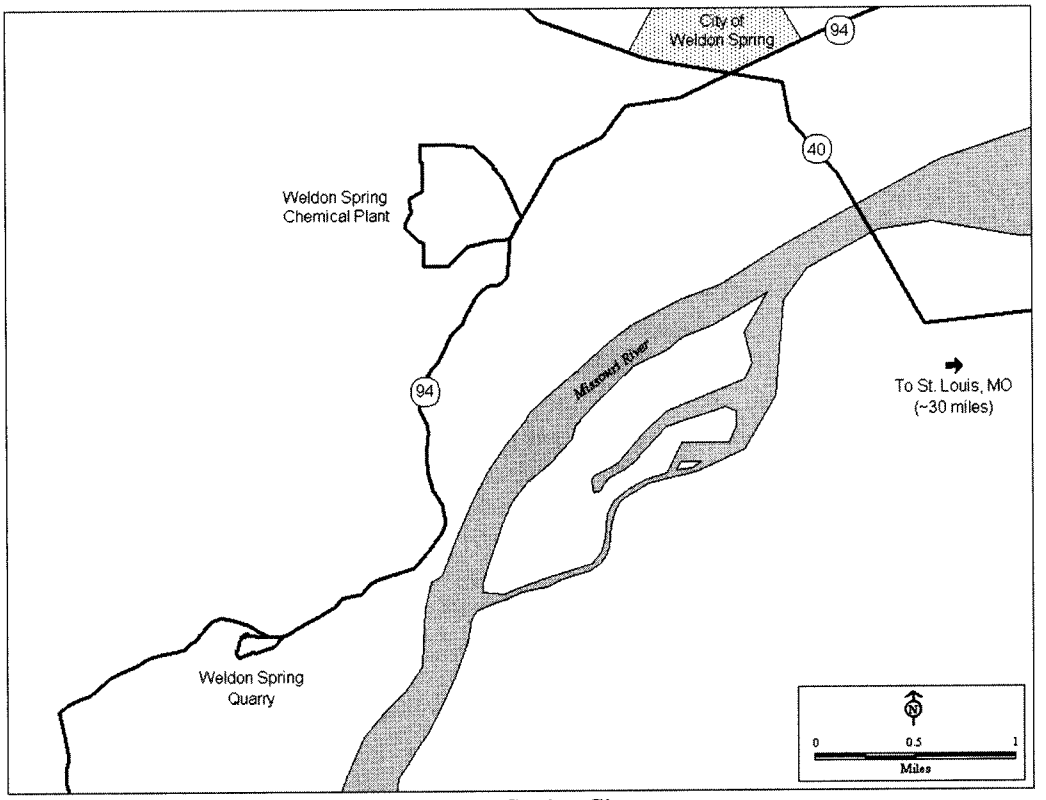
The Weldon Spring Site Quarry is a 3.6-hectare (nine-acre) limestone quarry located 6.5 kilometers (four miles) southwest of the chemical plant area. Historically, the site was used to dispose of manufacturing wastes and contaminated process residues from TNT and DNT production at the chemical plant, as well as radiologically contaminated wastes generated from processing uranium and thorium ores. Building rubble also was disposed of at the quarry after decommissioning of the explosives production facilities at the chemical plant site. The quarry is surrounded by the Weldon Spring Conservation Area. The Katy Trail State Park (Katy Trail) passes just south of the quarry. The St. Charles County well field is located southeast of the quarry between the Femme Osage Slough and the Missouri River. Groundwater for the quarry area lies between the quarry proper and the St. Charles County well field.

The Weldon Spring Remedial Action Project began in 1985. DOE is the current owner of the site and is responsible for conducting all site activities. Remediation of vicinity properties has been completed, and remediation of the quarry site and the chemical plant site is expected to be completed by 2002, after which the only ongoing mission at the Weldon Spring Site will be performing long-term stewardship activities. Long-term stewardship activities will be the responsibility of DOE.

1.2 Site Cleanup and Accomplishments

The sources of contamination at the Weldon Spring Site were the wastes and residues generated by explosives production and uranium and thorium processing operations. Completed remedial activities include the removal of 110,000 cubic meters (144,000 cubic yards) of bulk waste from the quarry site, removal and treatment of contaminated water from the quarry, power washing and sealing rock fractures, and removal of residual radioactive materials from 17 vicinity properties. The vicinity properties, with the exception of the Southeast Drainage and the Frog Pond Outlet, were remediated to standards that are appropriate for unrestricted use and

do not require long-term stewardship activities. The Southeast Drainage area was excavated to remove contaminated soil and sediment from 55 locations along the length of the drainage to levels considered protective under a "modified residential/child recreational" scenario. Soils exceeding the uranium cleanup criteria remain beneath the Frog Pond Outlet area. A risk assessment incorporating both recreational and industrial worker scenarios determined that potential risk levels fell within the acceptable range set by the Environmental Protection Agency.



Weldon Spring Site

Reclamation of the chemical plant site included: the demolition of all site buildings; excavation of contaminated soil from former onsite disposal areas and building locations; dredging raffinate pit sludge and subsequent treatment by chemical stabilization and solidification; and dredging sediment from ponds and some vicinity properties. Wastes were disposed of in a 17-hectare (42-acre) disposal cell, which was constructed with a double liner and leachate collection system and a multi-layered cap to minimize radon emissions and prevent infiltration of water and intrusion by plants and animals. Approximately 1,132,000 cubic meters (1,480,000 cubic yards) of radioactive and chemical wastes, contaminated soils, sediment, and debris were disposed of in the Weldon Spring Site disposal cell. DOE anticipates the disposal cell will be completed and capped in 2002.

Contaminated groundwater remains beneath the chemical plant area of the site, primarily in the western and southwestern portions of the site. Contaminants to the southwest include trichloroethene (TCE), uranium, nitrate and nitroaromatic compounds (2,4-DNT; 2,6-DNT; 2,4,6-TNT and 2,6-DNT). Groundwater in the western portion of the site contains nitrate; 2,4-DNT and 2,6-DNT. Nitroaromatic contamination is also present to a lesser extent on the eastern portion of the site, east of the chemical plant in one offsite well (uranium) as well as in two small, noncontiguous areas to the northeast (nitrate; 2,6-DNT; 2,4,6-TNT and 1,3,5-DNB).

Burgermeister Spring is routinely monitored for uranium and nitrate, while two springs located within the Southeast Drainage area are currently monitored for uranium and nitroaromatic compounds.

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Site-Wide Long-Term Stewardship Activities

Because of the contamination resulting from past operations, long-term stewardship activities will be required at the Weldon Spring Site. These activities will include maintaining restrictions on groundwater use, land use, and site access, and monitoring groundwater and surface water. Long-term stewardship activities also will include monitoring and maintaining the disposal cell and operating the disposal cell leachate collection system.

> ***LONG-TERM STEWARDSHIP GOALS***
>
> Maintain restrictions on groundwater use, land use, and site access; and monitor groundwater and surface water for continued protection of human health and the environment.

All records related to implementation of the long-term monitoring and maintenance plan for the Weldon Spring Site will be maintained in permanent site files in accordance with archival procedures set forth in Federal property management regulations. An annual report will be developed to summarize, describe, and evaluate all monitoring and maintenance actions conducted at the Weldon Spring Site, including annual site inspections, groundwater and surface water monitoring, any corrective actions, and any other activities conducted in conjunction with the long-term operations, surveillance, and maintenance of the site. The annual reports will be included in permanent files stored onsite, and will be available for review by affected regulatory agencies and other stakeholders. Public or small group meetings may be held following distribution of the annual reports, based on level of interest.

Institutional Controls

Institutional controls for the quarry site include restrictions on groundwater use, as well as restrictions on land use in the vicinity of the quarry site to recreational uses. Institutional controls at the chemical plant site include access restrictions to the leachate sump system and land use restrictions outside of the perimeter road. The chemical plant area outside of the perimeter road remains under DOE control and is being revegetated with native grasses and plant species. Post-closure land use restrictions for the chemical plant are required to preserve the final grading patterns of the site, which provide erosion control and prevent any drainage back towards the disposal cell. Institutional controls are also required to protect and maintain access to monitoring wells. Institutional controls are necessary in the vicinity of the quarry site to prevent groundwater use that would be inconsistent with recreational use, contribute to groundwater contaminant migration, or restrict municipal access to groundwater for domestic usage. For the Southeast Drainage, the existing easement agreement with the Missouri Department of Conservation will be modified to impose restrictions on future land use in order to ensure that no private development occurs within the drainage proper.

> ***STAKEHOLDER INVOLVEMENT***
>
> Public involvement with the Weldon Spring Site is conducted in accordance with the requirements of the *Comprehensive Environmental Compensation, Response, and Liability Act* (CERCLA) and DOE and EPA public involvement guidelines. The Weldon Spring Citizens Commission was established in January 1995 to serve as a monitoring committee and communications link between DOE and St. Charles County citizens and elected county officials.

Some surface water monitoring sites and monitoring wells used for groundwater monitoring are not located on

DOE-controlled land, but are located on either the adjacent U.S. Army Weldon Spring Training Area or the Missouri Department of Conservation property. Access agreements are in place between DOE, the U.S. Army, and the Missouri Department of Conservation regarding access to these wells and will be maintained, as required, based on long-term monitoring needs.

2.2 Regulatory Regime

Long-term stewardship activities at the Weldon Spring Site will begin in 2003. A Memorandum of Understanding between DOE and the U.S. Army resulted in transfer of the ownership of the Weldon Spring Site to DOE in 1985. The quarry site was placed on the U.S. Environmental Protection Agency's (EPA's) National Priorities List in 1987, and the remainder of the site was placed on the National Priorities List in 1989. Remediation of the quarry site was completed in 1996, in accordance with the *Record of Decision for the Management of Bulk Wastes at the Weldon Spring Quarry*, and the *Record of Decision for Remedial Action for the Quarry Residuals Operable Unit* under the *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA) under the supervision of EPA and the State of Missouri. Remediation of the chemical plant site is being conducted in accordance with the 1993 *Chemical Plant Record of Decision* and *Record of Decision for the Chemical Plant Groundwater Operable Unit* (anticipated to be issued in 2000) under CERCLA. Requirements for surveillance and maintenance of the engineered disposal cell, long-term monitoring of groundwater and surface water, and maintenance of institutional controls at the quarry and chemical plant sites are established in these Records of Decision (RODs).

Section 120 of CERCLA requires the negotiation of a legally binding Federal Facilities Agreement between agencies (i.e., DOE and EPA). This agreement establishes timetables, procedures, and documentation for the remedial action. Under the CERCLA process, a ROD formally documents the selection of a preferred remedial alternative. The ROD is a legally enforceable document that ensures all components of the remedial action are implemented. Once issued, the ROD is incorporated into the Federal Facilities Agreement; therefore, any physical or institutional controls specified in the ROD will be enforceable through the Federal Facilities Agreement.

Three RODs have been signed for both the chemical plant area and quarry area. The Quarry Residuals Operable Unit (OU) ROD and the Chemical Plant OU ROD specify long-term monitoring activities as a portion of the selected remedy. The ROD for the quarry also discusses implementation of institutional controls as a component of the cleanup action. The ROD for the chemical plant states that any institutional controls pertinent to the future use of the property, such as restrictions on the use of land or groundwater, will be deferred until the final remedy for groundwater is determined.

In addition to CERCLA, long-term stewardship activities at the Weldon Spring Site will be governed by several regulations, including the *Atomic Energy Act of 1954,* as amended; EPA groundwater protection standards, including Subparts B and C of the *Code of Federal Regulations*; and cooperative agreements with the U.S. Army, EPA, and the State of Missouri.

2.3 Assumptions and Uncertainties

Assumptions for the Weldon Spring Site are generally that the final site remediation and long-term stewardship activities will be conducted in accordance with the CERCLA RODs for the quarry and chemical plant sites. Uncertainties are addressed through contingency plans developed for the site. These plans address such issues as disposal cell cover settlement, biointrusion, surface erosion, changes in leachate flow rates, and potential migration of contaminants in the vicinity of the St. Charles County wellfield.

2.4 Estimated Site-Wide Long-Term Stewardship Costs

Long-term stewardship cost estimates for the Weldon Spring Site, identified in the table below, were based on a detailed long-term surveillance and maintenance cost estimate developed by the Weldon Spring Remedial Action Project. These estimates and were reviewed by DOE's Grand Junction Office.

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	***Amount***	***Year(s)***	***Amount***	***Year(s)***	***Amount***
FY 2000	$0	**FY 2008**	$1,005,589	**FY 2036-2040**	$5,027,945
FY 2001	$0	**FY 2009**	$1,005,589	**FY 2041-2045**	$5,027,945
FY 2002	$0	**FY 2010**	$1,005,589	**FY 2046-2050**	$5,027,945
FY 2003	$1,005,589	**FY 2011-2015**	$5,027,945	**FY 2051-2055**	$5,027,945
FY 2004	$1,005,589	**FY 2016-2020**	$5,027,945	**FY 2056-2060**	$5,027,945
FY 2005	$1,005,589	**FY 2021-2025**	$5,027,945	**FY 2061-2065**	$5,027,945
FY 2006	$1,005,589	**FY 2026-2030**	$5,027,945	**FY 2066-2070**	$5,027,945
FY 2007	$1,005,589	**FY 2031-2035**	$5,027,945		

3.0 PORTION OVERVIEW

The Weldon Spring Site's long-term stewardship activities will be performed at two portions of the site: the chemical plant site portion and the quarry groundwater portion. For the purposes of this report, a "portion" is a geographically contiguous and distinct area (which may involve residually contaminated facilities, engineered units, soil, groundwater, an/or surface water/sediment) for which cleanup, disposal, or stabilization will have been completed and long-term stewardship activities will be required as of 2006. These areas were reported as separate portions because they are 6.5 kilometers (four miles) apart, and because of their varying contamination and cleanup requirements. DOE conducted the active cleanup of these areas as separate operable units.

Long-Term Stewardship Information		
Portion	***Long-Term Stewardship Start Year***	***Long-Term Stewardship End Year***
Chemical Plant	2003	In perpetuity
Quarry Groundwater	2003	In perpetuity

3.1 Weldon Spring Chemical Plant Site Portion

The Weldon Spring Chemical Plant site portion consists of 87.8 hectares (217 acres) and operated as the Weldon Spring Uranium Feed Materials Plant until 1966. The plant converted uranium concentrates to uranium tetrafluoride and uranium metal. Thorium, also a radioactive metal, was processed at the plant. Residues from the processing operations were disposed in four large open raffinate pits that consisted of four settling basins covering 10.5 hectares (26 acres). The pits were radiologically contaminated with uranium and thorium residues, and chemical contaminants, including nitrate, fluoride, polychlorinated biphenyls (PCBs), and heavy metals. The

site also had two ponds: Ash Pond and Frog Pond. During plant operations from 1957 to 1966, the plant, buildings, equipment, soil surface, sewer system, and drainage into the Missouri River became contaminated with uranium and thorium and their decay products. The buildings were contaminated with asbestos, hazardous chemical substances, uranium, and thorium. After site reclamation activities, the groundwater and engineered disposal cell will require long-term stewardship activities.

WELDON SPRING CHEMICAL PLANT SITE HIGHLIGHTS

Major Long-Term Stewardship Activities - site inspections; groundwater monitoring; institutional controls
Portion Size - 87.8 hectares (217 acres)
Estimated Volume of Residual Contaminants - engineered units 1.13 million cubic meters (1.48 million cubic yards); groundwater unknown
Long-Term Stewardship Start-End Years - 2003-in perpetuity
Average Annual Long-Term Stewardship Cost FY 2003-2006 - $671,000

Long-term stewardship activities for the chemical plant site portion will include leachate management, site inspections, groundwater monitoring, lab analyses, record-keeping, and report preparation in accordance with the CERCLA RODs for both the chemical plant site and associated groundwater area. After remediation is complete, the final chemical plant site area will consist of the disposal cell, a leachate sump located to the north of the cell, and the perimeter access road. The land outside the perimeter road will remain under DOE control and will be revegetated with native grasses and plant species. At some point in the future, portions of this property may be permitted for use by other agencies, provided this use is consistent with land use restrictions and requirements.

Two buildings will remain at the chemical plant – the main administration building and the access control building. The administration building will be leased to Francis Howell School District for expansion of their administrative offices. Building maintenance and utilities upkeep will be the responsibilities of the school district. The access control building will house the Weldon Spring Site Interpretive Center. With the exception of the leachate sump, there will be no access restrictions around the disposal cell.

3.1.1 Groundwater

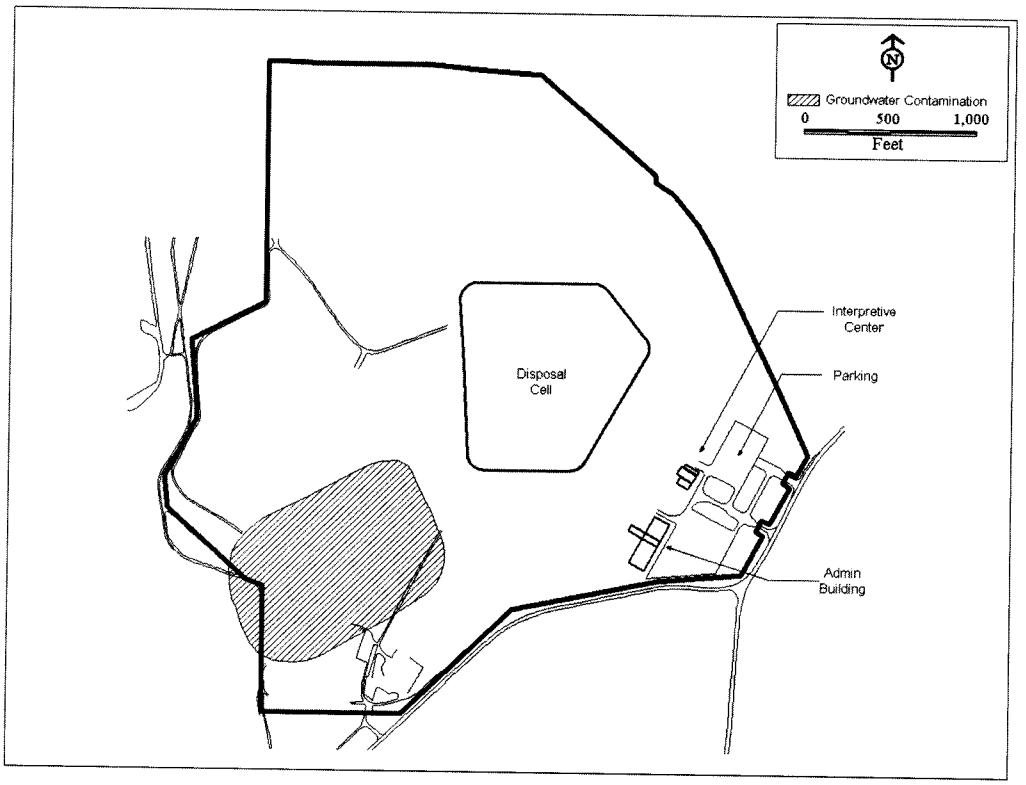
Contaminated groundwater, approximately 14 hectares (35 acres), remains beneath the chemical plant area of the site, primarily in the western and southwestern portions of the site. The chemical plant area is located on the Missouri-Mississippi River surface drainage divide. The northern and western portions of the site drain to tributaries flowing into the Mississippi River, while the southern portion of the site generally flows to the southeast drainage area tributary, which flows to the Missouri River. A similar groundwater divide transects the southern portion of the site, with groundwater from the southern portion of the site flowing towards the Mississippi River, and groundwater from the north and western portions flowing towards the Missouri. The Burgermeister Spring provides a localized point of emergence for groundwater flowing from the western and northern portions of the site.

The disposal cell groundwater monitoring system consists of five monitoring wells (four downgradient and one upgradient of the Burgermeister Spring). The system is designed to provide long-term monitoring of the disposal cell in compliance with the Resource Conservation and Recovery Act (RCRA) groundwater monitoring standard detailed in Title 40 of the *Code of Federal Regulations*, Part 264, Subpart F, and State regulation 10 CSR 25-7.264(2)(F). The system monitors groundwater quality in the shallow aquifer.

Standard operating procedures will be developed for monitoring well installation and development, water sampling, sample preservation and transport, field procedures, and chain of custody. All aspects of groundwater monitoring will be conducted in accordance with these procedures. The standard operating procedures are based

on industry standards, "best management" practices, and EPA guidance.

Details regarding implementation of the long-term monitoring program for groundwater at the chemical plant site will be developed once the groundwater ROD is finalized.



Weldon Spring Chemical Plant

Groundwater Long-Term Stewardship Activities

Long-term stewardship activities for the disposal cell groundwater monitoring system include contaminant detection monitoring, which will be conducted on a semi-annual basis for all compliance wells and Burgermeister Spring. DOE anticipates that if contaminant concentrations decrease over time and the disposal cell performance measures remain stable for a period of 30 years, the compliance monitoring program may be discontinued. If trends indicate an upward movement in contaminant concentrations, necessitating corrective actions for the cell, the program may be extended past the 30-year period, based upon discussion between DOE and the EPA. Long term stewardship activities for the site groundwater portion will be developed once the groundwater ROD is finalized.

3.1.2 Engineered Units

The disposal cell is the only remaining facility on the chemical plant portion that contains contaminated materials and requires long-term stewardship activities. The cell encompasses 17 hectares (42 acres). The cell was constructed with a double liner, a leachate collection system, and a multi-layered cap to minimize radon

emissions and prevent infiltration of water and intrusion by plants and animals. Approximately 1.13 million cubic meters (1.48 million cubic yards) of radioactive and chemical waste, and contaminated soil, sediment and debris are disposed of in the Weldon Spring Site disposal cell. DOE anticipates that the disposal cell will be completed and capped in 2002.

Engineered Unit Long-Term Stewardship Activities

Visual inspections of the disposal cell will be conducted on an annual basis. The inspection results will be recorded in the site maintenance log. Photographs will be taken, as necessary, to document changing site conditions. Annual inspections will continue for the first five years following closure of the disposal cell. If no changes are evident after this five-year time frame, inspections may be decreased as deemed appropriate.

3.1.3 Estimated Long-Term Stewardship Costs for Chemical Plant (Disposal Cell and Site Groundwater)

Long-Term Stewardship Costs (Constant Year 2000 Dollars)							
FY 2000 - FY 2010	*FY 2011 - FY 2020*	*FY 2021 - FY 2030*	*FY 2031 - FY 2040*	*FY 2041 - FY 2050*	*FY 2051 - FY 2060*	*FY 2061 - FY 2070*	*Estimated Total*
$5,370,656	$6,713,320	$6,713,320	$6,713,320	$6,713,320	$6,713,320	$6,713,320	$45,650,576

3.2 Quarry Groundwater Portion

The Weldon Spring Site quarry is a 3.6-hectare (nine-acre) limestone quarry located 6.5 kilometers (four miles) southwest of the chemical plant area. This site was historically used for disposal of manufacturing waste created during the ordnance works activities, contaminated process residue and building rubble from the decommissioning of the ordnance works, and radiologically contaminated wastes from the chemical plant area processing activities. No direct surface water runoff enters or exits the quarry due to the topography of the area. Prior to remediation, a small (0.08-hectare/0.2-acre) pond within the quarry proper acted as a sump to accumulate both direct rainfall and groundwater. Groundwater in the area is located within both alluvial and bedrock aquifer systems, and flows towards the Missouri River.

QUARRY GROUNDWATER HIGHLIGHTS

Major Long-Term Stewardship Activities - inspections; groundwater monitoring; institutional controls
Portion Size - 3.6 hectares (9 acres)
Estimated Volume of Residual Contaminants - groundwater 85,000 cubic meters (110,000 cubic yards)
Long-Term Stewardship Start-End Years - 2003-in perpetuity
Average Annual Long-Term Stewardship Cost FY 2003-2006 - $334,000

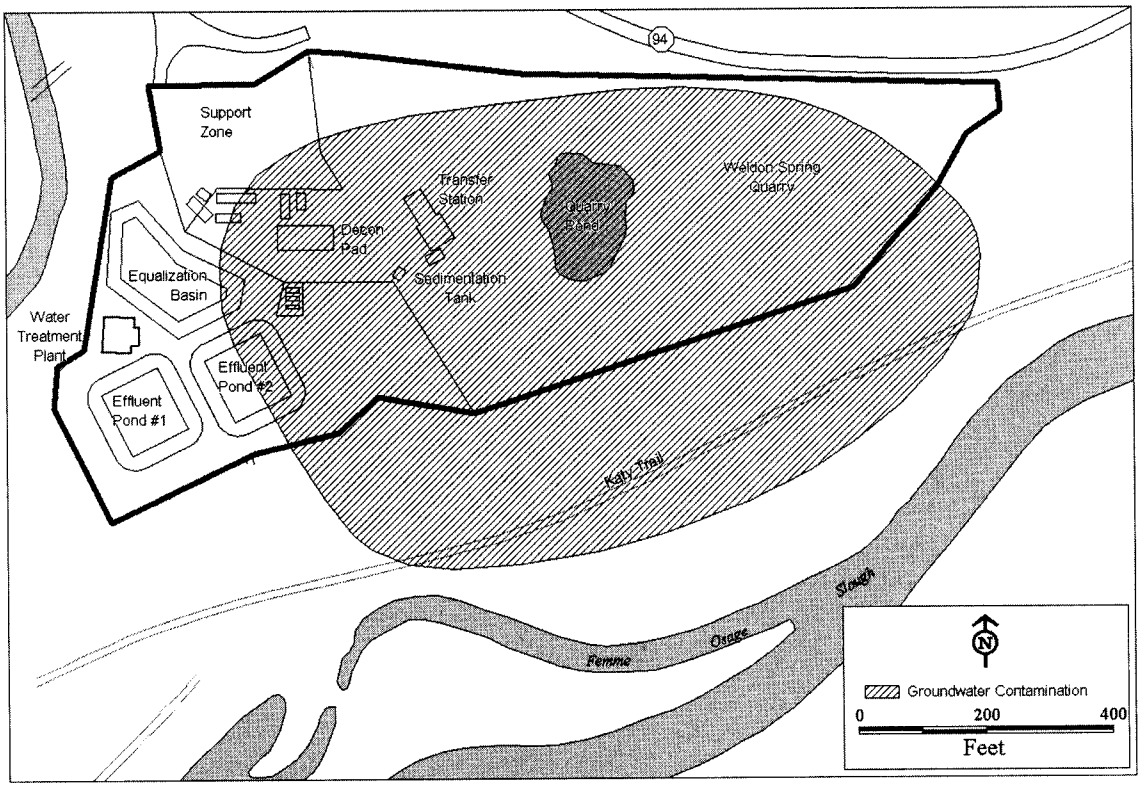
3.2.1 Groundwater

Approximately 110,000 cubic meters (144,000 cubic yards) of soil and waste material were removed from the quarry and transported to the chemical plant area as part of the remedial action stipulated in the CERCLA ROD for the management of the bulk wastes at the Weldon Spring Site quarry. Bulk waste removal was completed in October 1995. These wastes were staged in the Temporary Storage Area and were subsequently placed in the disposal cell in 1999. Rock fractures were power washed and sealed, to the extent practicable, to assist in removing residual contamination. Contaminated water contained in the quarry pond was also removed and treated through the quarry site water treatment plant. Quarry restoration is scheduled for completion in 2001. Restoration activities include demolition of the water treatment plant and other facilities used during bulk waste

removal, as well as backfilling of the quarry proper.

The ROD for the quarry identified long-term monitoring and institutional controls on groundwater usage as a component of the selected remedy. For uranium levels in the groundwater to the north of the Femme Osage Slough, the potential estimated risk is greater than the acceptable risk range of 10^{-6} to 10^{-4}. Both uranium and 2,4-DNT are being monitored in this area. South of the slough, uranium levels are within background ranges, and will continue to be monitored to ensure that levels remain protective.

As part of the remedial investigation/feasibility study process, risk assessments for both radiological and chemical contaminants were conducted on surface waters and sediment from the upper and lower reaches of the Femme Osage Slough, Little Femme Osage Creek, and downstream portions of the Femme Osage Creek. Results indicated that, under a recreational scenario, the potential risk for the slough and creeks is within or below the acceptable risk range of 10^{-6} to 10^{-4} and no further actions were warranted.



Quarry Groundwater Portion

Groundwater Long-Term Stewardship Activities

Contaminated groundwater north of the Femme Osage Slough was addressed as part of the Quarry remedial action. The St. Charles County well field is in close proximity to the area south of the slough. Monitoring of groundwater south of the slough will be conducted to ensure that residual contamination remains at levels deemed protective of human health and the environment.

Institutional controls for the groundwater north of the slough are necessary to prevent uses inconsistent with

recreational uses, or that would adversely affect contaminant migration. DOE, the Missouri Department of Conservation, and the Missouri Department of Natural Resources will establish a deed restriction that outlines the terms of an agreement to limit access to groundwater north of the slough for irrigation, consumption, or use as a surface water source. The terms of the agreement will be reviewed as part of each DOE five-year review cycle under CERCLA.

Once the long-term groundwater monitoring program is established for this operable unit, long-term stewardship activities will be defined, as appropriate. DOE will be responsible for groundwater monitoring activities. Access agreements are in place between the Missouri Department of Conservation and DOE to allow long-term access to the quarry monitoring well network.

3.2.2 Estimated Long-Term Stewardship Costs for Quarry Groundwater

Long-Term Stewardship Costs (Constant Year 2000 Dollars)							
FY 2000 - FY 2010	***FY 2011 - FY 2020***	***FY 2021 - FY 2030***	***FY 2031 - FY 2040***	***FY 2041 - FY 2050***	***FY 2051 - FY 2060***	***FY 2061 - FY 2070***	***Estimated Total***
$2,674,056	$3,342,570	$3,342,570	$3,342,570	$3,342,570	$3,342,570	$3,342,570	$22,729,476

4.0 FUTURE USES

A 17-hectare (42-acre) disposal cell will remain onsite in the chemical plant area. The disposal cell is accessible to the public and there are no access restrictions, except for the leachate sump. The chemical plant site area that is not occupied by the disposal cell, or otherwise required to be retained by DOE to perform long-term stewardship activities, will be released, as appropriate, subject to future land use restrictions. Currently, DOE anticipates that future land use of the chemical plant site outside of the perimeter road will include a combination of open space, recreational, and controlled access areas. DOE anticipates that the quarry site could be released to a Federal or state agency for recreational use. Final decisions concerning the future uses of the Weldon Spring Site will be based on the CERCLA five-year review process and the long-term monitoring requirements for groundwater at the site.

For additional information about the Weldon Spring Site, please contact:

Thomas Pauling, Environmental Engineer
U.S. Department of Energy, Weldon Spring Site Remedial Action Project
7295 Highway 94 South
St. Charles, MO, 63304
Phone: 636-441-8978
or visit the Internet website at http://www.em.doe.gov/wssrap

WESTLAKE DISPOSAL SITE[1]

1.0 SITE SUMMARY

1.1 Site Description and Mission

The Westlake Disposal Site is located near the city of St. Louis, Missouri, along the floodplain of the Missouri River and adjacent to agricultural land. The 81-hectare (200-acre) site has been used since 1962 for disposing of municipal refuse, industrial solid and liquid wastes, and construction demolition debris.

SITE HIGHLIGHTS

Total Site Area - 81 hectares (200 acres)
Reason Not Subject to NDAA Requirements - DOE is not expected to be responsible for long-term stewardship at the site

From 1939 to 1985, limestone was quarried on the site. Beginning in 1962, portions of the property were used for disposing of solid and liquid industrial wastes, municipal refuse, and construction debris. In 1973, Cotter Corporation disposed of over 47,000 tons of uranium ore processing residues mixed with soil in two areas covering a total of 6 hectares (16 acres) of the site.

1.2 Site Cleanup and Accomplishments

Due to these past disposal practices, radioactive contaminants (e.g., uranium) have been found in the soil and in groundwater beneath the site. Potential contaminant pathways exist for people who come into direct contact with or ingest contaminated groundwater or soil.

In 1976, the Missouri Department of Natural Resources (MDNR) closed the unregulated landfill. Since that time, MDNR had issued several permits for various portions of the 200-acre site. In 1990, an operating sanitary landfill had a permitted area of 52 acres (21 hectares), and an operating demolition landfill had a permitted area of 22 acres (9 hectares).

After listing the site on U.S. Environmental Protection Agency's (EPA) National Priorities List, the EPA completed a preliminary study and determined that no immediate actions were necessary at the Westlake Disposal Site while site studies were underway. A radiological survey conducted for the Nuclear Regulatory Commission (NRC) in 1981 and 1982 documented radioactive wastes on site. Property adjacent to the landfill was investigated in 1990, which identified radiological contamination that migrated from the landfill. Results indicate that large volumes of uranium ore residues, probably originating from the Hazelwood, Missouri, Latty Avenue site (DOE-leased property), have been buried at the Westlake Disposal Site. Two areas of contamination, covering more than 6 hectares (15 acres) and located at depths of up to 6 meters (20 feet) below the present surface, have been identified. There is no indication that significant quantities of contaminants are moving offsite

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[1]This report is developed in response to a Congressional request in the Fiscal Year (FY) 2000 National Defense Authorization Act (NDAA). As requested by the Act, this report addresses current and anticipated long-term stewardship activities at each site or portion of a site by the end of calendar year 2006 ("Conference Report on S.1059, National Defense Authorization Act for Fiscal Year 2000," *Congressional Record,* August 5, 1999).

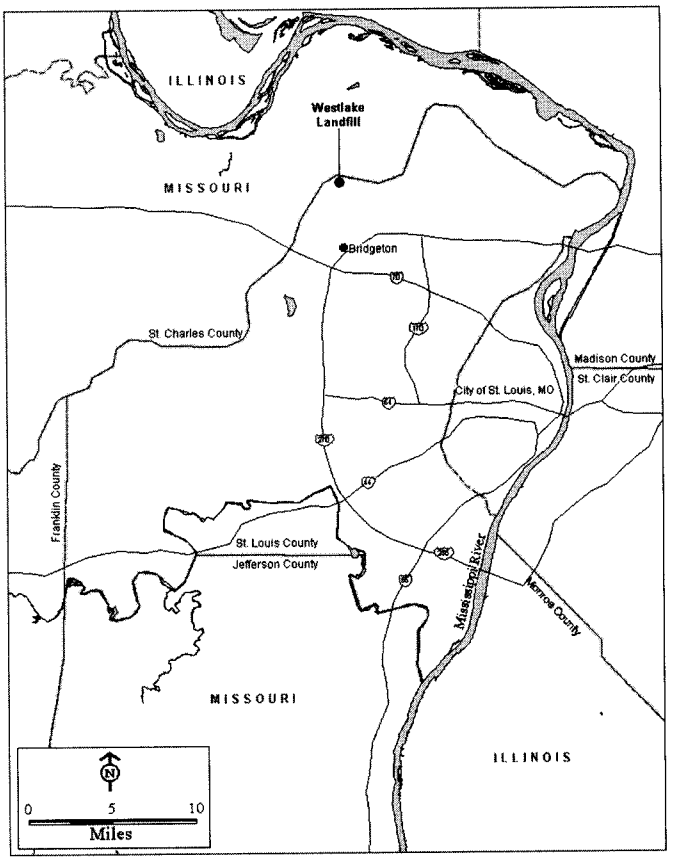
Based on current planning, the U.S. Department of Energy is not expected to be responsible for the long-term stewardship activities at the Westlake Disposal Site. However, since DOE sent waste to the disposal site and DOE was identified as a potentially responsible party, a description of the site and possible long-term stewardship responsibilities are included. (See Section 2.1.2 of Volume I).

at this time. However, in 1990, an estimated 60 people obtained drinking water from private wells within three miles of the site.

Studies are still being conducted to explore the nature and extent of contamination. The information will be used to identify the best cleanup strategy for the radiologic contaminants at the site and for the chemical contamination from the landfill.

2.0 EXPECTED FUTURE USES AND SITE RESPONSIBILITY

The Westlake Disposal Site is being addressed through Federal and potentially responsible parties' actions. It is possible that a portion of the radioactive waste disposed in the Westlake landfill was from the Latty Avenue Properties, a 4.6-hectare (11.6-acre), DOE-leased property used for interim storage of materials removed from vicinity properties. However, DOE's responsibility for both remediation and long-term stewardship activities as well as financial commitments have yet to be determined.



Westlake Disposal Site

For additional information about the Westlake Disposal Site, please contact:

the Environmental Protection Agency's Internet website at
http://www.epa.gov/region07/programs/spfd/nplfacts/westlake_landfill.pdf

Nebraska

Long-Term Stewardship Site Highlights

Hallam Nuclear Power Facility (page 3)
Major Activities - groundwater monitoring
Site Size - 7.3 hectares (18 acres)
Start/End Years - 1998/past 2070
Estimated Average Annual Cost FY 2006 - $46,000

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Hallam Nuclear Power Facility 3

HALLAM NUCLEAR POWER FACILITY

1.0 SITE SUMMARY

1.1 Site Description and Mission

The Hallam Nuclear Power Facility is a former sodium-cooled, graphite-moderated nuclear reactor. It was built and operated by the U.S. Atomic Energy Commission (AEC), the predecessor agency of the U.S. Department of Energy (DOE), between 1962 and 1964. The reactor was decommissioned and dismantled in 1969. The facility is located on a small portion of the 260-hectare (640-acre) site of the Sheldon Power Station in Lancaster County, Nebraska, approximately 30 kilometers (19 miles) south of Lincoln, on land owned by the Nebraska Public Power District.

LONG-TERM STEWARDSHIP HIGHLIGHTS

Major Long-Term Stewardship Activities - groundwater monitoring
Total Site Area - 7.3 hectares (18 acres)
Estimated Volume of Residual Contaminants - facilities unknown
Long-Term Stewardship Start-End Years - 1998-past 2070
Average Annual Long-Term Stewardship Cost FY 2000-2006 - $46,000
Landlord - U.S. Department of Energy, Grand Junction Office

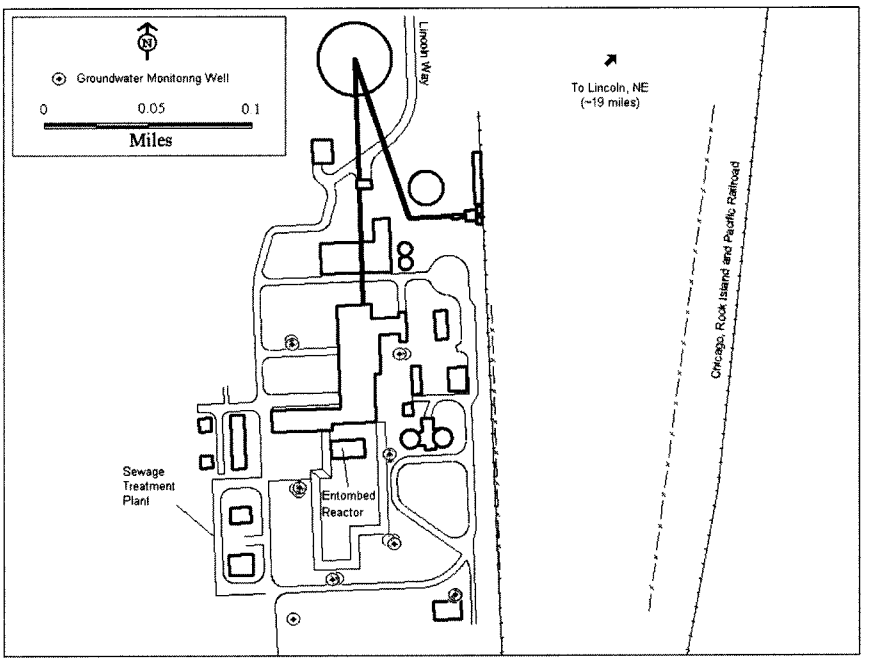
The current mission of the Hallam Nuclear Power Facility is to perform long-term stewardship activities, including monitoring of the groundwater. The AEC operated the 240-megawatt thermal reactor as a demonstration facility from 1962 until 1964. In 1965, the AEC terminated its agreement with the Nebraska Public Power District (then known as Consumers Public Power District) to operate the reactor facility. The Nebraska Public Power District dismantled and decommissioned the reactor from 1967 through 1969. In 1971, the AEC retired the facility.

1.2 Site Cleanup and Accomplishments

The Nebraska Public Power District dismantled and decommissioned the reactor core and removed most of the radioactive materials from the site; however, some radioactive materials were entombed in place. All potential contaminants at the site are contained within the entombment structure in Area 1 (reactor vessel and vessel containment structures), Area 2 (Fuel Storage Pit 3 thimbles), or Area 3 (moderator element storage cells). These contaminants include nickel-63, cobalt-60, iron-55, manganese-54, samarium-151, cesium-137, strontium-90, and tritium. The contaminants within the structure consist of activation products in the stainless steel reactor vessel and its internals. Lesser amounts of activation products are dispersed in the carbon steel thermal shield and guard vessel surrounding the reactor vessel and in the compartment liner itself.

The core and most of the radioactive materials, including all of the bulk sodium, were removed from the site. The residual sodium reacted with steam to form sodium hydroxide, removing the potential for hydrogen formation at a later date should water leak into the facility. The reactor vessel and surrounding guard vessel, which use double-walled piping, as well as most of the reactor vessel internals, remain within the compartment. Fuel Storage Pit 3 contains a number of stainless steel thimbles formerly used to store spent fuel elements. The storage pool was drained, and the thimbles now contain process tubes, control rod tubes, dummy elements, and a spent neutron source. To prevent leaks, closures and dust covers for each thimble have been welded in place and the interspace has been filled with expanding concrete.

Storage Area 3 consists of 12 storage cells containing three canistered moderator elements that experienced cladding failures during reactor operation. A number of parts such as pumps, valves, and segments of piping are stored in these cells. The moderator cells were sealed by welding the plug casings to the cell liners and filling



Hallam Nuclear Power Facility

the space above the plugs with expanding concrete.

The basement level of the facility contained radioactive waste disposal equipment, all of which has either been removed or decontaminated, as appropriate. All reactor compartments have been sealed, and the surface of the below-grade concrete structure was covered with sand, a waterproof polyvinyl membrane, and a covering of earth. The cover was sloped for proper drainage, and drain tile was installed at the periphery. Above-grade structures have been weatherproofed by a layer of polyvinyl and a protective cover of concrete. All that remains above ground is the sealed concrete intermediate heat exchanger building. Total radioactivity was 300,000 curies at the time of closure. By 2000, the activity level will have decayed to approximately 15,000 curies.

There is no known soil or groundwater contamination at the Hallam Nuclear Power Facility and no evidence of contamination being released from the site.

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

Although the Nebraska Public Power District owns the property, DOE currently has the responsibility to perform long-term stewardship activities for the entombed reactor structure at the Hallam Nuclear Power Facility. Long-term stewardship responsibility was transferred to the DOE Grand Junction Office in 1998. The former reactor site is now a 0.6 hectare (1.4 acre) grass-covered mound with a heat exchanger building. The installation of a shallow groundwater monitoring system was completed in 1995 and is used as part of the surveillance program for the entombed reactor. Groundwater monitoring is conducted annually and will continue indefinitely. Site records are kept in permanent storage at the DOE Grand Junction Office in Colorado. The types of records kept include characterization data, decommissioning design information, decommissioning report, annual inspection

reports, and groundwater monitoring results. In addition, the Nebraska Public Power District will control access to the site due to contaminated buried materials.

2.2 Specific Long-Term Stewardship Activities

Groundwater

Although there is no known groundwater contamination at the site, groundwater monitoring is conducted annually to ensure the stability of the entombed reactor. Water level measurements are obtained from all 19 DOE wells. Samples for analysis are obtained from 17 of the DOE wells. The samples are analyzed for gross alpha, gross beta, tritium, gamma spectrometry, and nickel-63. The annual monitoring and surveillance report discusses the results of the groundwater monitoring and summarizes the physical condition of the site. This report also discusses the need for follow-up inspections, monitoring, or maintenance actions, should any be necessary.

STAKEHOLDER INTERACTION

Community interaction at the site has been minimal to date. DOE sends a copy of the site's annual inspection report to the State of Nebraska and the Nebraska Public Power District.

Facilities

The reactor is entombed onsite. Access to the property is restricted, as entry can only be made through the secured property of an operating power plant where the site is located. Potential contaminants remain within the entombed reactor; however, DOE does not conduct any active monitoring of this area.

2.3 Regulatory Regime

Long-term stewardship activities at the Hallam Nuclear Power Facility is governed by several requirements in the following regulations: the *Atomic Energy Act of 1954,* as amended; EPA Groundwater Protection Standards; and the *National Environmental Policy Act of 1969,* as amended.

2.4 Assumptions and Uncertainties

DOE's Grand Junction Office plans to evaluate the monitoring program and may decrease the sampling frequency and the number of sampling locations. However, for the purpose of this report, groundwater monitoring is assumed to continue indefinitely. Because the site is already performing long-term stewardship activities, these activities are well known and are not expected to change dramatically. Site surveillance and maintenance will be required past 2070.

3.0 Estimated Long-Term Stewardship Costs

The following table shows the estimated costs of long-term stewardship activities for the Hallam Nuclear Power Facility. Because the site is already conducting long-term stewardship activities, costs are based on actual costs. The costs below include repairs to the roof and walls of the concrete structure in fiscal year (FY) 2001. These cost estimates reflect the current site agreements and monitoring frequencies. Thus, if the frequency and the number of sampling locations decrease, the costs will decrease.

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	***Amount***	***Year(s)***	***Amount***	***Year(s)***	***Amount***
FY 2000	$44,000	**FY 2008**	$30,500	**FY 2036-2040**	$208,100
FY 2001	$125,700	**FY 2009**	$30,500	**FY 2041-2045**	$160,000
FY 2002	$30,700	**FY 2010**	$30,500	**FY 2046-2050**	$160,100
FY 2003	$29,600	**FY 2011-2015**	$146,100	**FY 2051-2055**	$160,000
FY 2004	$30,000	**FY 2016-2020**	$187,700	**FY 2056-2060**	$208,100
FY 2005	$30,300	**FY 2021-2025**	$149,700	**FY 2061-2065**	$160,000
FY 2006	$30,700	**FY 2026-2030**	$158,400	**FY 2066-2070**	$160,100
FY 2007	$30,500	**FY 2031-2035**	$160,000		

4.0 FUTURE USES

The site is within an electrical generating power station owned by Nebraska Public Power District, which maintains security for the site. The facility will remain under controlled access due to contaminated materials. No drilling or other intrusive activities are allowed on the property. For any future inquiries, county land title records have been annotated regarding the presence of the decommissioned facility.

For more information about the Hallam Nuclear Power Facility, contact:

Art Kleinrath, Long-Term Surveillance and Maintenance Program Manager
U.S. Department of Energy, Grand Junction Office
2597 B3/4 Road, Grand Junction, CO 81503
Phone: 970-248-6037
or visit the Internet website at http://www.doegjpo.com

Nevada

Project Shoal

Central Nevada Test Area

Nevada Test Site and Tonopah Test Range

Long-Term Stewardship Site Highlights

Central Nevada Test Area (page 3)

Major Activities - groundwater monitoring; enforcing access restrictions for surface and subsurface contamination
Site Size - 1,036 hectares (2,560 acres)
Surface Start/End Years - 2001/in perpetuity
Subsurface Start/End Years - 2012/in perpetuity
Estimated Average Annual Cost FY 2000-2006 - $37,000

Nevada Test Site and Tonopah Test Range (page 9)

Major Activities - maintain site-wide institutional controls; conduct surveillance and monitoring around waste disposal areas; monitor groundwater flow from underground test areas
Site Size- 517,739 hectares (1,279,360 acres)
Estimated Average Annual Cost FY 2000-2006 - $1,540,000

Project Shoal (page 49)

Major Activities - groundwater monitoring; enforcing access restrictions for subsurface contamination
Site Size - 1,036 hectares (2,560 acres)
Surface Start/End Years - 1998/in perpetuity
Subsurface Start/End Years - 2008/in perpetuity
Estimated Average Annual Cost FY 2000-2006 - $37,000

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Central Nevada Test Area 3

Nevada Test Site and Tonopah Test Range 9

Project Shoal 49

CENTRAL NEVADA TEST AREA

1.0 SITE SUMMARY

1.1 Site Description and Mission

The Central Nevada Test Area (CNTA) covers approximately 1,036 hectares (2,553 acres) and is located approximately 97 kilometers (60 miles) northeast of Tonopah, Nevada, in a sparsely populated area. The CNTA was used by the U.S. Atomic Energy Commission (AEC), later known as the U.S. Department of Energy (DOE), for one subsurface nuclear test, known as Faultless, conducted on January 19, 1968. The test was designed to study the behavior of seismic waves and to determine the site's suitability for further high-yield weapons testing. The test produced a yield of between 200 and 1,000 kilotons and was detonated at a depth of 975 meters (3,200 feet). Seismic movement resulting from the Faultless test disqualified the site for larger tests. No additional testing was conducted at CNTA.

LONG-TERM STEWARDSHIP HIGHLIGHTS

Major Long-Term Stewardship Activities - groundwater monitoring; enforcing access restrictions for surface and subsurface contamination
Total Site Area - 1,036 hectares (2,560 acres)
Estimated Volume of Residual Contaminants - unknown
**Surface Long-Term Stewardship Start-End Years* - 2001-in perpetuity
**Subsurface Long-Term Stewardship Start-End Years* - 2012-in perpetuity
Average Annual Long-Term Stewardship Cost FY 2000-2006 - $37,000
Landlord - U.S. Department of Interior
*For purposes of this report, long-term stewardship activities for the surface will begin when surface remediation is complete in 2001. However, DOE recognizes that subsurface investigation and modeling activities will continue beyond the surface completion date.

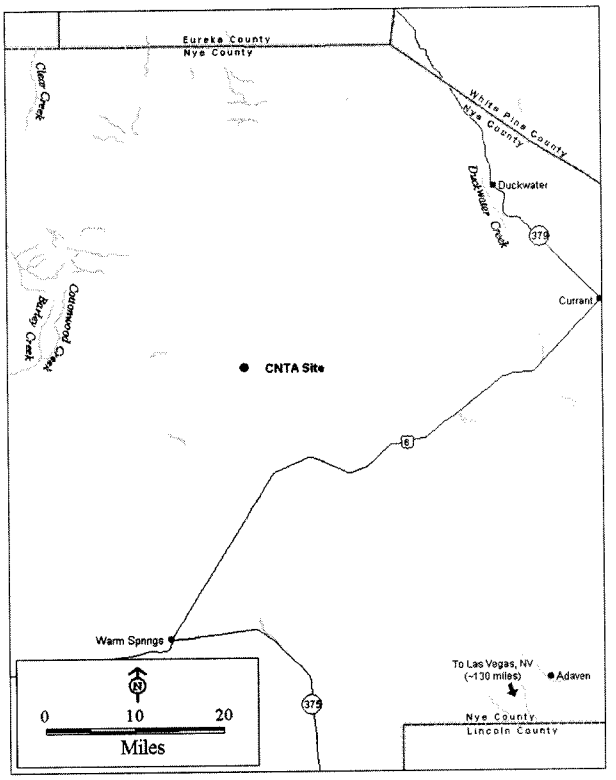
The CNTA is currently managed by DOE under a land withdrawal from the U.S. Department of the Interior. Under the withdrawal agreement, the U.S. Department of Interior and the U.S. Department of Agriculture will accept transfer of the CNTA surface after surface closure is complete. DOE's ongoing mission at the site is to complete remediation of surface contamination, characterize the subsurface contamination, and continue long-term stewardship activities for the subsurface contamination.

1.2 Site Cleanup and Accomplishments

The potential contaminants of concern for the subsurface are mixed fission products, plutonium, uranium, and tritium. DOE began modeling of the groundwater in 1999 but will collect additional data to reduce uncertainties associated with the model. Between 2000 and 2006, DOE will prepare a Data Decision Analysis to guide the collection of additional site data, which will reduce the groundwater uncertainties; collect site-specific data; prepare a well completion report; and develop the second groundwater model. Between 2006 and closure of the subsurface in 2012, DOE will establish a compliance boundary and potential refinement to the existing subsurface intrusion restrictions, based on modeling results, and implement a five-year proof-of-concept monitoring program. However, DOE does not plan to remediate the subsurface contamination because of the lack of feasible technologies for removing subsurface contamination from the site.

Drilling operations for the emplacement holes and for post-test sampling resulted in contaminated mud pits. The potential contaminants of concern on the surface are total petroleum hydrocarbons, lead, chromium, and tritium. The State of Nevada has agreed to allow surface-contaminated soils to remain in place at two mud pits, the UC-1 central mud pit and the UC-4 mud pit. These areas cover 1.4 and 0.1 hectares (3.5 and 0.3) acres respectively, with a total volume of 51,540 cubic meters (67,500 cubic yards) of contaminated soils. The uncapped central mud pit is a potential physical hazard to livestock and wildlife. DOE will cap the mud pits with a native soil barrier to control erosion, limit precipitation infiltration, and mitigate potential exposure pathways. DOE used the capped soil areas in lieu of a clean closure due to the arid, remote location of CNTA. DOE expects to complete the final capping of surface contamination in 2001. The cap will be modified for consolidation and

visually inspected for erosions, animal burrowing, water ponding, and vegetation growth. The cap will be monitored for six months, followed by semi-annual monitoring for two years. The frequency of the cap monitoring after this period will be negotiated with the State.



Central Nevada Test Area

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

Surface remediation will be complete and institutional controls, if necessary, will be in place by 2001 for the long-term stewardship of the surface. DOE will continue to investigate and model subsurface contamination, which is not expected to be complete until 2012. Existing subsurface intrusion restrictions will be refined, as necessary, based on the outcome of the investigation and modeling efforts.

DOE will be responsible for monitoring and maintaining institutional controls over the subsurface contamination in perpetuity. DOE will initiate agreements with the U.S. Department of the Interior to transfer responsibility for the surface area to the Department of Interior under the land withdrawal agreement. DOE anticipates that the CNTA will continue to be managed for the foreseeable future by the Department of the Interior and used for cattle grazing. DOE will continue to restrict access to the test cavity, subsurface soil, and groundwater through the use of institutional controls. DOE will conduct periodic monitoring to analyze contaminant migration from the test cavity to the groundwater.

DOE maintains the project-specific records at the Nevada Operations Office in Las Vegas, Nevada, per the requirements set forth in the Federal Facility Agreement and Consent Order (FFACO). These records include Corrective Action Investigation Work Plans and reports; Corrective Action Decision Documents; health assessments; risk assessments; information submitted by the public; National Environmental Policy Act documents; Public Involvement Plan; public notices; and the FFACO. The DOE Public Reading Facility and the Nevada Division of Environmental Protection Administrative Record are provided with copies of these documents. Upon the completion of the project, all DOE project files will be transferred to controlled storage at the Nevada Operations Office. Records are retained according to DOE and Department of Defense records retention procedures. DOE shall notify Nevada Division of Environmental Protection at least 180 calendar days prior to the proposed destruction or disposal of any documents or records described above.

2.2 Specific Long-Term Stewardship Activities

Groundwater

DOE will maintain institutional controls over the subsurface to prevent access to the test cavities, groundwater, and associated subsurface contamination in perpetuity. The institutional controls will include a restriction on all subsurface intrusions on the site. A monument has been placed at the site to mark the location of the test. DOE will continue to conduct periodic groundwater monitoring at the site for at least 100 years after closure of the subsurface in 2012. DOE estimates that repair or replacement of groundwater monitoring wells will occur every 25 years. At the end of the post-closure groundwater monitoring period in 2112, and when State approval is received, the monitoring wells will be plugged and abandoned in place in accordance with State regulations.

Engineered Units

DOE will impose institutional controls over the two capped mud pits to prevent surface intrusions. Both units will be fenced with warning signs posted. DOE's major long-term stewardship activities for capped surface areas at the site will include drilling restrictions to prevent access to the residual contamination. DOE will inspect fences and signs annually and repair or replace them, as needed.

STAKEHOLDER INVOLVEMENT

The primary vehicle for public participation by DOE stakeholders is through the Community Advisory Board (CAB) for Nevada Test Site (NTS) Programs. The CAB is a formal group of volunteer, independent, nonpartisan citizens and ex officio members organized and dedicated to providing informed recommendations and advice to DOE on policy, technical issues, and long-term stewardship decisions related to cleanup and waste management activities at the NTS. Public participation is encouraged at both the regularly scheduled CAB meetings as well as the associated topic-specific committee meetings. The CAB's Stewardship Committee has been evaluating issues related to long-term stewardship and serves as the primary avenue for public comment on this issue to the DOE. Other opportunities for public involvement and public outreach include: public workshops; topic-specific working groups; informational and technical briefings; document reviews; the development of community involvement plans; periodic informational mailings to Nevada stakeholders (e.g., the *EM Update*, which focuses on activities within DOE's Environmental Management Program, fact sheets, brochures, etc.); and access to the DOE Public Reading Facility. A Rapid Cultural Assessment by the Consolidated Group of Tribes and Organizations (CGTO) representatives was conducted, as well as Native American Graves Protection and Repatriation Act (NAGPRA) consultation on the Hot Creek artifact collection, which was collected in conjunction with CNTA activities. NAGPRA consultation is ongoing and is expected to end in calendar year 2000 with repatriation of sacred objects.

2.3 Regulatory Regime

All activities at CNTA must be compliant with the FFACO signed in May 1996 between the Nevada Department of Conservation and Natural Resources, the Department of Energy, and the Department of Defense. Remediation activities conducted under the FFACO are regulated under the *Resource Conservation and Recovery Act*.

DOE is responsible for identifying the nature and extent of contamination, determining potential risk to the public and the environment, and performing the necessary corrective actions in compliance with guidelines and requirements under federal regulatory drivers, as well as the State-specific regulatory drivers associated with the site location. These responsibilities are delegated to the DOE Environmental Management program. Key regulatory drivers include the following:

Resource Conservation and Recovery Act (RCRA): RCRA was the first comprehensive federal effort to deal with solid and hazardous waste and regulates the generation, transportation, treatment, storage, and disposal of hazardous waste. At CNTA, RCRA is enforced to protect human health and the environment; conserve energy and natural resources; reduce the amount of generated waste; and ensure that wastes are managed in an environmentally sound manner.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA): CERCLA supplies a system for identifying and providing corrective action to sites where hazardous substances have been released into any part of the air, water, groundwater, or land. Provisions of CERCLA include a National Contingency Plan, which establishes procedures for corrective action for hazardous substance releases. CNTA is not regulated under CERCLA; however, the regulations are useful as developmental guidelines.

In addition to federal requirements, DOE must comply with State regulatory requirements in Nevada. In most cases, State of Nevada requirements are based on federal guidelines; however, in specific cases they may be more detailed and stringent than federal requirements.

Nuclear Regulatory Commission (NRC): NRC regulations establish "free release" criteria. CNTA is not regulated under the NRC; however, the regulations are useful as developmental guidelines.

2.4 Assumptions and Uncertainties

DOE has yet to fully characterize the site. DOE will develop subsurface models and use them to define a contaminant boundary and refine the existing subsurface intrusion restrictions, if necessary.

DOE does not plan to remove subsurface waste in and around the test cavities. Groundwater monitoring will continue annually until subsurface closure is finalized. Post-closure monitoring will be conducted, as agreed upon in the site closure reports for the subsurface, to detect changes in the subsurface conditions. The schedule for groundwater monitoring after closure of the subsurface will be defined in the subsurface closure report.

Current land use designations and subsurface intrusion restrictions will continue into the foreseeable future. However, DOE has not fully characterized the contamination and long-term stewardship activities have not yet been finalized with the Federal and State regulators. Therefore, long-term stewardship activities and associated costs may change, depending on final agreements. DOE will reevaluate and modify the subsurface restrictions, as appropriate, as part of the assessment and/or corrective action activities.

3.0 Estimated Long-Term Stewardship Costs

The cost profile, identified in the table below, applies to the entire CNTA. The major long-term stewardship costs are for monitoring activities, inspecting of capped surface areas, data analysis, and repair and replacement of monitoring wells. The spikes in cost are a result of costs associated with repairing or replacing monitoring wells, which were assumed to require maintenance every 25 years.

The long-term stewardship costs for CNTA remain constant at $40,000 annually through 2015. The cost increase from $17,000 in FY 2000 to $40,000 in FY 2001 is the result of the costs associated with the new Real Estate Operations Permit (RE-OP) requirements. The $73,000 increase between 2011-2015 and 2016-2020 is for the periodic review and analysis of the data to evaluate and possibly refine the monitoring strategy. This review and analysis will occur every five years. DOE projects that the total post-FY 2070 cost will be approximately $3.7 million dollars and includes costs associated with plugging and abandoning groundwater monitoring wells at the end of the monitoring period.

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	*Amount*	*Year(s)*	*Amount*	*Year(s)*	*Amount*
FY 2000	$17,000	**FY 2008**	$40,000	**FY 2036-2040**	$273,000
FY 2001	$40,000	**FY 2009**	$40,000	**FY 2041-2045**	$272,000
FY 2002	$40,000	**FY 2010**	$40,000	**FY 2046-2050**	$272,000
FY 2003	$40,000	**FY 2011-2015**	$200,000	**FY 2051-2055**	$272,000
FY 2004	$40,000	**FY 2016-2020**	$273,000	**FY 2056-2060**	$1,072,000
FY 2005	$40,000	**FY 2021-2025**	$272,000	**FY 2061-2065**	$272,000
FY 2006	$40,000	**FY 2026-2030**	$272,000	**FY 2066-2070**	$272,000
FY 2007	$40,000	**FY 2031-2035**	$1,072,000	**Post FY 2070**	$3,700,000

4.0 FUTURE USES

DOE's anticipated future use for the majority of the surface area (1,036 hectares or 2,553 acres) at the site is open space managed by the Department of Interior. The approximately four acres of capped soil contamination will remain fenced with warning signs posted. Deed restrictions will prevent access to the test cavities, subsurface soil, and groundwater in perpetuity.

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NEVADA TEST SITE AND TONOPAH TEST RANGE

1.0 SITE SUMMARY

1.1 Site Description and Mission

The Nevada Test Site, operated by the U.S. Department of Energy (DOE), is located approximately 104 kilometers (65 miles) northwest of Las Vegas, Nevada, in a sparsely populated region about the size of the State of Rhode Island. The site encompasses 3,561 square kilometers (approximately 1,375 square miles) of desert and mountainous terrain and is surrounded on three sides by the Nellis Air Force Range, which provides a substantial buffer between the site and public lands. The Tonopah Test Range, an Air Force munitions range and research and development site, is located north of the Nevada Test Site approximately 240 kilometers (150 miles) northwest of Las Vegas, Nevada. The Tonopah Test Range comprises 1,616 square kilometers (624 square miles) and is also surrounded on three sides by the Nellis Air Force Range and to the north by Bureau of Land Management open range. The majority of the Nevada Test Site and the Tonopah Test Range are located in Nye County, Nevada. This land area has been withdrawn from all forms of appropriation under public land laws.

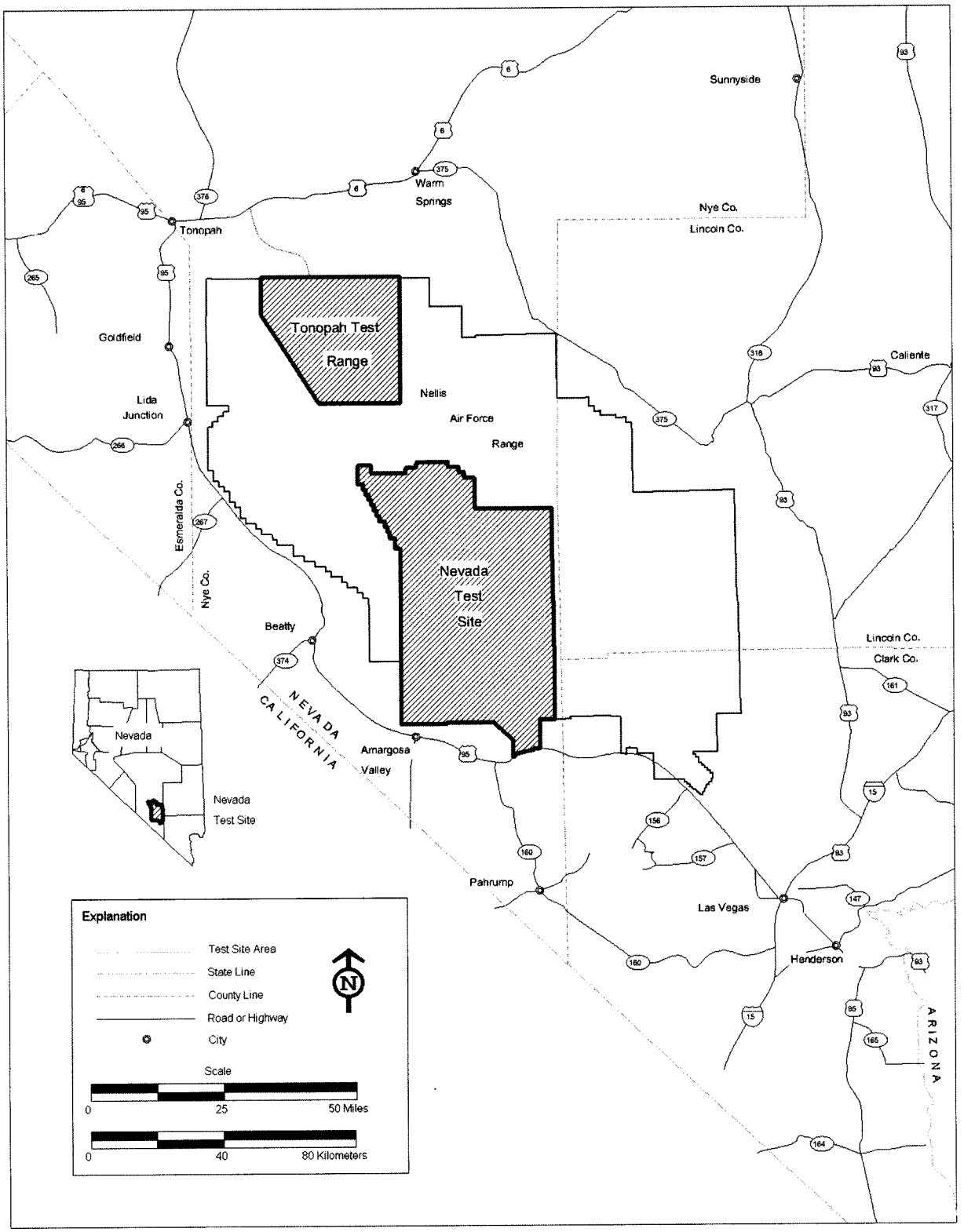
LONG-TERM STEWARDSHIP HIGHLIGHTS

Major Long-Term Stewardship Activities - maintain site-wide institutional controls; conduct surveillance and monitoring around waste disposal areas; monitor groundwater flow from underground test areas
Total Site Area - 517,739 hectares (1,279,360 acres)
Estimated Volume of Residual Contaminants - to be determined
Portions Requiring Long-Term Stewardship as of 2006 - 0
Average Annual Long-Term Stewardship Cost FY 2000-2006 - $1,540,000
Landlord - Nevada Test Site: U.S. Department of Energy, Office of Defense Programs/Tonopah Test Range; U.S. Department of Defense, U.S. Air Force

The Nevada Test Site was established in the 1950s to conduct field testing of nuclear explosives in connection with the research and development of nuclear weapons. In addition to weapons tests, the Nevada Test Site has also hosted secondary missions, including neutron and gamma-ray interaction studies; open-air nuclear reactor, nuclear engine, and nuclear furnace tests; hazardous materials spill response testing; and experiments conducted by the Department of Defense (DoD) involving radioactive and nonradioactive materials. In the 1950s, aboveground atmospheric tests were the predominant site activity. Atmospheric testing of nuclear weapons ceased in 1963, and offsite subsurface tests conducted at eight locations in five states ceased in 1973. Underground nuclear testing was suspended in October 1992, although a readiness posture is maintained by Presidential mandate. Since this moratorium on nuclear testing began, the primary mission of the Nevada Test Site has changed to support the DOE Stockpile Stewardship and Management Program for the nation's nuclear weapon stockpile. The current mission of the Nevada Test Site is composed of five elements: national security, environmental management, technology diversification, energy efficiency and renewable energy, and stewardship of the Nevada Test Site.

The Tonopah Test Range was historically used by DOE and the DoD for research and development of ordnance delivery systems, electronic training missions, and other activities. The Tonopah Test Range was withdrawn for military use in the 1940s. Since 1956, the Tonopah Test Range has been managed by DOE and its predecessors agencies under a Memorandum of Understanding with the U.S. Air Force.

The topography of the Nevada Test Site has been altered by DOE actions, particularly underground nuclear testing. The principal effect of testing has been the creation of numerous subsidence craters in Yucca Flat and on Pahute and Rainier Mesas. Lesser alterations have occurred as a result of road building, sand and gravel mining, the construction of waste disposal areas, and flood control and drainage improvements.



Nevada Test Site and Tonopah Test Range

The Nevada Test Site is the site of two permanent waste storage and disposal facilities for low-level radioactive waste and mixed waste. These two sites are known as the Area 5 and Area 3 Radioactive Waste Management Sites (RWMSs). The Area 5 RWMS occupies 290 hectares (732 acres) and is located in Frenchman Flat. The Area 3 RWMS occupies 51 hectares (125 acres) in Yucca Flat. The Area 5 RWMS contains traditional engineered shallow landfill units for disposal of DOE-affiliated onsite and offsite generated low-level waste and onsite generated low-level mixed waste. Area 5 is also used for the temporary storage of 621 cubic meters (21,500 cubic feet) of transuranic waste pending shipment to the Waste Isolation Pilot Plant in New Mexico. The Area 3 site is used for bulk (such as debris from atmospheric nuclear test locations) and packaged low-level waste. The site is comprised of seven subsidence craters (formed as a result of prior underground nuclear tests), four of which have had the area between the craters excavated to make two oval-shaped landfill units. Of the seven craters, two are filled, and three are actively used for waste disposal.

Although large parts of the Nevada Test Site have been affected by human activities, the majority of this site remains relatively undisturbed. Most of the disturbances are concentrated at Yucca Flat, Frenchman Flat, Jackass Flats, and on parts of Pahute and Rainier Mesas. Much of the rest of the Nevada Test Site, including large areas in the central western part of the site, has few permanent disturbances and little human activity.

1999 ACCOMPLISHMENTS

- Disposed of approximately 17,125 cubic meters (593,000 cubic feet) of low-level waste and two cubic meters (69 cubic feet) of mixed low-level waste
- Completed characterization of contaminated surface soils at Clean Slates 1, 2, and 3 (Testing Sites) at Tonopah Test Range
- Completed Value of Information Analysis report and Corrective Action Investigation Plan for Frenchman Flat
- Processed 830 mixed transuranic waste drums; of these, 360 drums were radiographed and 130 drums were repackaged
- Shipped 12 cubic meters (415 cubic feet) of mixed low-level waste offsite for treatment
- Completed assessments of seven Corrective Action Sites and closure of 28 Corrective Action Sites
- Completed installation of seven deep groundwater monitoring wells for the Underground Test Area (UGTA) Project

2000 COMMITMENTS

- Complete installation of one deep groundwater monitoring well
- Complete assessments of 17 Corrective Action Sites, and closure of 42 Corrective Action Sites
- Repack 195 transuranic/mixed transuranic drums through the Waste Examination Facility (WEF)
- Store 621 cubic meters (21,500 cubic feet) of transuranic/mixed transuranic waste

2001 PLANNED ACCOMPLISHMENTS

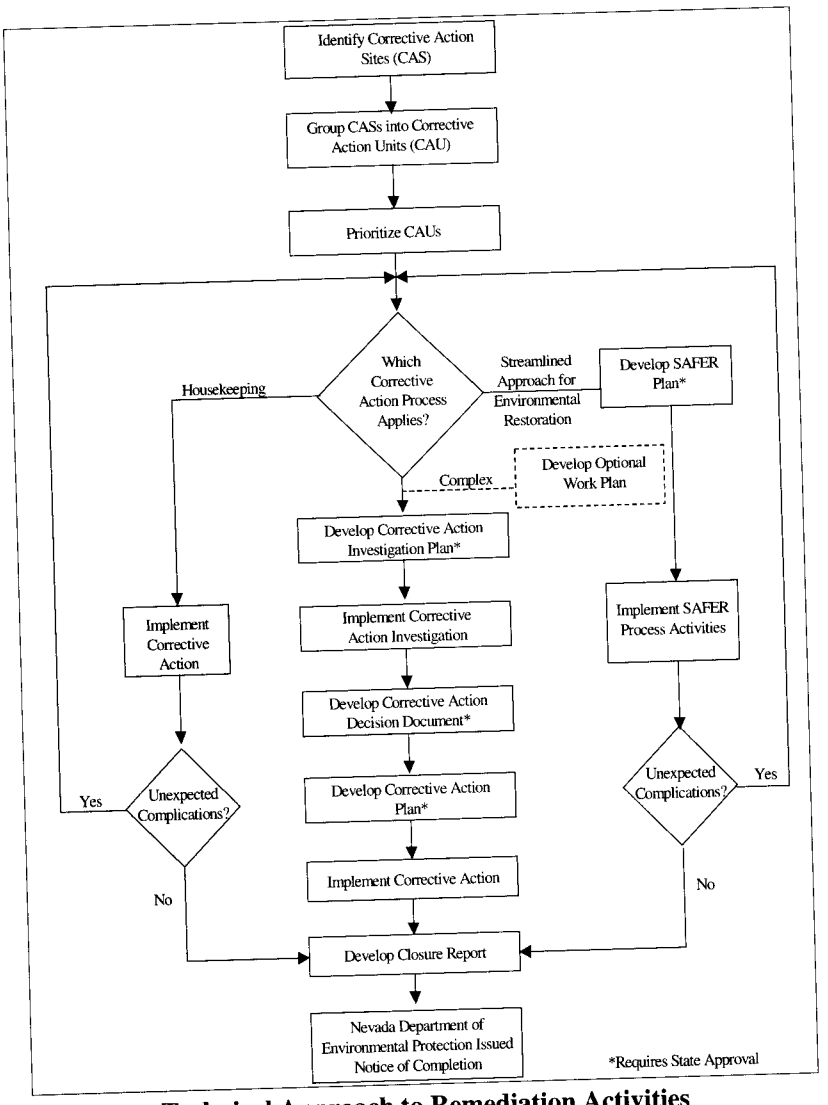
- Complete assessment of 7 Corrective Action Sites and closure of 52 Corrective Action Sites
- Complete installation of one well at Frenchman Flat.
- Store 621 cubic meters (21,500 cubic feet) of transuranic/mixed transuranic waste

1.2 Site Cleanup and Accomplishments

As a result of nuclear testing activities, portions of the Nevada Test Site and the Tonopah Test Range are contaminated with surface and subsurface radionuclides; organic compounds; metals; petroleum; and residues from plastics, epoxy, and drilling muds used during test hole drilling and instrumentation.

Coordinated environmental restoration activities at the Nevada Test Site began in 1989 and focused on characterizing and remediating sites and facilities contaminated as a result of nuclear testing activities. Contaminants released were an unavoidable consequence of testing activities. Most of the waste generated was from post-test sampling, construction and/or maintenance operations associated with testing. Disposal of this waste occurred in landfills, underground injection wells, sumps, and leachfields, as well as offsite disposal. Some residual materials remain in inactive storage tanks. When atmospheric and shallow cratering tests are included, the total contaminated area increases to approximately 10,900 hectares (27,000 acres).

In the late 1980s, DOE's Albuquerque Operations Office initiated the environmental restoration activities at the Tonopah Test Range. In 1987, DOE conducted a preliminary assessment that was evaluated by Environmental Protection Agency-Region IX in 1988. The Environmental Protection Agency declared the facility to be in a No Further Action Planned status with respect to the *Comprehensive Environmental Response, Compensation and Liability Act* activities. Corrective actions would, however, continue to be completed according to the requirements of the *Resource Conservation and Recovery Act*. In 1993, for logistical reasons, the Albuquerque Operations Office agreed to turn over environmental restoration responsibilities for the Tonopah Test Range to the Nevada Operations Office. Since 1993, the Nevada Operations Office has conducted a comprehensive inventory of potential release sites and has identified approximately 40 sites that will require site characterization activities. Environmental restoration activities at the Tonopah Test Range are managed under the Industrial Sites grouping of the Environmental Management mission of the Nevada Operations Office.



Technical Approach to Remediation Activities

The process shown in the above figure, depicts the approach used by the Nevada Operations Office to clean up a site. This approach, which applies to all DOE sites in Nevada, groups the sites into Corrective Action Sites (CASs) and then groups these into Corrective Action Units (CAUs) to facilitate administration. This process has been agreed to by the State of Nevada through the Federal Facility Agreement and Consent Order (FFACO).

Once the Nevada Operations Office completes several steps mandated by environmental regulations, a closure report is submitted to the State of Nevada certifying the site has been closed properly and corrective actions are complete.

The corrective action strategy portion of the Federal Facility Agreement and Consent Order establishes the

FEDERAL FACILITY AGREEMENT AND CONSENT ORDER

The Federal Facility Agreement and Consent Order is a negotiated tri-party agreement between the Department of Energy's Nevada Operations Office, the State of Nevada Division of Environmental Protection, and the Department of Defense. The Federal Facility Agreement and Consent Order establishes a framework for identifying, prioritizing, investigating, remediating, and monitoring Nevada sites contaminated by Department of Energy and Department of Defense activities.

method by which site investigations and corrective actions will take place. In general, the strategy allows sites to be grouped using various combinations of similarity, including site "owner," functional category, location, and length of time required for corrective action. The groupings enable economies from common work, including approach and logistics during assessment and remediation. The amount of waste which will remain in place is considered when choosing a corrective action in an effort to minimize long-term monitoring needs. The Streamlined Approach for Environmental Restoration, often referred to as SAFER, will be used to increase programmatic efficiency when it is applicable and acceptable to the State of Nevada. The probable remediation method will be considered when performing and coordinating site assessments.

MAJOR ENVIRONMENTAL RESTORATION ACTIVITY MILESTONES

Task	*Completion Date*
Industrial Sites	
Assessment/Remedial Action	2010
Decommissioning	2010
Soil Sites	
Assessment/Remedial Action	2015
Underground Test Areas	
Assessment/Remedial Action	2017

Within the Nevada Test Site and the Tonopah Test Range, approximately 2,400 potential CASs have or will require some level of investigation and possible remediation. Approximately 930 of these sites are related to the underground testing of nuclear weapons; more than 100 CASs resulted from above-ground testing. The remaining sites include waste disposal facilities, leach fields, landfills, storage tanks, injection wells, inactive and abandoned buildings, and associated equipment contaminated by prior operations, spill areas, and hundreds of other small sites where unregulated disposal or storage of waste materials occurred during more than 40 years of operations. The Department has divided the assessment and remediation of these sites into three categories: Industrial Sites, which include all sites used in support of testing operations; Soils Sites, which include all surface and shallow subsurface soil contamination resulting primarily from safety tests; and the Underground Test Areas, which are sites that were impacted by underground testing activities. Activities within the Industrial Sites focus on physical investigation and remediation of the individual sites. Soil project activities focus on defining appropriate cleanup levels and remediating surface soils where potential risk exists to workers and the public justifies cleanup. Within Underground Test Areas, the focus is on determining the potential boundaries of contamination and the requirements to monitor the identified boundaries. Two other areas, also known as the Radioactive Waste Management Areas, are used for the disposal of radioactive waste and are still considered active waste management disposal areas. Activities here do not involve remediation but include disposal, disposal cell closure, and long-term stewardship activities, such as institutional and engineered controls and monitoring.

Industrial Sites

Industrial Sites include potentially impacted sites and facilities contaminated as a result of nuclear testing and support activities. CASs within the project vary greatly in size and complexity and are extensive in number. For management purposes, sites have been grouped into source groupings. The CASs have been organized into over 325 similar groups or CAUs. Sites have been grouped additionally by technical similarity into 12 source groupings: Disposal Wells; Inactive Tanks; Contaminated Waste Sites; Septic Tanks and Lagoons; Inactive Ponds and Tunnel Muckpiles; Drains and Sumps; Ordnance Sites; Bunkers, Chemicals, and Materials Storage; Spill Sites; Part A Sites; Miscellaneous Sites; and Deactivation and Decommissioning Facilities. The majority of the sites are located on the Nevada Test Site; however, some sites are located north of the Nevada Test Site on the Tonopah Test Range. The contaminants at both locations include various combinations of organic and inorganic chemicals, metals, unexploded ordnance and related contaminants, and radioactive materials.
Initial assessment activities indicate contamination problems, including surface and subsurface soils that have been impacted by releases from leachfields, sumps, disposal wells, leaking tanks, and other sources of waste.

Contaminants may include petroleum hydrocarbons, hazardous waste, low-level radioactive materials, and mixed waste. It is assumed that most of the soil contamination related to the units in the industrial sites category is confined to the vadose zone at the Nevada Test Site.

Completed remediation activities include abandoned septic tanks and leachfields, U3fi Injection Well, the Area 27 Explosive Ordinance Disposal Facility, the Area 6 Bitcutter Shop Injection Well, the Tonopah Test Range 5 Points Landfill, the Jr. Hot Cell, and the EPA Farm. DOE completed field verification on 864 CASs, surveyed 670 CASs, and identified 134 new CASs.

Remediation of the Industrial Sites is based on a prioritization model that provides the greatest weight to a site's future use potential. For example, the remediation for some sites is being completed to support certain non-defense "commercial" reuse activities, and, for other sites, remediation is being completed to support the readiness program for nuclear testing. Many sites may be clean closed; however, given expected restricted access and limited land-uses, some of the industrial sites on the Nevada Test Site will be remediated to negotiated levels that are below regulatory limits for risks to human health and the environment and closed in place.

Industrial Sites also include facilities no longer needed for DOE mission-related activities. Decommissioning activities will include the decontamination and decommissioning of these surplus facilities. Surveillance and monitoring of the identified facilities are ongoing, and initial decommissioning activities were conducted at the sites in 1974 and 1983.

To date, approximately 700 Industrial Sites CASs have been remediated and closed. All work at the Industrial Sites is governed by the *Resource Conservation and Recovery Act* Permit, except decommissioning, which is currently governed by DOE Orders. All work is governed by requirements of the Federal Facility Agreement and Consent Order, which establishes the method by which all site investigation and corrective actions will take place. Corrective action activities are expected to continue through 2010.

CORRECTIVE ACTION UNITS (CAU) CLEAN CLOSED TO DATE AT INDUSTRIAL SITES

Source Groups	# of CAUs
Bunkers, Chemicals and Materials	1
Contaminated Waste Sites	2
Disposal Wells	1
Inactive Tanks	10
Miscellaneous Sites	71
Decontamination and Decommission	2
Ordnance Sites	4
Part A Sites	3
Septic Tanks and Lagoons	2
Spill Sites	1

Soils Sites

The Soils Sites comprise several activities related to the investigation of and remedial actions for contaminated surface and shallow subsurface soils on the Nevada Test Site, Tonopah Test Range, and Nellis Air Force Range. Contamination is the result of DOE atmospheric tests, cratering experiments, safety tests, and rocket engine development. Contaminants may include americium, plutonium, depleted uranium, and other radionuclides, including fission products. In addition, metals, particularly lead, are of concern at some sites. Based on the source of the contamination, the Soils Project is broken into 20 CAUs located on the Nevada Test Site, Nellis Air Force Range, and Tonopah Test Range.

- The Soils Sites include nine cratering events from shallow nuclear tests. The events used nuclear devices to excavate large volumes of earth. Contamination from these tests includes impacts to subsurface (less

than 300 meters (984 feet) deep) soils and impacts to surface soils as the result of material expelled during testing. Cratering experiments were conducted in NTS Areas 10, 18, 20, and 30.

- Safety tests were conducted at several locations on the Nellis Air Force Range and Tonopah Test Range (Double Tracks; Clean Slates 1, 2, and 3; and Area 13); at Plutonium Valley in Area 11 of the Nevada Test Site; and the GMX site in Area 5 of the Nevada Test Site. The safety tests did not result in significant nuclear yield, but did disperse contaminants in excess of 40 picocuries per gram in surficial soils over more than 1,200 hectares (3,000 acres). When 82 atmospheric and near surface tests are included, the acreage contaminated in excess of 40 picocuries per gram increases to approximately 10,800 hectares (27,000 acres). Most of the increased area is on the Nevada Test Site.

Most sites within the Soils Project have sufficient background data available regarding the sources of contamination. All assessment activities concentrate on determining the type and extent of contamination.

Assessment activities completed include the characterization effort in support of the Interim Corrective Action for the Double Tracks site on Nellis Air Force Range and characterization of Clean Slates 1, 2, and 3 sites on the Tonopah Test Range. Interim corrective actions have been completed at Double Tracks, and corrective action under the FFACO were completed at Clean Slate 1. However, current assessment activities have been suspended pending concurrence on a corrective action level with identified stakeholders.

SOIL SITES CORRECTIVE ACTION UNITS (CAU) BEING REMEDIATED FOR CLOSURE

CAU	Closure Date
Nevada Test Site	
Area 5 GMX Unit Safety Tests	2012
Area 11 Plutonium Valley Unit Safety Tests	2014
Area 25 Nuclear Rocket Engine Experiment	2015
Tonopah Test Range	
Clean Slate I Plutonium Dispersion	2008
Clean Slate II Plutonium Dispersion	2009
Clean Slate III Plutonium Dispersion	2011
Double Tracks Plutonium Dispersion	2008
Project 57 No.1 Plutonium Dispersion	2012

Surface soil remedies will include in situ identification and removal of hot spot materials located in small selected areas. Larger areas will require the use of mechanical excavation to remove the contaminated materials. Mechanical excavation may use size separators or other physical processes to reduce waste volumes. Subsurface remedies will vary for sites on and off the Nevada Test Site and will range from soil excavation to containment strategies. For example, some sites that straddle or lie outside the Nevada Test Site boundaries, such as sites on the Tonopah Test Range and Nellis Air Force Range, will be characterized, the surface soil plumes will be remediated, and the sites made available for alternative "controlled" uses, while activities at other sites reserved for future testing may be limited to characterization and monitoring. For those sites that will be remediated, corrective action levels will correspond to future military missions and the possible impacts to human health and environmental safety. It is anticipated that the Soil Sites that will be remediated will have a dose limit of 25 millirems per year. "Clean closure" of these sites is not expected given the current and expected land use.

All remedial actions will be based on applicable regulatory national standards or proposed cleanup levels. If no standards apply proposed levels will be based on pertinent factors, including, but not limited to, assessment of risk, current and projected land use, resource management, and technical and cost feasibility. Where sufficient information is available, DOE will use the Streamlined Approach for Environmental Restoration process. Interim removal actions will be performed based on risk to workers and the public.

Underground Test Areas

Between 1951 and 1992, various underground nuclear tests were conducted at the Nevada Test Site by DOE and DoD, which resulted in subsurface soil and groundwater contamination. Since late 1962, nearly all tests have been conducted in vertical shafts drilled into Yucca Flat and Pahute Mesa or in horizontal tunnels mined into Rainier Mesa.

Over 900 nuclear detonations were conducted in shafts or tunnels at the Nevada Test Site. These tests resulted in the formation of hundreds of craters at the Nevada Test Site, leaving Yucca Flat with a "pockmarked" appearance that is even visible on satellite images of the area. The tests had yields ranging from zero to greater than 1,000 kilotons. Underground testing left an estimated source term of 300 million curies in the environmental media (soil and groundwater). Because an estimated 38 percent of the tests were conducted under or within 100 meters (328 feet) of the water table, the groundwater beneath the site now contains an estimated 120 million curies of radioactivity. Collectively, the tests resulted in hundreds of subsidence craters and caused contamination of the subsurface geologic media, surface soils, and groundwater over an estimated 780 square kilometer area (300 square miles).

These release sites are grouped into five CAUs. The CAUs are geographically distinct with different contaminant sources and with geologic characteristics related to their location. The CAUs are expected to have similar residual contaminants, cleanup strategies, and long-term stewardship requirements. Under these five CAUs, 878 CASs have been identified for cleanup. The table below describes each of the five areas.

Corrective Action Units	
Area	***Description and Contaminant Transport***
Frenchman Flat	The Frenchman Flat CAU consists of 10 CASs located in the northern part of Area 5 and the southern part of Area 11 on the Nevada Test Site. The detonations were conducted in vertical emplacement holes and mine shafts and were located in alluvium of great depth. The deeper geology is not well known. Lateral transport in the alluvium is very slow due to the low lateral hydraulic gradient.
Western Pahute Mesa	Western Pahute Mesa CAU consists of 18 CASs along the western edge of Area 20 of the Nevada Test Site. The detonations were all conducted in vertical emplacement holes. This CAU is separated from Central Pahute Mesa by the Boxcar Fault and is distinguished by the relative abundance of tritium. Transport of contaminants on and from Western Pahute Mesa involves groundwater flow in welded and vitric tuffs in the rock matrix and in the fracture system.
Yucca Flat	The Yucca Flat CAU consists of 720 CASs located on the Nevada Test Site in Areas 1, 2, 3, 4, 6, 7, 8, 9, 10, and 15. These detonations were conducted in vertical emplacements holes. Contaminant transport media in Yucca Flat may involve alluvium, welded and vitric tuffs, and carbonate rocks.
Central Pahute Mesa	Central Pahute Mesa CAU consists of 64 CASs in Areas 19 and 20 of Pahute Mesa. These detonations were all conducted in vertical emplacement holes. While distinguished from Western Pahute Mesa only by the presence of the Boxcar Fault, this CAU also contains a relative abundance of tritium. In addition, transport of contaminants from Central Pahute Mesa occurs by groundwater flow in volcanic rocks and flow in both the rock matrix and the fracture system. The influence of the large-scale block faulting is not well known.

Corrective Action Units	
Area	***Description and Contaminant Transport***
Rainier Mesa/Shoshone Mountain	Rainier Mesa/Shoshone Mountain CAU consists of 66 CASs on Rainier Mesa and six CASs on Shoshone Mountain, which are located in Areas 12 and 16 of the Nevada Test Site. These detonations were conducted in tunnels. Contaminants from this CAU flow in volcanic rock and fractured media.

The Department is investigating the effects of the underground testing on the ground water and surrounding media in these areas. Investigations are using data collection and analysis to determine whether contaminants have migrated from the nuclear explosion locations. Because all of the sites are under institutional control, the Department considers risk to public health and the environment from the testing activities to be minor. The ambient or background radiological conditions around the site are normal. However, assessment activities will include risk assessment to quantify risk to human health and the environment.

Field activities include the use of new and existing wells for monitoring and testing to help develop transport models. DOE will install wells to collect data about the near-field environment. DOE expects to encounter tritium during drilling; therefore, the liquid will be handled onsite. Retardation characteristics provide for little migration of radionuclides other than tritium. Other radionuclides will be included in the source evaluation if tritium migration indicates the need.

Because no cost-effective technologies have been developed to remove or stabilize the nuclear-related groundwater contaminants, DOE will concentrate on modeling and groundwater monitoring activities to accurately define the extent of contamination. These actions will be in accord with the Federal Facility Agreement and Consent Order. Remedial actions might be necessary if contamination exceeds the boundaries agreed upon for closure.

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

DOE's Office of Defense Programs has an ongoing national security mission to preserve the capability to resume underground nuclear testing and perform subcritical and other weapons physics experiments. Due to this mission, the site will require institutional controls in perpetuity.

The site will complete all required assessment and corrective action activities in accordance with parameters and plans identified in the Federal Facility Agreement and Consent Order with the State of Nevada and land use decisions outlined in the Nevada Test Site, Site-Wide Environmental Impact Statement and the Nevada Test Site Resource Management Plan. Waste management activities will be completed in compliance with the Federal Facility Compliance Act and Consent Order, Site Treatment Plan, Mutual Consent Order, and the Transuranic (TRU) Settlement Agreement.

In general, in future use areas of the Nevada Test Site, surface areas will have corrective actions performed that allow the surface to be released for alternate uses. For surface sites in future testing zones, assessment activities will be completed and limited corrective action performed if there is a significant risk to human health (worker) and the environment, or if it is economically feasible. Corrective action for underground testing areas throughout the Nevada Test Site will consist of modeling the underground regime to determine flow and transport and to refine the potential contaminant boundary and develop monitoring procedures to assure protection of the public and workers. Access to the subsurface will be permanently restricted. Filled waste disposal cells will be capped

and closed in accordance with applicable requirements. Monitoring of individual sites upon completion of required regulatory actions will be in accordance with State-approved Closure Plans. Monitoring of the site will occur in perpetuity.

Current post-closure surveillance and monitoring activities at the Industrial Sites include: quarterly monitoring of the Area 23 Hazardous Waste Trenches and U3fi Injection Well. At this time, maintenance of these systems consists of an inspection of the condition of the Area 23 closure cap for erosion or other disturbances, and monitoring the general integrity of the U-3fi Injection Well unit. Post-closure monitoring of the Soils Sites and Underground Test Area will begin when the site receives the Notice of Completion approval of the final corrective actions. Post-closure monitoring of Area 3 and Area 5 Radioactive Waste Management Sites will begin in 2016.

Institutional and Engineered Controls

The Nevada Test Site is a restricted access site, with personnel entry and exit controlled by a dedicated security force. The site is surrounded by government-controlled buffer zones and protected by entrance guards, mobile patrols, and highly trained emergency-response teams. The site is a controlled-access area with road access beginning at the guard station on Mercury Highway, approximately 1.2 kilometers (four miles) from the U.S. Highway 95 Mercury exit. Although a security clearance is not required for entry, access is not allowed without proper identification and badging. The perimeter of the site is not fenced but is posted as a restricted area. Access is prohibited except at designated entrances. Beyond the perimeter, the U.S. Bureau of Land Management and Nellis Air Force Range provide buffer zones, especially for the testing areas of the site. The few roads that access site boundaries are controlled by barricades and/or guard stations.

DOE assumes it will retain oversight and management of the Nevada Test Site in perpetuity, as well as institutional control of the existing boundaries. The restriction boundaries may at some point be modified to include other areas where groundwater modeling and risk assessment indicate that groundwater contamination may migrate beyond existing boundaries. Therefore, DOE currently assumes that long-term stewardship and maintenance activities, including monitoring technology enhancements, will be continued in perpetuity.

Institutional controls include restricting access to the Nevada Test Site and drilling restrictions, which will be maintained for the subsurface to prevent access to test cavities and associated subsurface contamination, and the renewal of land withdrawals that reserve the land areas that comprise the Nevada Test Site.

Engineered controls include fencing to restrict access to contaminated areas and flood control channels, levees, containment berms at waste management sites, and cover caps for some of the closed-in-place Industrial Site CAUs.

Record-Keeping

DOE's Nevada Operations Office maintains project-specific records at its office in Las Vegas, Nevada, per the requirements set forth in the Federal Facility Agreement and Consent Order. The State of Nevada Division of Environmental Protection maintains the official Administrative Record for all activities conducted under the Federal Facility Agreement and Consent Order. Upon the completion of the project, all project files are transferred to DOE/Nevada Operations Office for controlled storage at its facility. Records are managed according to National Archives and Records Administration-approved records schedules, DOE Records Schedules, and General Records Schedules.

2.2 Long-Term Stewardship Technology Development and Deployment

Science and technology development and deployment at the Nevada Test Site is facilitated by the Site Technology Coordinating Group (STCG). The STCG includes representatives from DOE Nevada Operations, support contractors, academia, research institutions, national laboratories, regulatory agencies, and stakeholders. Public meetings are held approximately four times per year to present technology development updates to regulators and stakeholders, and to receive comments. The regulators and stakeholders also participate in the prioritizing of technology needs, based on the technology needs summaries and presentations. The STCG identifies and recommends technological solutions to address site needs.

Other science and technology support to site activities is provided by the Remote Sensing Laboratory (RSL) and the Special Technologies Laboratory (STL). RSL develops, evaluates, and uses sensing technology for environmental restoration and waste management activities. STL develops measuring and sensing instruments, which can be used to detect surface contamination or contamination inside pipes and vessels.

The Characterization, Monitoring, and Sensor Technologies Crosscutting Program (CMST-CP) is headquartered at DOE Nevada Operations Office. This national program within the Office of Science and Technology (EM-50) supports research, development, and deployment for characterization, monitoring, and sensor technologies for use by both DOE and non-DOE end-users.

The STCG has been instrumental in identifying and using technologies developed through the efforts of STL, RSL, and the CMST-CP. The DOE Nevada Operations Office will continue to use technologies that address project needs.

2.3 Assumptions and Uncertainties

It is assumed that the Nevada Test Site will remain under government control in perpetuity. There are no plans for land transfers, and the entire site is restricted access.

Soil Sites remediation activities will be suspended until 2008 or until DOE, the U.S. Air Force, and State regulators can come to an agreement on the appropriate corrective action levels.

Oversized transuranic waste (TRU) boxes and classified TRU materials will be treated offsite prior to shipment to the Waste Isolation Pilot Plant (WIPP). A size reduction facility will be available by 2003, and a sanitization facility will be available by 2007.

Long-term stewardship will be continually refined in reaction to mitigating factors such as new technologies, stakeholder concerns, corrective action strategies, and State regulatory requirements.

2.4 Estimated Site-Wide Long-Term Stewardship Costs

Long-term stewardship costs for the Nevada Test Site are summarized in the table below. Included in the cost estimate are those costs related to funding a long-term surveillance and maintenance program, as agreed to with the State of Nevada upon the closure of each site. Specifically, the costs include, among other activities, air and water sampling, groundwater model validation, and well replacement. The cost spike in FY 2036 to FY 2045 is due to replacement of wells in the UGTA long-term surveillance and maintenance program.

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	*Amount*	*Year(s)*	*Amount*	*Year(s)*	*Amount*
FY 2000	$2,023,000	**FY 2008**	$3,356,000	**FY 2036-2040**	$39,397,000
FY 2001	$887,000	**FY 2009**	$3,860,000	**FY 2041-2045**	$29,146,000
FY 2002	$1,054,000	**FY 2010**	$3,520,000	**FY 2046-2050**	$14,670,000
FY 2003	$1,194,000	**FY 2011-2015**	$31,782,000	**FY 2051-2055**	$14,659,000
FY 2004	$1,618,000	**FY 2016-2020**	$16,391,000	**FY 2056-2060**	$14,670,000
FY 2005	$1,852,000	**FY 2021-2025**	$17,034,000	**FY 2061-2065**	$46,449,000
FY 2006	$2,155,000	**FY 2026-2030**	$17,034,000	**FY 2066-2070**	$26,767,000
FY 2007	$2,578,000	**FY 2031-2035**	$17,034,000	**FY 2071-2117**	$109,548,000

3.0 PORTION OVERVIEW

Five portions have been defined for the Nevada Test Site and Tonopah Test Range for long-term stewardship. The Underground Test Areas (UGTAs), the Soils Sites, the Industrial Sites, the Area 3 RWMS, and the Area 5 RWMS. Three of these portions (UGTA, Soils Sites, and Industrial Sites) were defined based on the Nevada Test Site's approach to remedial actions on the site and, in some cases, overlap in geographic area. The other two portions are the active waste management areas (Area 3 RWMS and the Area 5 RWMS). Although these portions are not necessarily geographically based, they include geographically based sub-units, where possible. The portions are described in detail in the cleanup discussion above. The table below describes the anticipated start and end years for long-term stewardship of the portions.

Long-Term Stewardship Information		
Portion	*Long-Term Stewardship Start Year*	*Long-Term Stewardship End Year*
Underground Test Areas	2018	2117
Soil Sites	2009	2016
Industrial Sites	2010	2014
Area 3 Radioactive Waste Management Site	2016	2045
Area 5 Radioactive Waste Management Site	2016	2045

3.1 Underground Test Areas

Various underground nuclear tests conducted at the Nevada Test Site by DOE and DoD resulted in subsurface soil and groundwater contamination. These tests resulted in the formation of hundreds of craters at the Nevada Test Site, leaving Yucca Flat and other CAUs with a "pockmarked" appearance that is even visible on satellite images of the area. The tests had yields ranging from zero to greater than 1,000 kilotons. Underground testing left an estimated source term of 300 million curies in the environmental media (soil and groundwater). Because an estimated 38 percent of the tests were conducted under or within 100 meters (328 feet) of the water table, the

groundwater beneath the site now contains an estimated 120 million curies of radioactivity. Collectively, the tests resulted in hundreds of subsidence craters and caused contamination of the subsurface geologic media, surface soils, and groundwater over an estimated 780 square kilometer area (300 square miles).

UNDERGROUND TEST AREAS PORTION HIGHLIGHTS

Major Long-Term Stewardship Activities - maintain subsurface intrusion restrictions
Portion Size - undetermined
Estimated Volume of Residual Contaminants - 300 million curies in soil and groundwater
Long-Term Stewardship Start-End Years - 2018 - 2117
Average Annual Long-Term Stewardship Costs FY 2000- 2006 - not applicable

3.1.1 Groundwater

Although the groundwater resources of the region are large, their physical availability is quite variable. All potentially affected areas are located within the Death Valley flow system. The Death Valley flow system is composed of 30 individual hydrographic basins and 41,440 square kilometers (16,000 square miles) of the Great Basin. This flow system originates primarily from the infiltration of precipitation over mountainous areas and flows toward the regional groundwater depression at Death Valley or smaller depressions in Sarcobatus Flats, Oasis Valley, Ash Meadows, and the Amargosa Desert.

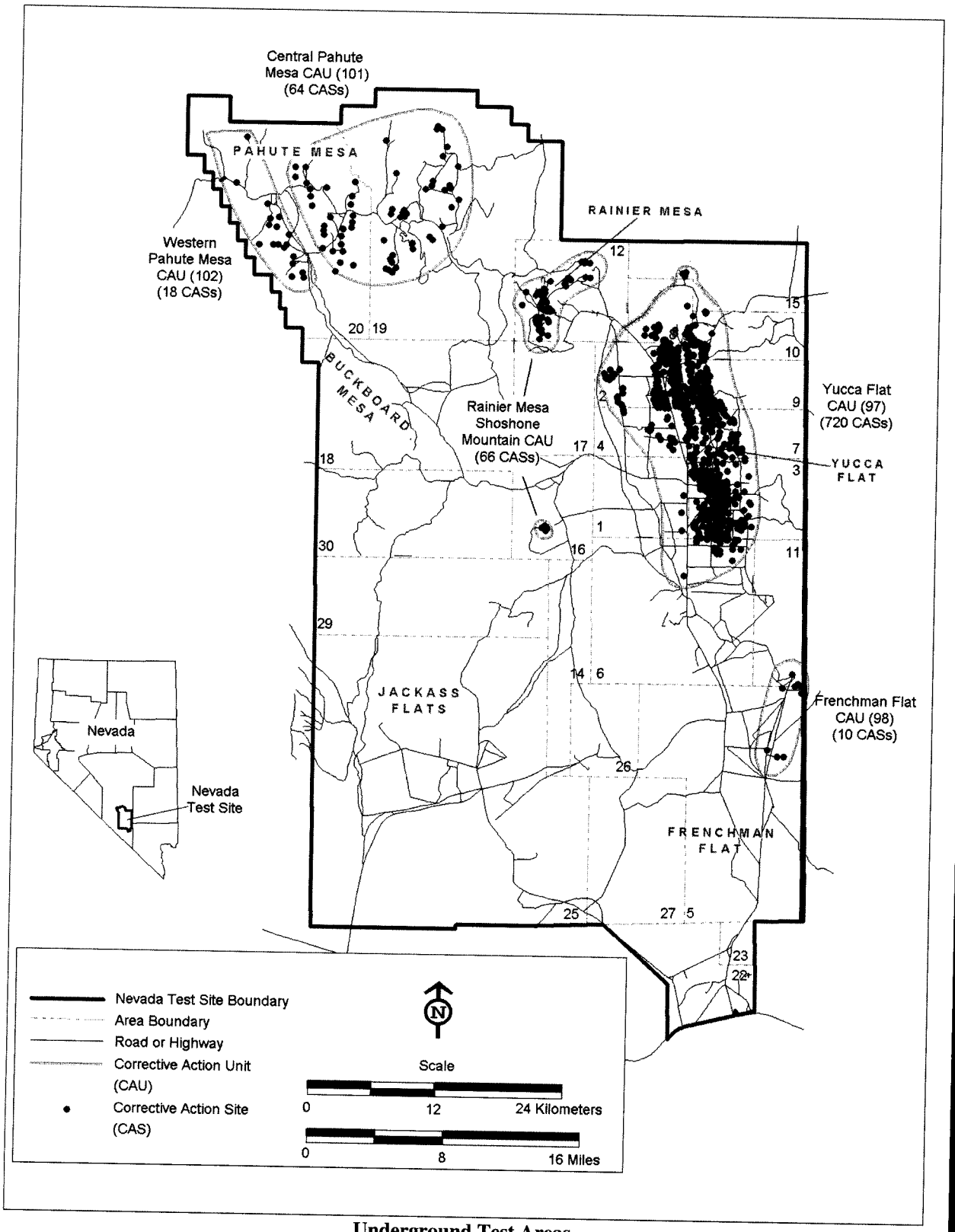
The depth to the groundwater in wells at the Nevada Test Site varies from about 79 meters (260 feet) below land surface in the extreme southwest part of the Nevada Test Site and about 160 meters (525 feet) below land surface in portions of Frenchman Flat and Yucca Flat weapons test basin, to more than 610 meters (2,000 feet) under the upland portions of Pahute Mesa. Groundwater flows generally south and southwest. The flow system extends from the water table level to a depth of approximately 3,000 meters (9,843 feet), where the transmissivity of the rocks becomes much less. Perched groundwater is known to occur in some parts of the Nevada Test Site, mainly in the volcanic rocks of the Pahute Mesa area.

The groundwater underlying the Nevada Test Site and surrounding areas is derived from two sources: underflow from basins upgradient of the area and recharge over the upland areas within the Nevada Test Site boundaries. Upland recharge occurs predominately by slow percolation of surface water through the unsaturated zone that overlies the water table. Most of this recharge is restricted to higher elevations where precipitation is greatest and along upland canyons and alluvial fans adjacent to upland areas. Recharge from upland areas of the Nevada Test Site is far more limited, about one-tenth of that derived from underflow. Most of the recharge originates over the upland areas of Pahute Mesa, Timber Mountain, and the Belted Range.

The soil and the groundwater at the Underground Test Areas are contaminated with mixed fission products (tritium, fission products, and activation products) as the result of underground nuclear test activities. Currently, there is no feasible method to remove this subsurface contamination; therefore, until technology becomes available, the contamination will remain in place.

Remediation of the groundwater contamination associated with the underground test areas will consist of modeling to define the contaminant boundaries and long-term monitoring. The perimeter boundaries will be used to determine the aggregate maximum extent of contamination transport at or above concentrations of concern for the CAU. Saturated groundwater conditions will be used to determine the extent of contamination in Frenchman Flat, Yucca Flat, Western Pahute Mesa, and Central Pahute Mesa. Saturated groundwater flow conditions will be evaluated to determine if the saturated zone has been impacted for Rainier Mesa and Shoshone Mountain.

Once the State of Nevada Division of Environmental Protection has accepted the proposed contaminant boundaries, either a contaminant control program or five-year monitoring program will be initiated. If the results



Underground Test Areas

of the monitoring fall within limits agreed to with the State of Nevada Division of Environmental Protection at the end of the five-year pre-closure monitoring period, then a closure report will be developed and the CAU will be designated as a closed unit.

Groundwater Long-Term Stewardship Activities

The Long-Term Stewardship program will be negotiated with the State of Nevada, with input from other stakeholders and representatives of tribal nations. Responsibility for conducting long-term stewardship activities for groundwater associated with the underground test areas is expected to be transferred to DOE's Office of Defense Programs in 2018. Groundwater monitoring will be considered part of the long-term surveillance and monitoring program once a final agreement is reached with the State of Nevada on the appropriate final remedial actions. Subsurface contaminants in and around the cavities will be closed in place due to the lack of cost-effective groundwater technologies to remove or stabilize the radioactive contaminants. Included in the groundwater long-term stewardship are all monitoring activities, data analysis activities, equipment repairs, documentation, and reporting activities. Annual post-closure groundwater monitoring will continue through at least 2117. All existing and new monitoring wells are estimated to require renovation or replacement every 25 years. Institutional controls restricting access to the subsurface and use of groundwater will be maintained in perpetuity. Institutional controls, including subsurface intrusion restrictions, are established and will be maintained at Underground Test Area sites to prevent access to the test cavities and subsurface contamination. The restriction boundaries may be modified to include other areas where groundwater modeling and risk assessment indicate that radioactive groundwater contamination may occur.

3.1.2 Estimated Long-Term Stewardship Costs for the Underground Test Areas

The table below provides the estimated long-term stewardship costs for the Underground Test Areas. The spike in costs, beginning in the 2036 timeframe, is due to costs for replacement of monitoring wells every 25 years. Included in the cost estimate are those costs related to funding a long-term stewardship program, as agreed to with the State of Nevada upon the closure of each site. Specifically, the costs include, among other activities, water sampling, underground water model validation, and well replacements.

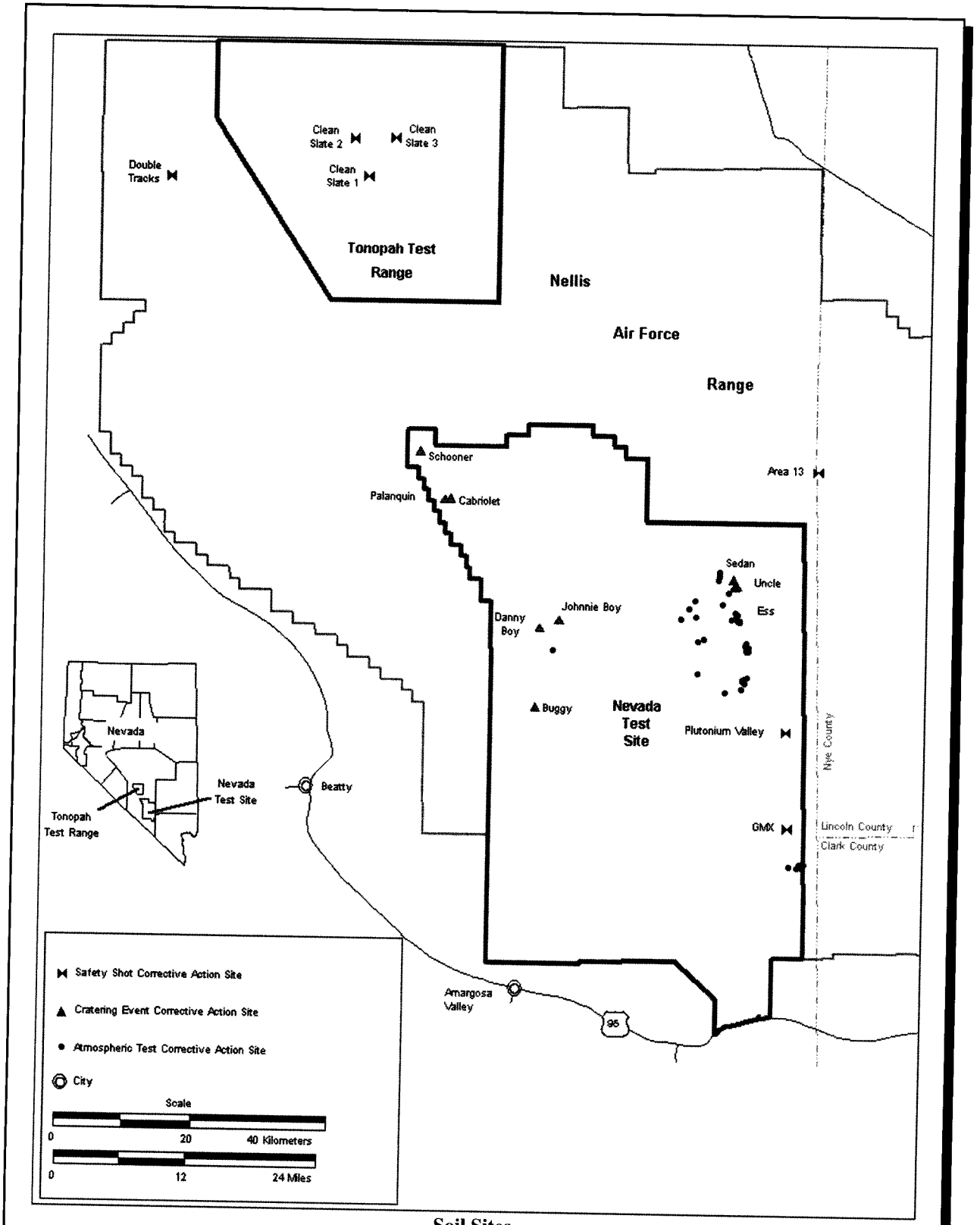
Long-Term Stewardship Costs (Constant Year 2000 Dollars)							
FY 2000 - FY 2010	***FY 2011 - FY 2020***	***FY 2021 - FY 2030***	***FY 2031 - FY 2040***	***FY 2041 - FY 2050***	***FY 2051 - FY 2060***	***FY 2061 - FY 2070***	***Estimated Total***
$0	$18,524,000	$29,318,000	$51,681,000	$41,441,000	$29,329,000	$73,216,000	$243,509,000

3.2 Soil Sites Portion

SOILS SITES PORTION HIGHLIGHTS

Major Long-Term Stewardship Activities - maintain site-wide institutional controls restrictions
Portion Size - n/a
Estimated Volume of Residual Contaminants - undetermined
Long-Term Stewardship Start-End Years - 2009-2016
Average Annual Long-Term Stewardship Costs FY 2000- 2006 - n/a

Soil contamination at the Nevada Test Site and the Tonopah Test Range consists of surface and shallow subsurface soil contamination resulting primarily from atmospheric testing of nuclear devices and safety tests, although soil was also contaminated from cratering tests and nuclear rocket engine tests. Atmospheric tests have contaminated soil near the test ground zero at a few sites throughout Yucca Flat. Safety tests have distributed plutonium particulates over soils in Area 5 and Area 11 of the Nevada Test Site and at areas on the Tonopah Test Range and the Nellis Air Force Range. Near-surface cratering experiments dispersed radioactive


Clean Slate 2
Clean Slate 3
Clean Slate 1
Double Tracks
Tonopah Test Range
Nellis
Air Force
Range
Schooner
Palanquin
Cabriolet
Area 13
Sedan
Uncle
Ess
Johnnie Boy
Danny Boy
Buggy
Nevada Test Site
Plutonium Valley
Nye County
Nevada
Nevada Test Site
Tonopah Test Range
Beatty
GMX
Lincoln County
Clark County
Amargosa Valley
95
Safety Shot Corrective Action Site
Cratering Event Corrective Action Site
Atmospheric Test Corrective Action Site
City
Scale
0
20
40 Kilometers
0
12
24 Miles

Soil Sites

rock and soil about the ground zero. Some deep underground tests have inadvertently vented radioactive materials to the surface. Remediation of the soil is being completed through the environmental restoration program known as the Soils Project. (See Section 1.2, Site Cleanup and Accomplishments)

3.2.1 Soil

The volume of contaminated soil requiring remediation is undetermined at this time because a final corrective action level has not been established. Once a cleanup level is negotiated with the State of Nevada and the U.S. Air Force, the extent of remediation can be determined. Interim corrective actions have been performed at Clean Slate 1 and Double Tracks sites; approval of the activities is pending an agreement on corrective action levels. When economically feasible, contaminated soil areas will be remediated to levels that would allow for unrestricted use, regardless of their location on the Nevada Test Site, Tonopah Test Range, or Nellis Air Force Range.

Soil Long-Term Stewardship Activities

Unremediated soil CAUs will require long-term stewardship activities. The long-term stewardship program will be negotiated with the State of Nevada, with input from other stakeholders and representatives of tribal nations as part of the final cleanup negotiations. Specific surveillance and monitoring requirements for each CAU will be defined in the closure report developed for the unit. The requirements for engineering controls will be finalized as part of the cleanup negotiations. It is anticipated that engineered controls, including fencing and signage, may be established and maintained at the Soils Sites to restrict access. The CAUs where no corrective actions are completed will be properly fenced, posted with warning signs, and will remain under institutional controls. Institutional controls limiting access to the site and monitoring the soils for contaminant migration will remain in place.

3.2.2 Estimated Long-Term Stewardship Costs for the Soil Sites

Estimated costs associated with long-term stewardship of the Soils Sites portion are identified in the table below. Long-term stewardship activities directly funded by the Soils Project are projected to end in 2016.

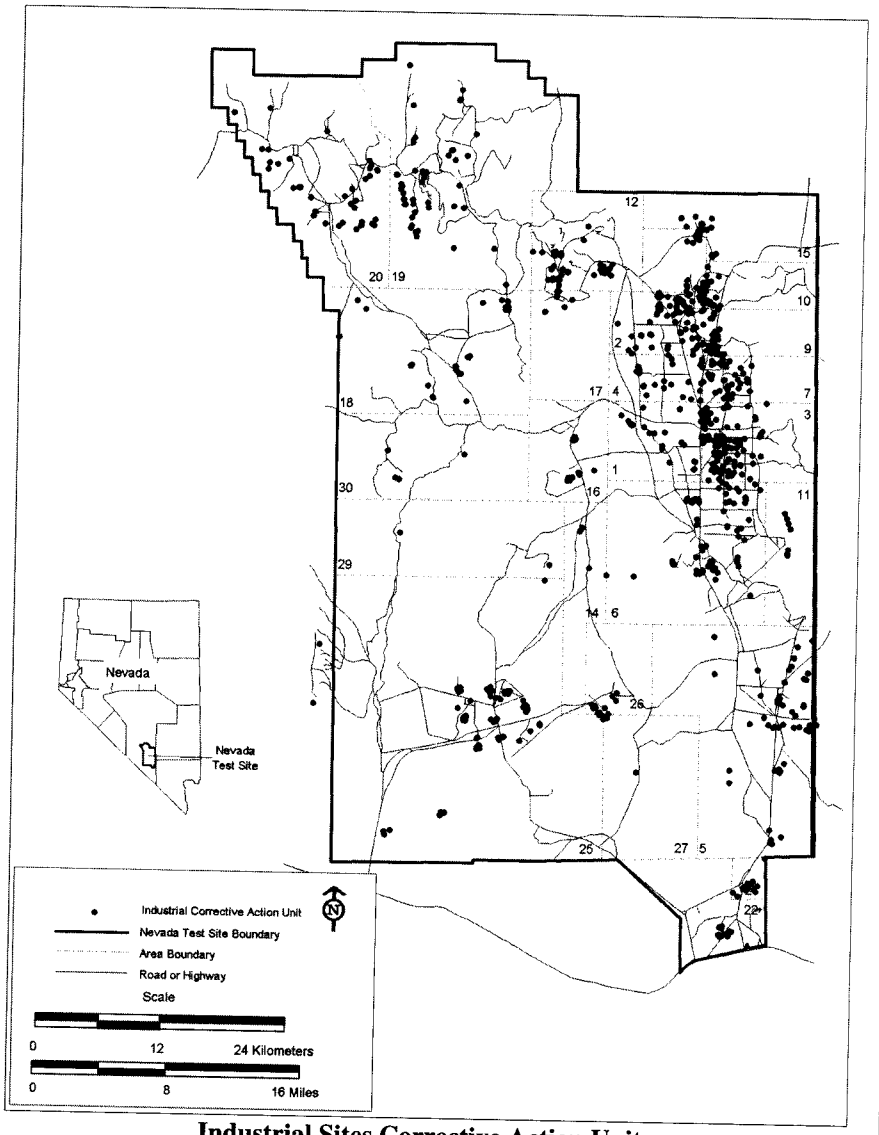
Long-Term Stewardship Costs (Constant Year 2000 Dollars)							
FY 2000 - FY 2010	*FY 2011 - FY 2020*	*FY 2021 - FY 2030*	*FY 2031 - FY 2040*	*FY 2041 - FY 2050*	*FY 2051 - FY 2060*	*FY 2061 - FY 2070*	*Estimated Total*
$318,000	$1,909,000	$0	$0	$0	$0	$0	$2,227,000

3.3 Industrial Sites Portion

The long-term stewardship activities for the CAUs will be limited to use restrictions and ongoing monitoring efforts. The institutional controls for the industrial sites will consist of the controls established for the Nevada Test Site and Tonopah Test Range. Engineered controls, including fencing and signage, may be established and maintained for Industrial Sites that have not undergone clean closure; although, the requirements for engineering controls have not been finalized for all Industrial Sites.

INDUSTRIAL SITES PORTION HIGHLIGHTS

Major Long-Term Stewardship Activities - maintain site-wide institutional controls restrictions
Portion Size -n/a
Estimated Volume of Residual Contaminants - undetermined
Long-Term Stewardship Start-End Years - 2010-2014
Average Annual Long-Term Stewardship Costs FY 2000-2006 - $10,783,000



Industrial Sites Corrective Action Units

3.3.1 Disposal Wells

Disposal wells include dry wells and underground discharge points where solid or liquid wastes were disposed. Approximately 26 CAUs have been identified for this source group. This medium consists of contaminated surface and subsurface soils. The total size and volume of residual contamination has not been determined because characterization is not complete. The sites vary in size and spacial location, and the nature of contamination has not been fully determined. Site characterizations are ongoing. Site contaminants may include chemicals, metals, debris, and radioactive materials.

3.3.2 Inactive Tanks

This source group is comprised of inactive or abandoned underground or above-ground storage tanks, vaults, and associated appurtenances located on the Nevada Test Site and Tonopah Test Range. This source group is comprised of 46 CAUs and consists of contaminated surface and subsurface soils. The size and volume of residual contamination of this source group has not yet been determined because characterization activities are not yet complete. The nature of contamination has not been fully determined at this time. Site characterizations are ongoing. Site contaminants may include chemicals, metals, debris, and radioactive materials. Characterization and required remedial actions will be implemented at sites in this source group. Depending on the site, both close-in-place and clean closure actions are anticipated within this group. Monitoring may be conducted at sites, if required.

CAU	*Corrective Action Site*	*Long-Term Stewardship Activities*
Area 12 Underground Storage Tanks and Spills Area 12 Camp	Spill 960722-02 (from UST 12-B-3)	use restrictions and monitoring
Area 12 Underground Storage Tanks and Spills Area 12 Camp	Spill H950919A (from UST 12-COMM-1)	use restrictions and monitoring
Area 12 Underground Storage Tanks and Spills Area 12 Camp	UST 12-COMM-1	use restrictions and monitoring
Area 12 Underground Storage Tanks and Spills Area 12 Camp	Spill H950524F (from UST 12-B-1)	use restrictions and monitoring
Area 12 Underground Storage Tanks and Spills Area 12 Camp	UST 12-B-3	use restrictions and monitoring
Area 12 Underground Storage Tanks and Spills Area 12 Camp	UST 12-B-1	use restrictions and monitoring
Area 23 Underground Storage Tank and Spill at the NTSO Building	UST 23-111-1	use restrictions and monitoring
Area 25 Underground Storage Tanks and Spills	Spill H940825C (from UST 25-3101-1)	use restrictions and monitoring
Area 25 Underground Storage Tanks and Spills	Spill H941020E (from UST 25-3152-1)	use restrictions and monitoring
Area 25 Underground Storage Tanks and Spills	Spill H940314E (from UST 25-3102-3)	use restrictions and monitoring
Area 25 Underground Storage Tanks and Spills	UST 25-3101-1	use restrictions and monitoring
Area 25 Underground Storage Tanks and Spills	UST 25-3152-1	use restrictions and monitoring
Area 25 Underground Storage Tanks and Spills	UST 25-3102-3	use restrictions and monitoring
Area 3 Second Gas Station Underground Storage Tank (TTR)	Underground Storage Tanks	use restrictions and monitoring

CAU	Corrective Action Site	Long-Term Stewardship Activities
Areas 2,9 Underground Storage Tanks and Spills Bunkers 2-300, 9-300	UST 9-300-1	use restrictions and monitoring
Areas 2,9 Underground Storage Tanks and Spills Bunkers 2-300, 9-300	UST 2-300-1	use restrictions and monitoring

3.3.3 Contaminated Waste Sites

This source group is comprised of landfills, contaminated waste dumps, and other areas and materials with potential chemical and radiological contamination located on the Nevada Test Site and Tonopah Test Range. This source group contains approximately 137 CAUs and consists of contaminated surface and subsurface soils. The total size and volume of residual contamination has not been determined because characterization is not complete. The sites vary in size and spacial location, and the nature of contamination has not been fully determined. Site characterizations are ongoing. Site contaminants may include chemicals, metals, debris, and radioactive materials. Characterization and required remedial actions will be implemented at sites in this source group. Monitoring may be conducted at sites, if required.

CAU	Location	Corrective Action Site	Long-Term Stewardship Activities
Area 16 Camp Burn Pit	Tippipah Spring	Area 16 Disposal Site (Burn Pit)	use restrictions and monitoring
Area 18 Disposal Site	Ammonia Tanks	Area 18 Disposal Site	use restrictions and monitoring
Area 19 Pahute Mesa Road Landfill	Silent Butte	Area 19 Disposal Site	use restrictions and monitoring
Area 20 Pahute Lake Landfill	Scrugham Peak	Area 20 Disposal Site	use restrictions and monitoring
Area 25 Cane Springs Landfill	Skull Mountain	Cane Springs Landfill/Disposal Site	use restrictions and monitoring
Area 25 FOC Construction Landfills		FOC Disposal Site	use restrictions and monitoring
Area 25 FOC Construction Landfills		FOC Disposal Site East	use restrictions and monitoring
Area 25 RMAD Landfill	Skull Mountain	Disposal Site	use restrictions and monitoring
Area 27 Landfill	Cane Spring	Area 27 Disposal Site	use restrictions and monitoring
Area 3 BJY Disposal Site	Yucca Flat	BJY Disposal Site	use restrictions and monitoring
Area 3 Landfill Complexes	Tonopah Test Range	Landfill Cell A3-5	use restrictions and monitoring
Area 3 Landfill Complexes	Tonopah Test Range	Landfill Cell A3-1	use restrictions and monitoring
Area 3 Landfill Complexes	Tonopah Test Range	Landfill Cell A3-2	use restrictions and monitoring
Area 3 Landfill Complexes	Tonopah Test Range	Landfill Cell A3-4	use restrictions and monitoring
Area 3 Landfill Complexes	Tonopah Test Range	Landfill Cell A3-6	use restrictions and monitoring

CAU	Location	Corrective Action Site	Long-Term Stewardship Activities
Area 3 Landfill Complexes	Tonopah Test Range	Landfill Cell A3-7	use restrictions and monitoring
Area 3 Landfill Complexes	Tonopah Test Range	Landfill Cell A3-8	use restrictions and monitoring
Area 3 Landfill Complexes	Tonopah Test Range	Landfill Cell A3-3	use restrictions and monitoring
Area 30 Landfill	Timber Mountain	Area 30 Disposal Site	use restrictions and monitoring
Cactus Spring Waste Trenches	Tonopah Test Range	Waste Trenches	use restrictions and monitoring

3.3.4 Septic Tanks and Lagoons

This source group is comprised of inactive or abandoned septic tanks, leachfield systems, sewage lagoons, sewage systems and associated appurtenances on the Nevada Test Site and Tonopah Test Range. This source group contains 44 CAUs and consists of contaminated surface and subsurface soils. The total size and volume of residual contamination has not been determined because characterization is not complete. The sites vary in size and spacial location, and the nature of contamination has not been fully determined. Site characterizations are ongoing. Site contaminants may include chemicals, metals, debris, and radioactive materials. Characterization and required remedial actions will be implemented at sites in this source group. Monitoring may be conducted at sites, if required.

CAU	Location	Corrective Action Site	Long-Term Stewardship Activities
Area 3 Septic Waste Systems 2, 6 (TTR)	Tonopah Test Range	Septic Waste System	use restrictions and monitoring
Area 3 Septic Waste Systems 2, 6 (TTR)	Tonopah Test Range	Septic Waste System	use restrictions and monitoring
Roller Coaster Lagoons and Trench (TTR)	Tonopah Test Range	Roller Coaster N. Disposal Trench	use restrictions and monitoring
Roller Coaster Lagoons and Trench (TTR)	Tonopah Test Range	Roller Coaster Lagoons	use restrictions and monitoring

3.3.5 Inactive Ponds and Tunnel Muckpiles

Inactive ponds and tunnel muckpiles are sites contaminated or potentially contaminated as a result of tunnel drilling operations. This source group contains 12 CAUs and consists of contaminated surface and subsurface soils. A total size and volume of residual contamination has not been determined because characterization is not complete. The sites vary in size and spacial location, and the nature of contamination has not been fully determined. Site characterizations are ongoing. Site contaminants may include chemicals, metals, debris, and radioactive and materials. Characterization and required remedial actions will be implemented at sites in this source group. These sites are usually remediated as complex sites. Monitoring may be conducted at sites, if required.

3.3.6 Drains and Sumps

This source group is comprised of decontamination facilities, decontamination pads, wash-down areas, drainage sumps and associated appurtenances on the Nevada Test Site and Tonopah Test Range. This source group contains 23 CAUs and consists of contaminated surface and subsurface soils. The total size and volume of residual contamination has not been determined because characterization is not complete. The sites vary in size and spacial location, and the nature of contamination has not been fully determined. Site characterizations are ongoing. Site contaminants may include chemicals, metals, debris, and radioactive materials. Characterization and required remedial actions will be implemented at sites in this source group. Monitoring may be conducted at sites, if required.

CAU	*Location*	*Corrective Action Site*	*Long-Term Stewardship Activities*
Area 3 Underground Discharge Point, Building 0360	Tonopah Test Range	Underground Discharge Point	use restrictions and monitoring

3.3.7 Ordnance Sites

Sites in this source group typically contain exposed (at the ground surface) or buried unexploded ordnance, ordnance debris, or test ordnance not containing explosives. This source group contains seven CAUs and consists of contaminated surface and subsurface soils. The total size and volume of residual contamination has not been determined because characterization is not complete. The sites vary in size and spacial location, and the nature of contamination has not been fully determined. Site characterizations are ongoing. Site contaminants may include chemicals, metals, debris, and radioactive materials. Characterization and required remedial actions will be implemented at sites in this source group. These sites are typically remediated as SAFER sites. Monitoring may be conducted at these sites, if required.

CAU	*Location*	*Corrective Action Site*	*Long-Term Stewardship Activities*
Area 9 UXO Landfill (TTR)	Tonopah Test Range	Area 9 Landfill	use restrictions and monitoring

3.3.8 Bunkers, Chemicals & Materials Storage

This source group consists of camera and storage bunkers, containing unused or discarded chemicals, and miscellaneous materials storage areas. This source group contains 10 CAUs and consists of contaminated surface and subsurface soils. The total size and volume of residual contamination has not been determined because characterization is not complete. The sites vary in size and spacial location, and the nature of contamination has not been fully determined. Site characterizations are ongoing. Site contaminants may include chemicals, metals, debris, and radioactive materials. Characterization and required remedial actions will be implemented at sites in this source group. Monitoring may be conducted at sites, if required.

3.3.9 Spill Sites

This source group is comprised of sites impacted by the release of chemicals, oil, solvents and other contaminants located on the Nevada Test Site and Tonopah Test Range. This source group contains 35 CAUs and consists of contaminated surface and subsurface soils. The total size and volume of residual contamination has not been

determined because characterization is not complete. The sites vary in size and spacial location, and the nature of contamination has not been fully determined. Site characterizations are ongoing. Site contaminants may include chemicals, metals, debris, and radioactive materials. Characterization and required remedial actions will be implemented at sites in this source group. Monitoring may be conducted at sites, if required.

3.3.10 Part A Sites

Sites in this source group are listed in the Resource Conservation and Recovery Act (RCRA) Part B Permit for the Nevada Test Site. This source group contains sites contaminated by the disposal of RCRA hazardous waste. This source group contains nine CAUs and consists of contaminated surface and subsurface soils. The total size and volume of residual contamination has not been determined because characterization in not complete. The sites vary in size and spacial location, and the nature of contamination has not been fully determined. Site characterizations are ongoing. Site contaminants may include RCRA regulated constituents. Characterization and required remedial actions will be implemented at sites in this source group. Monitoring may be conducted at sites, if required.

CAU	*Location*	*Corrective Action Site*	*Long-Term Stewardship Activities*
Area 2 Bitcutter Containment	Oak Spring	Bitcutter/PS Inj. Wells (3) (RCRA)	use restrictions and monitoring
Area 2 Bitcutter Containment	Oak Spring	Wastewater Pit	use restrictions and monitoring
Area 23 Hazardous Waste Trenches		Area 23 Haz. Waste Trenches (RCRA)	use restrictions and monitoring
Area 3 U-3fi Injection Well	Yucca Flat	U-3fi Waste Disposal Unit (RCRA)	use restrictions and monitoring
Area 6 Decon Pond Facility	Yucca Lake	Decon Pad Oil/Water Separator	use restrictions and monitoring
Area 6 Decon Pond Facility	Yucca Lake	Decontamination Pond (RCRA)	use restrictions and monitoring

3.3.11 Miscellaneous Sites

This source group contains approximately 104 CAUs and consists of contaminated surface and subsurface soils. The total size and volume of residual contamination has not been determined because characterization is not complete. The sites vary in size and spacial location, and the nature of contamination has not been fully determined. Site characterizations are ongoing. Site contaminants may include chemicals, metals, debris, and radioactive and materials. Characterization and required remedial actions will be implemented at sites in this source group. At these sites, data gathered during records searches and field verification activities justify the removal of source materials and directly impacted soil and subsequent confirmatory sampling without additional investigation. Monitoring may be conducted at some sites, if required.

3.3.12 Deactivation and Decommissioning Facilities

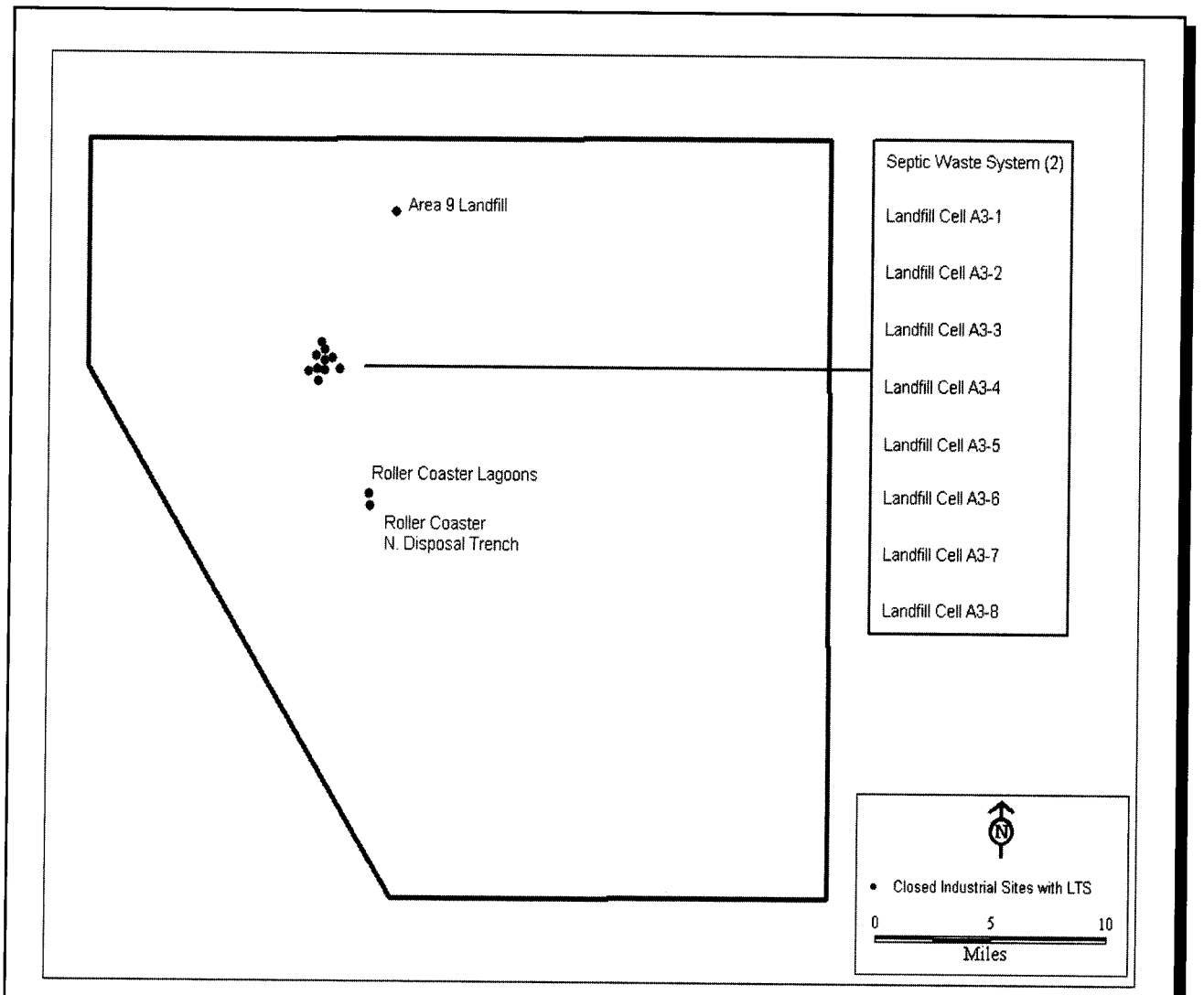
Deactivation and Decommissioning facilities include the R-MAD Facility, Pluto Disassembly Facility, Super Kukla Reactor Facility, Test Cell A, Test Cell C, and the Engine Maintenance and Disassembly Facility. These CAUs use characterization and remediation techniques that are the same as those used by other sites. Direct frisk

and wipe sampling, decontamination, and dismantlement techniques will be used. Closure of these facilities follows one of the standard Federal Facility Agreement and Consent Order processes. No long-term stewardship activities are anticipated.

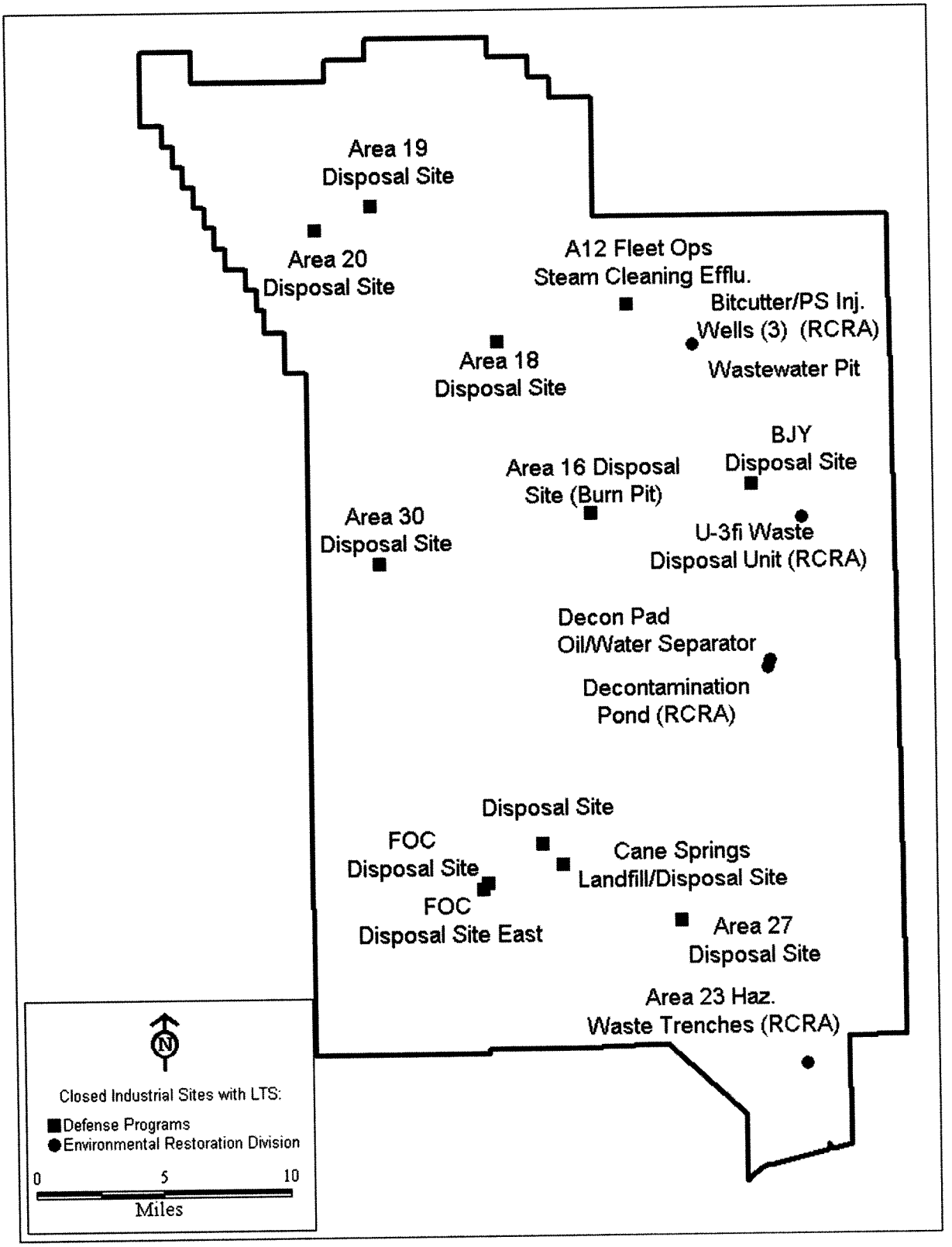
3.3.13 Estimated Long-Term Stewardship Costs for Industrial Sites

The costs associated with long-term stewardship of the Industrial Sites portion are depicted below. Long-term stewardship and maintenance activities directly funded by Industrial Sites are projected to end in 2014.

Long-Term Stewardship Costs (Constant Year 2000 Dollars)							
FY 2000 - FY 2010	***FY 2011 - FY 2020***	***FY 2021 - FY 2030***	***FY 2031 - FY 2040***	***FY 2041 - FY 2050***	***FY 2051 - FY 2060***	***FY 2061 - FY 2070***	***Estimated Total***
$23,779,000	$11,468,000	$0	$0	$0	$0	$0	$35,247,000



Industrial Sites Requiring Long-Term Stewardship at TTR



Industrial Sites Requiring Long-Term Stewardship at NTS

3.4 Area 3 Radioactive Waste Management Site (RWMS) Portion

> ***AREA 3 RADIOACTIVE WASTE MANAGEMENT SITE PORTION HIGHLIGHTS***
>
> *Major Long-Term Stewardship Activities* - access restrictions; cap monitoring and maintenance
> *Portion Size* - 50 hectares (125 acres)
> *Estimated Volume of Residual Contaminants* - 257,000 cubic meters (336,143 cubic yards)
> *Long-Term Stewardship Start-End Years* - 2016-2045
> *Average Annual Long-Term Stewardship Costs FY 2000-2006* - n/a (costs begin in FY 2016)

The Area 3 RWMS Portion covers approximately 50 hectares (125 acres) and is located in Yucca Flat, approximately 120 kilometers (75 miles) northwest of Las Vegas, Nevada. Since the mid-1960s, the Area 3 RWMS was used primarily for the disposal of contaminated waste generated from the Nevada Test Site Atmospheric Testing Debris Disposal Program, which involved the cleanup of atmospheric testing sites. Area 3 is now used for the disposal of bulk and packaged low-level waste from onsite and offsite DOE-approved generators. The only structures within the Area 3 RWMS are a semi-permanent structure (trailer) and a guard house. The Area 3 RWMS also has two other craters that are currently unused but may become disposal units in the future if additional space is required. These two craters have a combined capacity of 227,000 cubic meters (eight million cubic feet).

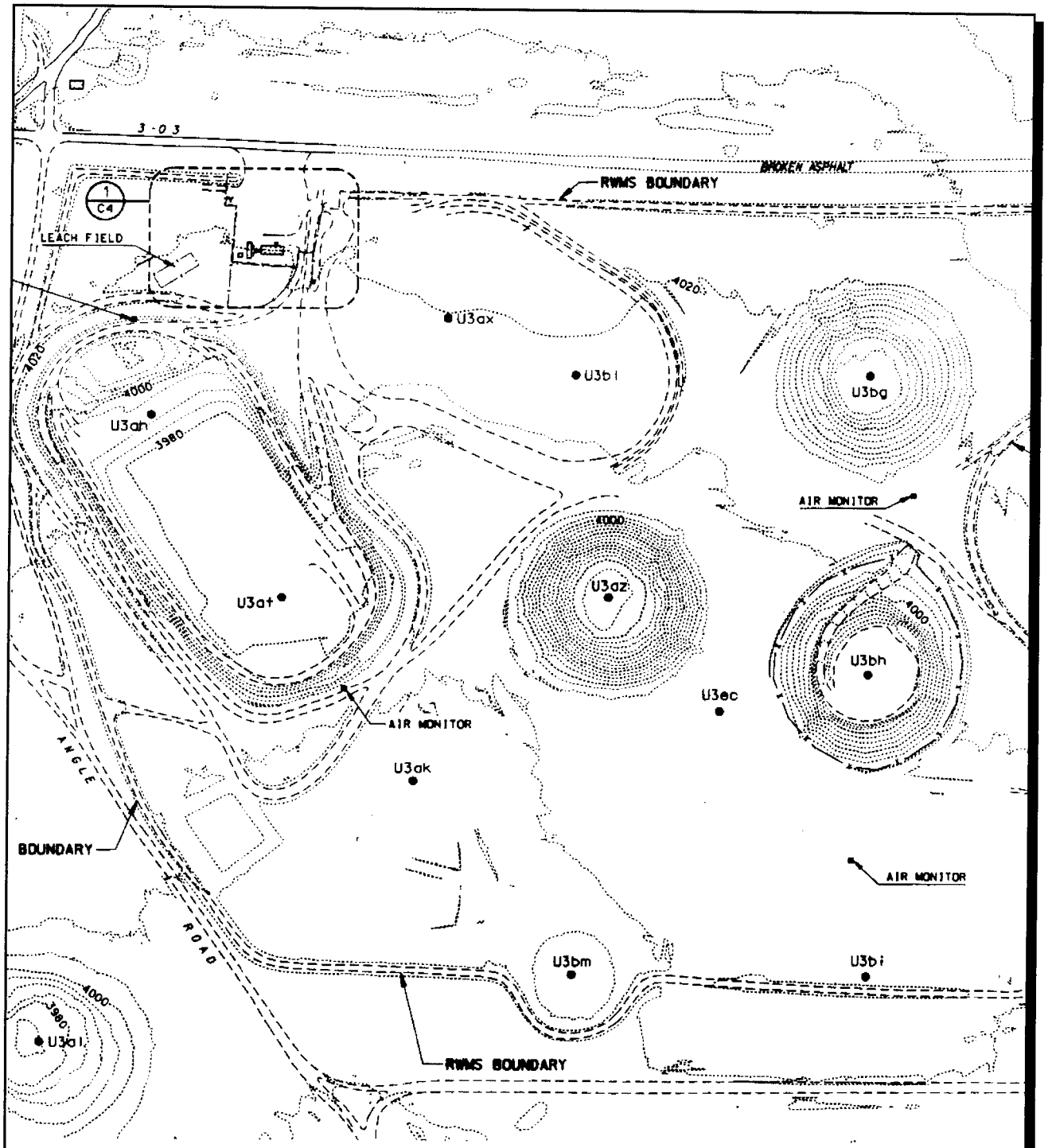
There is little or no potential for groundwater contamination in the uppermost aquifer in the future. The amount of waste in the Area 3 RWMS is small compared to the total volume of radioactive materials already placed in or near the aquifer by underground weapons testing. Although there is a large volume of soil buried in this location (288,000 cubic meters, 10 million cubic feet), the curie content is small (less than 3,000 curies) and the depth to groundwater is approximately 488 meters (1,600 feet).

3.4.1 Engineered Units

The engineered units currently consist of three separate disposal units: U3ax/bl, U3ah/at, and U3bh. U3ah/at utilizes two subsidence craters, U3ah and U3at, for disposal of large bulk packages. The earth separating these craters has been excavated and used for waste covering, resulting in a single disposal unit having a volume of approximately 257,000 cubic meters (nine million cubic feet). The U3ax/bl disposal cell is retired; all waste disposed in this cell has been buried, and a final closure plan will be submitted to the State of Nevada prior to commencement of closure activities. Two additional craters have been reserved for future use. Summary information on crater disposal cells is given in the table below.

U3ax/bl Waste Disposal Unit: U3ax/bl is an unlined disposal unit and will be closed as a mixed low-level waste disposal unit. Waste disposal at the U3ax/bl disposal unit (combination of U3ax and U3bl craters) began in the late 1960s and continued until it was closed at the end of 1987. Eighty percent of the waste in U3ax was disposed of after 1979 by the Waste Consolidation Project (WCP), which consolidated atmospheric testing debris and contaminated debris associated with atmospheric tests. Contaminated debris was disposed and covered by clean backfill soil. The two craters and the excavated area between the craters was completely filled in 1987 with 219,914 cubic meters (7,763,000 cubic feet) of contaminated waste and material, with a total of 1,211 curies. The U3ax/bl disposal unit is full and is currently covered with a minimum of 30 centimeters (one foot) of backfill that is serving as a temporary cover. The most abundant radionuclides are hydrogen-3 (85%), plutonium-239, plutonium-240, uranium-238, and uranium-234.

U3ah/at Waste Disposal Unit: In 1988, the waste disposed by the WCP moved from the closed U3ax/bl unit to the U3ah crater. Two layers of non-containerized waste were place in the crater before 1989. Subsequently, the area between the U3at and U3ah craters was excavated and disposal expanded into the U3ah crater. Since 1987, the U3ah/at disposal unit has disposed of mostly containerized bulk waste from offsite generators. As of 1995,



Area 3 Radioactive Waste Management Site

there were four tiers, or layers, of waste separated by approximately three feet of clean cover soil in U3ah/at. Seven tiers of waste are anticipated when the unit closes, with a total volume of approximately 270,000 cubic meters (9,534,960 cubic feet) and an estimated 700 curies. The most abundant, long-lived radionuclides are

hydrogen-3, plutonium-239, plutonium-240, plutonium-241, cesium-137, strontium-90, uranium-238, and uranium-234.

U3bh Waste Disposal Unit: Non-containerized, plutonium-contaminated soil from the Clean Slate I safety test site (Tonopah Test Range) was disposed in the U3bh crater. Current plans are to dispose of the plutonium-contaminated soil from the Clean Slate 1, 2 and 3 sites (Tonopah Test Range) in the U3bh crater. The total volume of this waste is unknown, as it has yet to be generated, but it is expected to be contaminated with plutonium radionuclides.

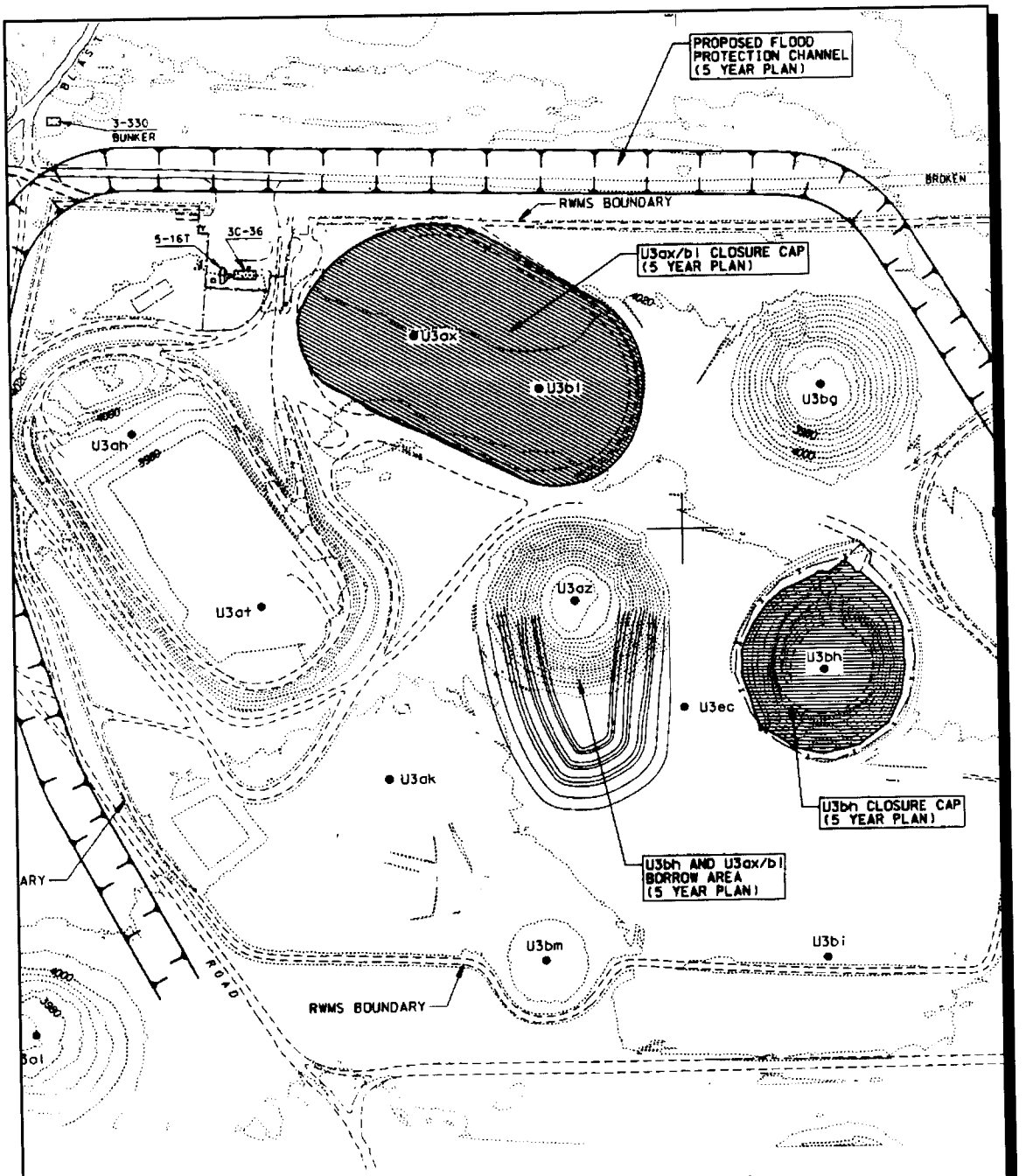
Disposal Cell Data					
Crate Unit ID	***Opened***	***Status***	***Disposal Start Date***	***Disposal Completion Date***	***Surface Area***
U3ax U3bl	5/7/62 8/24/62	covered	9/68	12/87	418905
U3at U3ah	12/3/61 3/1/63	open	1/88	active	640562
U3az	4/5/62	open	n/a	n/a	229022
U3bg	2/8/63	open	n/a	n/a	229022
U3bh	9/14/62	open	5/97	active	51472

Source: Nevada Test Site Area 3 Radioactive Waste Management Site (RWMS)Site Atlas, 5/12/99, drawing number CS-003-RWMS-C11 Rev. 0

Engineered Units Long-Term Stewardship Activities

It is currently planned that low-level waste will be received at the Area 3 RWMS through 2010. In 2011 the long-term stewardship responsibilities for this site will be transferred to the lead PSO (i.e., the National Nuclear Security Administration). Each unit will have a minimum soil cover (at closure) of 2.4-3.0 meters (8-10 feet) and will be marked with concrete monuments to identify the location of the waste units. Because Area 3 of the Nevada Test Site was the location of numerous underground nuclear tests, institutional controls, including drilling restrictions and groundwater use restrictions, are in place for this portion of the test site. Institutional controls will be maintained to prevent access to surface and subsurface contamination. It is assumed that future zoning restrictions will eliminate human intrusion into the waste. Active institutional controls, where the land remains inaccessible to the public due to the presence of DOE or some other governing entity, are expected to continue for at least 100 years, or until 2115. Due to the extensive cratering and other effects of nuclear testing, the Yucca Flat area will never be released for unrestricted use. This will ensure institutional control for as long as the waste presents a radiological hazard to workers or the public. It is assumed that this constraint will exist in perpetuity.

Plans are to establish a long-term program for surveillance and maintenance, which includes monthly and quarterly gathering of environmental data, subsidence monitoring, mitigation of subsidence occurrences, and fencing and sign maintenance, should either be necessary. Record-keeping will continue as long as waste emplacement occurs, and these records will establish a documented land deed record in State and County government files.



Caps in Radioactive Waste Management Area 3

3.4.2 Estimated Long-Term Stewardship Costs for the Area 3 RWMS

The costs associated with long-term stewardship of the Area 3 RWMS portion are depicted in the table below. Current plans call for low-level waste from DOE's Environmental Management Program to be received at the Area 3 RWMS through 2014, and for long-term surveillance and maintenance to be carried out as part of the stewardship program for 30 years after closure in 2015. DOE assumes that a charge-back system will continue to be in place for disposal operations and that stewardship costs are for maintaining the capability for low-level waste disposal (i.e., performance assessments, closure, operational monitoring, safety analysis, etc.) for five years

after the Environmental Management mission is complete. Stewardship costs also include funding to ensure a smooth transition to DOE's Defense Programs. The decrease in costs in the 2041-through-2050 time frame is because costs were only projected through 2045.

Long-Term Stewardship Costs (Constant Year 2000 Dollars)							
FY 2000 - FY 2010	***FY 2011 - FY 2020***	***FY 2021 - FY 2030***	***FY 2031 -FY 2040***	***FY 2041 - FY 2050***	***FY 2051 - FY 2060***	***FY 2061 - FY 2070***	***Estimated Total***
$0	$8,136,000	$2,375,000	$2,375,000	$1,187,500	$0	$0	$14,073,500

3.5 Area 5 Radioactive Waste Management Site Portion

AREA 5 RADIOACTIVE WASTE MANAGEMENT SITE PORTION HIGHLIGHTS

Major Long-Term Stewardship Activities - access restrictions; cap monitoring and maintenance
Portion Size - 296 hectares (732 acres)
Estimated Volume of Residual Contaminants - undetermined
Long-Term Stewardship Start-End Years - 2016 - 2045
Average Annual Long-Term Stewardship Costs FY 2000- 2006 - n/a (costs begin in FY 2016)

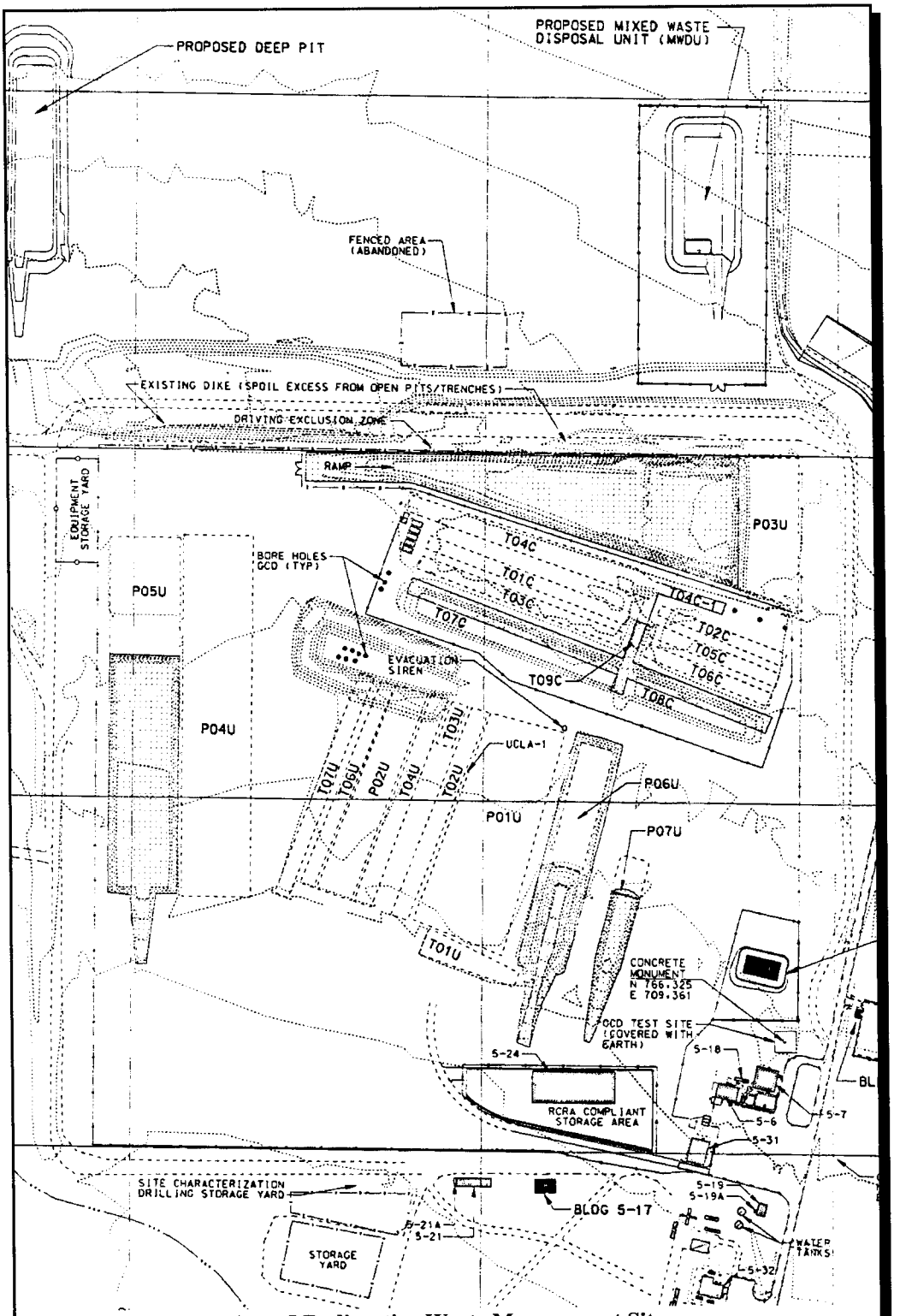
The Area 5 RWMS portion covers approximately 296 hectares (732 acres) and is located in the northern Frenchman Flat of the Nevada Test Site. In 1961, Area 5 RWMS was established for the disposal of low-level waste and classified low-level waste from both onsite and offsite DOE generators. Most (259 hectares, 640 acres) of the Area 5 Site is undeveloped. The developed area of the waste site, referred to as the Low-Level Waste Management Unit, covers 37.2 hectares (92 acres) in the southeast corner and consists of 23 landfill cells (pits and trenches), 13 greater confinement disposal boreholes, and a transuranic waste storage pad. The developed area is surrounded by a 305-meter (1,000-foot) buffer zone. The perimeter of the low-level waste management unit is completely fenced, and there is only one point of access. Associated with the Low-Level Waste Management Unit is the Hazardous Waste Storage Unit, the Waste Examination Facility, and several administrative support structures. The Mound Strategic Storage Yard was closed in 1997 after the waste stored there was shipped offsite.

The uppermost aquifer is located within the alluvium, 240 meters (790 feet) beneath the Area 5 RWMS. The water table is nearly flat, and there is no significant horizontal flow beneath the RWMS in the saturated zone. The Tuff Aquitard, which is estimated to be in excess of 1,370 meters (4,495 feet) thick, lies below the alluvium. Because of its relatively large areal extent and thickness, it is a major barrier for groundwater to move from the uppermost aquifers into the Lower Carbonate Aquifer below, which is part of the Ash Meadows Groundwater Basin. Four active water supply wells and three RCRA monitoring wells around the Area 5 RWMS have shown no contamination related to either waste disposal or underground nuclear testing.

3.5.1 Engineered Units

All of the 23 engineered units contain low-level waste. A single pit, P03U, has received mixed low-level waste. The greater confinement disposal boreholes have received low-level waste (including high-specific activity waste), transuranic waste, and mixed waste. Disposal in the greater confinement disposal boreholes began in 1983 and continued until 1989.

From 1960 to 1978, only low-level waste generated by Nevada Test Site operations were disposed at the site by shallow land burial. Eight trenches were filled with byproducts of nuclear weapons testing and nuclear rocket testing and contained predominantly fission products, activation products, and lesser amounts of actinides. The trenches were operationally closed during this period.



Area 5 Radioactive Waste Management Site

Starting in 1978, the Nevada Test Site began accepting low-level waste generated by offsite DOE facilities. By 1988, a total of 11 shallow pits and trenches had been operationally closed and four remained open. Waste

generated by offsite DOE generators commonly contains radionuclides used in, or produced as a byproduct of, the production of nuclear weapons. Major radionuclides in this group include tritium and isotopes of uranium and plutonium. However, since the 1980s, with the decommissioning of weapons production facilities, most of the disposed waste has consisted predominantly of decontamination and decommissioning debris from the former weapons production sites.

Currently, the Area 5 RWMS is open and receiving low-level waste from the Nevada Test Site and offsite generators, as well as mixed low-level waste from the NTS for storage and disposal. The Area 5 RWMS does not accept nonradioactive hazardous waste or nonradioactive solid waste for disposal. The table below lists the status of each engineered unit

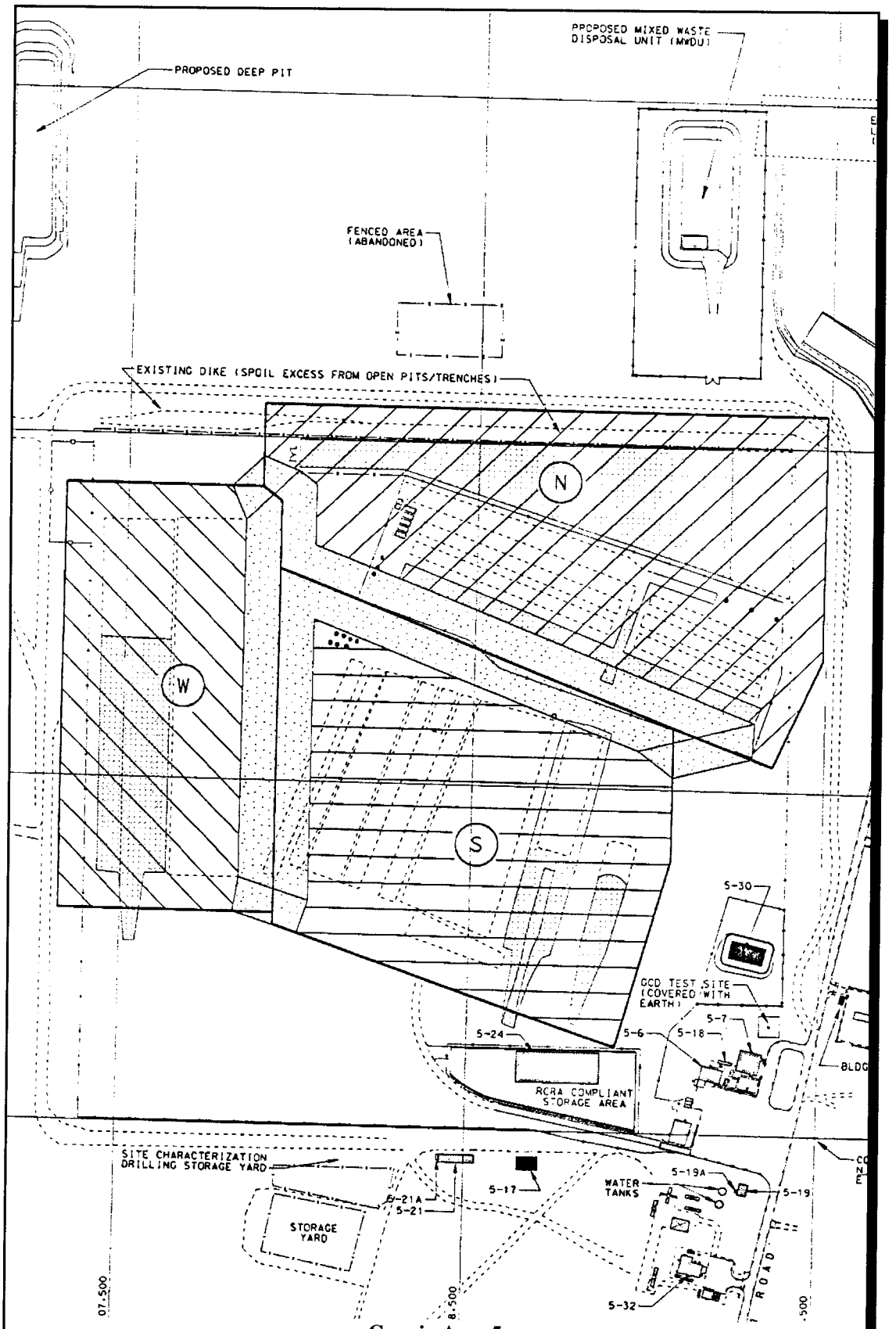
Waste containers in the units are typically stacked to about 1.2 meters (four feet) below original grade. Periodically, soil backfill is pushed over the waste in a single lift. The placed fill layer is approximately 2.4 meters (eight feet) thick, which provides a final grade about 1.2 meters (four feet) above the original ground elevation. The upper portion of the soil cap is compacted in place. This cover is referred to as a temporary closure cap or operational cover because the native material is applied routinely over the filled portions of the waste disposal cells.

Area 5 Shallow Pits and Trenches		
Disposal Unit	***Date Opened***	***Date Closed***
T01U	01/- /61	07/- /65
T02U	12/- /72	12/- /78
T04U	02/- /70	12/- /78
T06U	05/- /65	02/- /70
T07U	09/04/68	12/21/87
P01U	11/01/78	04/18/85
P02U	04/24/85	01/- /87
P04U	06/21/88	05/11/95
T03U	- /- /84	Open
P03U	01/- /87	Open
P05U	02/23/95	Open
P06U Upper	- /- /94	Open
P06U Lower	- /- /94	Open
P07U	02/- /97	Open
T01C	- /- /60	03/- /69
T02C	12/05/88	- /- /-
T03C	- /- /60	03/- /69

Area 5 Shallow Pits and Trenches		
Disposal Unit	***Date Opened***	***Date Closed***
T04C	03/- /69	08/03/95
T04C-1	03/- /69	08/03/95
T05C	- /- /60	03/- /69
T06C	- /- /60	03/- /69
T07C	- /- /95	Open
T08C	- /- /95	Open
T09C	- /- /95	Open

The Area 5 Greater Confinement Disposal Boreholes are unlined, except for the upper three meters (10 feet), which are cased with a corrugated steel culvert. Each is approximately three to 3.6 meters (10 to 12 feet) in diameter, with a total depth of 36 meters (120 feet). Waste packages are placed in the bottom of the Greater Confinement Disposal Boreholes to approximately 21 meters (70 feet) from the land surface. The holes are then backfilled with native soil. A 1.8-meter (six-foot) long concrete monument indicates the location (borehole designation), operation dates, and coordinates of the borehole. Waste disposed in the Greater Confinement Disposal Boreholes includes low-level waste; transuranic waste, including nuclear weapon accident residues and high-specific-activity tritium waste; and wastes such as irradiated fuel rod cladding, sealed sources, and radioisotope thermoelectric generators. On an activity basis, the greater confinement disposal inventory is hydrogen-3, cesium-137, and strontium-90. After a few hundred years of decay, the primary contaminants will be plutonium-240, plutonium -239, and americium-241. The table below gives the status of Area 5 Greater Confinement Disposal Boreholes.

Area 5 Greater Confinement Disposal Boreholes		
GCD Borehole	***Date Opened***	***Date Closed***
Greater Confinement Disposal Test	- /- /83	- /- /84
U5RWMS01C	- /- /84	- /- /84
U5RWMS02C	- /- /84	- /- /84
U5RWMS03C	- /- /84	- /- /84
U5RWMS04C	07/19/85	01/14/87
U5RWMS05U	02/05/86	04/08/87
U5RWMS06U	07/16/86	Open (Inactive)
U5RWMS07C	07/07/89	Open (Inactive)
U5RWMS08C	- /- /87	Open (Empty)
U5RWMS09U	- /- /87	Open (Empty)
U5RWMS010U	12/11/87	11/03/89
U5RWMS011U	- /- /89	Open (Empty)
U5RWMS012U	- /- /89	Open (Empty)



Caps in Area 5

Engineered Units Long-Term Stewardship Activities

Long-term stewardship responsibilities for this portion are expected to be transferred to the site landlord, the Office of Defense Programs, in 2011 and will be required in perpetuity. Institutional controls, including subsurface intrusion restrictions, are currently in place and will be maintained to prevent access to the disposed waste. In addition, a flood control channel and levee on the north side of the RWMS is in place to provide engineered protection for the disposal areas. Three groundwater monitoring wells near the north and southeast corners of the Area 5 RWMS are in place. In addition, several trenches and pits are instrumented with vadose zone monitoring devices.

The Area 5 RWMS disposal units are assumed to be closed with a monofill native alluvium cap. The cap is assumed to be maintained for at least 100 years after closure. Maintenance activities are assumed to include removal of all deeply rooted plants and repair of subsidence during institutional control. Subsidence is assumed to cause cracks to form in the cap that may create preferential pathways for the release of volatile and gaseous radionuclides and focus infiltration of water. Cap thickness is assumed to be sufficient so that the cap remains above grade after subsidence is complete. The cap is assumed to be at least 2.5 to eight meters (six to 20 feet) thick throughout the compliance period. The following map depicts the caps.

3.5.2 Estimated Long-Term Stewardship Costs for Area 5 RWMS

The costs associated with long-term stewardship of the Area 5 RWMS portion are described below. Current Plans call for low-level waste to be received at the Area 5 RWMS through FY2014, and for long-term surveillance and maintenance to be carried out as part of the long-term stewardship program for 30 years after closure in FY2015. DOE assumes that a chargeback system will continue to be in place for disposal operations, and that long-term stewardship costs are for maintaining the capability for low-level waste disposal (i.e., performance assessments, closure, operational monitoring, safety analysis, etc.) for five years after the EM mission is complete. Long-term stewardship costs are provided to ensure a smooth transition to DOE's Defense Programs, including funding to maintain the radioactive waste management basis.

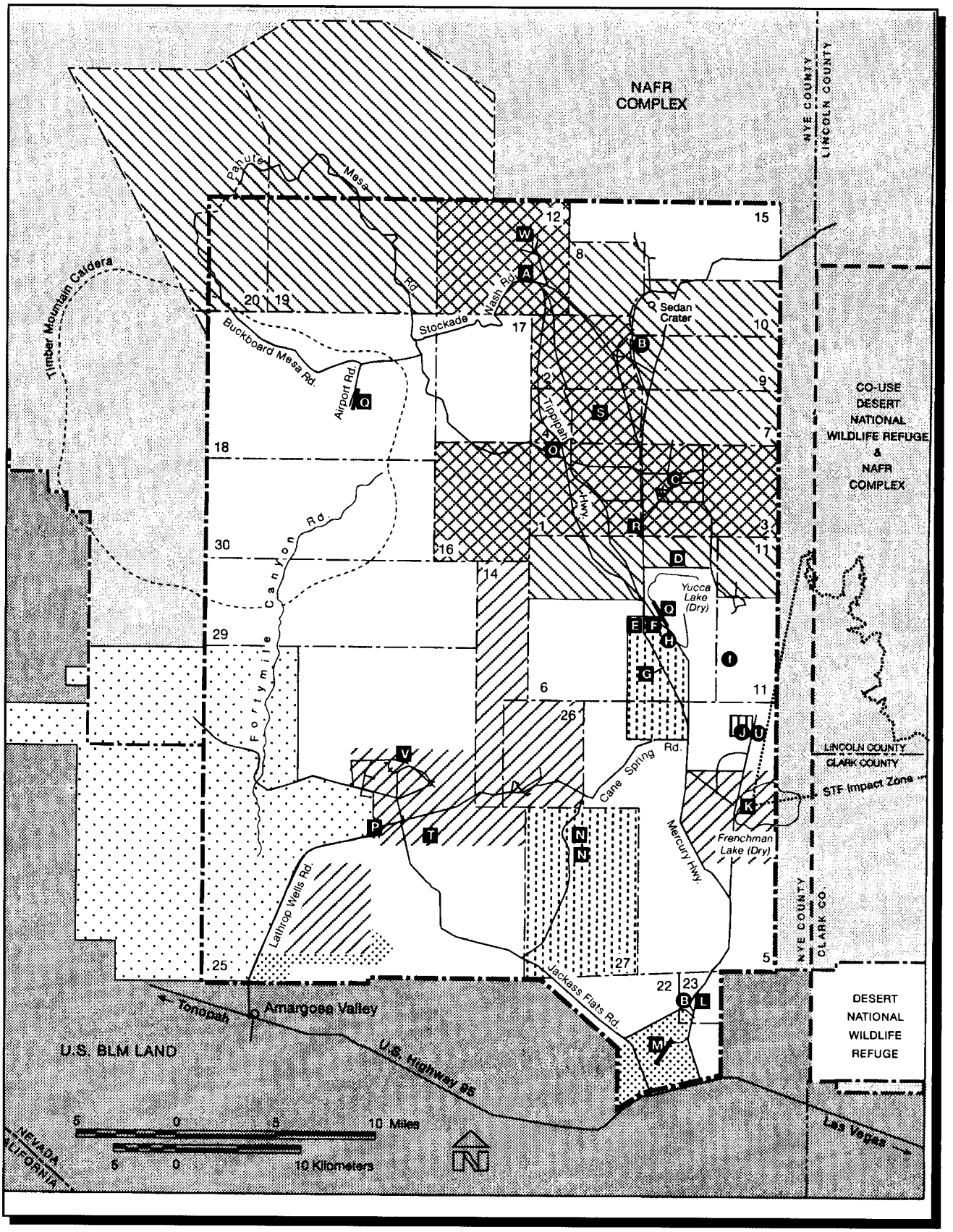
Long-Term Stewardship Costs (Constant Year 2000 Dollars)							
FY 2000 - FY 2010	***FY 2011 - FY 2020***	***FY 2021 - FY 2030***	***FY 2031 - FY 2040***	***FY 2041 - FY 2050***	***FY 2051 - FY 2060***	***FY 2061 - FY 2070***	***Estimated Total***
$0	$8,136,000	$2,375,000	$2,375,000	$1,187,500	$0	$0	$14,073,500

4.0 FUTURE USES

It is anticipated that the federal government will own the land for the Nevada Test Site in perpetuity. DOE's Office of Defense Programs is expected to remain the landlord. Future land use decisions for the Nevada Test Site will be compatible with the Nevada Test Site Final Environmental Impact Statement (DOE/EIS 0243, dated August 1996) and the Resource Management Plan. Decisions involving resources management, future land use, and private development will be completed in partnership with and in the interests of DOE, the national laboratories, the U.S. Air Force, the Bureau of Land Management, Tribal Governments, State and local agencies, and stakeholders. Most of the site and facilities will be used to support ongoing Defense Program operations and will remain under institutional control with controlled access. Approximately 4,650 hectares (11,500 acres) in portions of Areas 22 and 23 (the proposed Desert Rock Sky Park), and a section in the southwestern portion of Area 25, all located in the southern part of the Nevada Test Site, have been designated for potential industrial redevelopment. Institutional control will be maintained regardless of any redevelopment activities.

Responsibility for the future land use on the Tonopah Test Range falls within the purview of the DoD, U.S. Air Force. The DoD is in the process of developing an environmental impact statement governing Air Force activities on the Nellis Air Force Range, which includes the Tonopah Test Range. Future uses are assumed to remain status quo. DOE will maintain monitoring responsibility, if required, for any DOE sites on the Tonopah Test Range, which will be transferred to the landlord in 2010.

DOE's preferred alternative for future land uses from the Final Environmental Impact Statement for the Nevada Test Site is depicted in the following map. The future land uses include all currently planned and proposed projects, all currently ongoing interagency programs and operations, and the potential project activities resulting from other DOE Environmental Impact Statements. These additional project activities include the modification and/or expansion of existing facilities and the construction of new facilities.


NAFR COMPLEX
NYE COUNTY
LINCOLN COUNTY
Timber Mountain Caldera
Pahute Mesa Rd.
Stockade Wash Rd.
Buckboard Mesa Rd.
Airport Rd.
Sedan Crater
Tippipah Hwy.
Fortymile Canyon Rd.
Yucca Lake (Dry)
CO-USE DESERT NATIONAL WILDLIFE REFUGE & NAFR COMPLEX
LINCOLN COUNTY
CLARK COUNTY
STF Impact Zone
Cane Spring Rd.
Mercury Hwy.
Frenchman Lake (Dry)
Lathrop Wells Rd.
Jackass Flats Rd.
Tonopah
Amargosa Valley
U.S. BLM LAND
U.S. Highway 95
DESERT NATIONAL WILDLIFE REFUGE
Las Vegas
NEVADA
CALIFORNIA
5 0 5 10 Miles
5 0 10 Kilometers
N

Land Use Map

LEGEND

- Nuclear Test Zone
- Nuclear and High Explosive Test Zone
- Research, Test, and Experiment Zone
- Radioactive Waste Management Zone
- Yucca Mtn. Site Characterization Zone
- Solar Enterprise Zone
- Reserved Zone (within the NTS areas)
- Defense Industrial Zone
- U.S. Bureau of Land Management (BLM)
- NAFR Complex
- Co-Use Desert National Wildlife Range and NAFR Complex
- Desert National Wildlife Refuge Boundary
- Spill Test Facility (STF) Impact Zone Boundary
- County Line
- NTS Boundary Line
- NTS Area Boundary Line

- Waste Management Site
- Industrial, Research, and Support Site
- A Area 12 Camp
- B Non Hazardous Waste Landfill
- C Area 3 Radioactive Waste Management Site (Zone)
- D Area 6 Construction Facilities
- E Control Point
- F Yucca Lake Facilities
- G Device Assembly Facility
- H Hydrocarbon Contaminated Soils Disposal Site
- I Explosive Ordnance Disposal Site
- J Area 5 Radioactive Waste Management Site
- K Spill Test Facility
- L Mercury
- M Desert Rock Airport
- N Area 27 Assembly/Storage Facilities
- O Area 1 Industrial Complex
- P Area 25 Central Support Site
- Q Airstrip
- R Lyner Complex
- S Big Explosives Experimental Facility
- T BREN Tower
- U Hazardous Waste Storage Site
- V Treatability Test Facility
- W P-Tunnel Complex

For additional information about the Nevada Test Site or the Tonopah Test Range, please contact:

Ms. Bobbie McClure
U.S. Department of Energy, Nevada Operations Office
Program Integration Team
Federal Express Address:
232 Energy Way
North Las Vegas, NV 89030-4199
Phone: 702-295-1862
E:Mail Address: McClure@nv.doe.gov
or visit the Internet website at http://www.nv.doe.gov

Post Office Address:
Post Office Box 98518
Las Vegas, NV 89193-8518

PROJECT SHOAL

1.0 SITE SUMMARY

1.1 Site Description and Mission

The Project Shoal site covers approximately 1,036 hectares (2,560 acres) and is located approximately 48 kilometers (30 miles) southeast of Fallon, Nevada. The U.S. Atomic Energy Commission (AEC), later known as the U.S. Department of Energy (DOE), conducted a nuclear test at the site in October 1963 to determine the effects of a nuclear detonation in a granite rock formation and to compare the seismic signal of natural earthquakes with the seismic signal from an underground nuclear test. A 12-kiloton device was detonated at a depth of 369 meters (1,211 feet). This test helped to improve the ability to detect underground nuclear explosions.

The Project Shoal site is currently managed by the Department of Defense and has no ongoing DOE mission other than the continued long-term stewardship of residual subsurface contamination. DOE completed remediation of surface areas at the site in 1998 to levels approved by the State of Nevada.

LONG-TERM STEWARDSHIP HIGHLIGHTS

Major Long-Term Stewardship Activities - groundwater monitoring; enforcing access restrictions for subsurface contamination
Total Site Area - 1,036 hectares (2,560 acres)
Estimated Volume of Residual Contaminants - unknown
**Surface Long-Term Stewardship Start-End Years* - 1998-in perpetuity
**Subsurface Long-Term Stewardship Start-End Years* - 2008-in perpetuity
Average Annual Long-Term Stewardship Cost FY 2000-2006 - $37,000
Landlord - U.S. Department of Defense
*For purposes of this report, long-term stewardship activities for the surface began when surface remediation was completed in 1998. However, DOE recognizes that subsurface investigation and modeling activities are on-going and are not anticipated to be complete until 2008.

1.2 Site Cleanup and Accomplishments

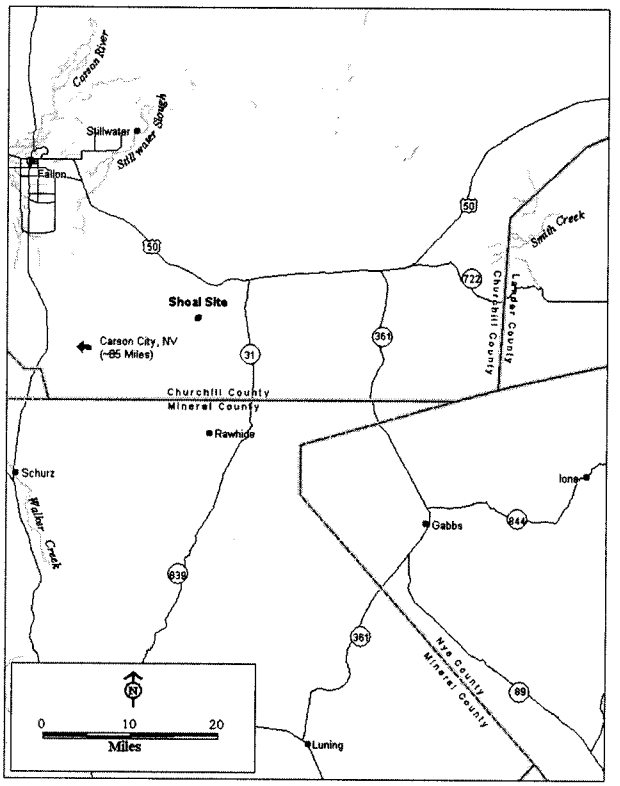
DOE's underground nuclear detonation at the site resulted in contamination in subsurface areas surrounding the shot cavities and possibly in groundwater. The potential contaminants of concern for the subsurface are mixed fission products, including plutonium, uranium, and tritium. DOE will use modeling and characterization data to determine the exact extent of existing subsurface contamination and establish a compliance boundary and to refine the existing subsurface intrusion restrictions, if required. DOE has completed the initial groundwater modeling based on data collected through the installation and testing of four wells and has completed the installation of four additional groundwater monitoring wells to reduce the model uncertainty and determine the boundary for institutional controls. DOE began the second round of groundwater modeling in January 2000 to reduce the uncertainties associated with the model. DOE expects subsurface modelling to be completed by September 2000, and all subsurface closure work will be completed no later than 2008. However, DOE does not plan to remediate subsurface contamination because of the lack of viable technologies for removing subsurface contamination from the site.

Surface contamination at the site consisted of mud pits from well drilling activities and included petroleum hydrocarbons from diesel and drilling additives, lead, and chromium. DOE removed surface contamination and transported it to the Nevada Test Site for disposal. In 1998, the State of Nevada approved the characterization and remediation of surface contamination. DOE does not plan to conduct any additional surface remediation at this site.

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

Surface remediation was completed in 1998. DOE will continue to investigate and model subsurface contamination, which is not expected to be complete until 2008. Existing subsurface intrusion restrictions will be refined, as necessary, based on the outcome of the investigation and modeling efforts.



Project Shoal

DOE will be responsible for monitoring and maintaining institutional controls over subsurface resources. DOE will restrict access to the test cavities, subsurface soil, and groundwater through the use of institutional controls. Periodic monitoring will be conducted to ensure that there is no contaminant migration from the test cavity to the groundwater.

DOE shall remain responsible for the subsurface withdrawn and reserved by Public Land Order Number 2771, as amended by Public Land Order Number 2834, for the foreseeable future. The Department of Defense shall be responsible for the management and use of the surface pursuant to the withdrawal and public law 106-65 (10/5/99).

DOE maintains the project-specific records at the Nevada Operations Office in Las Vegas, per the requirements set forth in the Federal Facility Agreement and Consent Order (FFACO). These records include corrective action investigation work plans and reports; corrective action decision documents; health assessments; risk assessments; information submitted by the public; National Environmental Policy Act documents; Public Involvement Plan; public notices; and the FFACO. The DOE Public Reading Facility and the Nevada Division of Environmental Protection Administrative Record are provided with copies of these documents. Upon the completion of the project, all DOE project files will be transferred to controlled storage at the Nevada Operations Office. Records are retained according to DOE and Department of Defense records retention procedures. DOE is required to notify the Nevada Division of Environmental Protection at least 180 calendar days prior to the proposed destruction or disposal of any documents or records described above.

2.2 Specific Long-Term Stewardship Activities

Groundwater

DOE will maintain institutional controls over the subsurface to prevent access to the test cavity, groundwater, and associated subsurface contamination in perpetuity. A monument has been placed at the site to mark the location of the test shot cavity. The institutional controls will include a restriction on all subsurface intrusions

on the site. DOE will continue to conduct periodic groundwater monitoring at the site for at least 100 years after closure of the subsurface in 2008. DOE will repair or replace groundwater monitoring wells every 25 years. At the end of the post-closure groundwater monitoring period in 2108, and if State approval is received, the monitoring wells will be plugged and abandoned in place in accordance with State regulations.

2.3 Regulatory Regime

All activities at Project Shoal must be compliant with the *Federal Facility Agreement and Consent Order* (FFACO) signed in May of 1996 between the Nevada Department of Conservation and Natural Resources, the Department of Energy, and the Department of Defense. Remediation activities conducted under the FFACO are regulated under the *Resource Conservation and Recovery Act.*

DOE is responsible for identifying the nature and extent of contamination, determining potential risk to the public and the environment, and performing the necessary corrective actions in compliance with guidelines and requirements under federal regulatory drivers, as well as the State-specific regulatory drivers associated with the site location. Key regulatory drivers include the following:

Resource Conservation and Recovery Act (RCRA): RCRA was the first comprehensive federal effort to deal with solid and hazardous waste and regulates the generation, transportation, treatment, storage, and disposal of hazardous waste. At Project Shoal, RCRA is enforced to protect human health and the environment; conserve energy and natural resources; reduce the amount of generated waste; and ensure that wastes are managed in an environmentally sound manner.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA): CERCLA supplies a system for identifying and providing corrective action to sites where hazardous substances have been released into any part of the air, water, groundwater, or land. Provisions of CERCLA include a National Contingency Plan, which establishes procedures for corrective action for hazardous substance releases. Project Shoal is not regulated under CERCLA; however, the regulations are useful as developmental guidelines.

STAKEHOLDER INVOLVEMENT

The primary vehicle for public participation by DOE stakeholders is through the Community Advisory Board (CAB) for Nevada Test Site (NTS) Programs. The CAB is a formal group of volunteer, independent, nonpartisan citizens and ex officio members organized and dedicated to providing informed recommendations and advice to DOE on policy, technical issues, and long-term stewardship decisions related to cleanup and waste management activities at the NTS. Public participation is encouraged at both the regularly scheduled CAB meetings, as well as the associated topic-specific committee meetings. The CAB's Stewardship Committee has been evaluating issues related to long-term stewardship for over a year and serves as the primary conduit for public comment on this issue to the DOE. Other opportunities for public involvement and public outreach include: public workshops; topic-specific working groups; informational and technical briefings; document reviews; the development of community involvement plans; periodic informational mailings to Nevada stakeholders (e.g., the *EM Update*, a newsletter focusing on activities within DOE Environmental Management Program, fact sheets, brochures); access to the DOE Public Reading Room; workshops; informational and technical briefings; site tours; and document reviews.

In addition to federal regulations, DOE must comply with State regulatory requirements in Nevada. In most cases, State of Nevada requirements are based on federal guidelines; however, in specific cases they may be more detailed and stringent than federal regulations.

Nuclear Regulatory Commission (NRC): NRC regulations establish "free release" criteria. Project Shoal is not regulated under the NRC; however, the regulations are useful as developmental guidelines.

2.4 Assumptions and Uncertainties

DOE has yet to fully characterize the site. DOE will develop subsurface models and use them to define a contaminant boundary and refine the existing subsurface intrusion restrictions, if necessary.

DOE does not plan to remove subsurface waste in and around the test cavities. Groundwater monitoring will continue annually until subsurface closure is finalized. Post-closure monitoring will be conducted, as agreed upon in the site closure reports for the subsurface, to detect changes in the subsurface conditions. The schedule for groundwater monitoring after closure of the subsurface will be defined in the subsurface closure report. DOE assumes that groundwater monitoring will be performed for 100 years (2008-2108).

Current land use designations and subsurface intrusion restrictions will continue into the foreseeable future. However, DOE has not fully characterized the contamination and long-term stewardship activities have not yet been finalized with the State and regulators. Therefore, long-term stewardship activities and associated costs may change, depending on final agreements. DOE will reevaluate and modify the subsurface restrictions, as appropriate, as part of the assessment and/or corrective action activities.

3.0 Estimated Long-Term Stewardship Costs

The cost profile, identified in the table below, applies to the entire Project Shoal site. The major long-term stewardship costs are for monitoring activities, data analysis, and repair and replacement of monitoring wells. The spikes in cost are a result of costs associated with repairing or replacing monitoring wells, which were assumed to require maintenance every 25 years.

The long-term stewardship costs for the Project Shoal remain roughly constant at $40,000 annually through FY 2010. The cost increase from $16,000 in FY 2000 to $40,000 in FY 2001 is the result of the costs associated with the new Real Estate Operations Permit (RE-OP) requirements. An additional $73,000 will be spent beginning in the period FY 2011-2015 for the periodic review and analysis of the data to evaluate and possibly refine the monitoring strategy. This review and analysis will occur once every five years. DOE projects that the total post-FY 2070 cost will be approximately $2.8 million dollars and will include costs associated with plugging and abandoning groundwater monitoring wells at the end of the monitoring period.

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	***Amount***	***Year(s)***	***Amount***	***Year(s)***	***Amount***
FY 2000	$16,000	**FY 2008**	$40,000	**FY 2036-2040**	$272,000
FY 2001	$40,000	**FY 2009**	$40,000	**FY 2041-2045**	$272,000
FY 2002	$40,000	**FY 2010**	$40,000	**FY 2046-2050**	$273,000
FY 2003	$40,000	**FY 2011-2015**	$272,000	**FY 2051-2055**	$272,000
FY 2004	$40,000	**FY 2016-2020**	$272,000	**FY 2056-2060**	$647,000
FY 2005	$40,000	**FY 2021-2025**	$272,000	**FY 2061-2065**	$272,000
FY 2006	$40,000	**FY 2026-2030**	$272,000	**FY 2066-2070**	$272,000
FY 2007	$40,000	**FY 2031-2035**	$647,000	**Post FY 2070**	$2,800,000

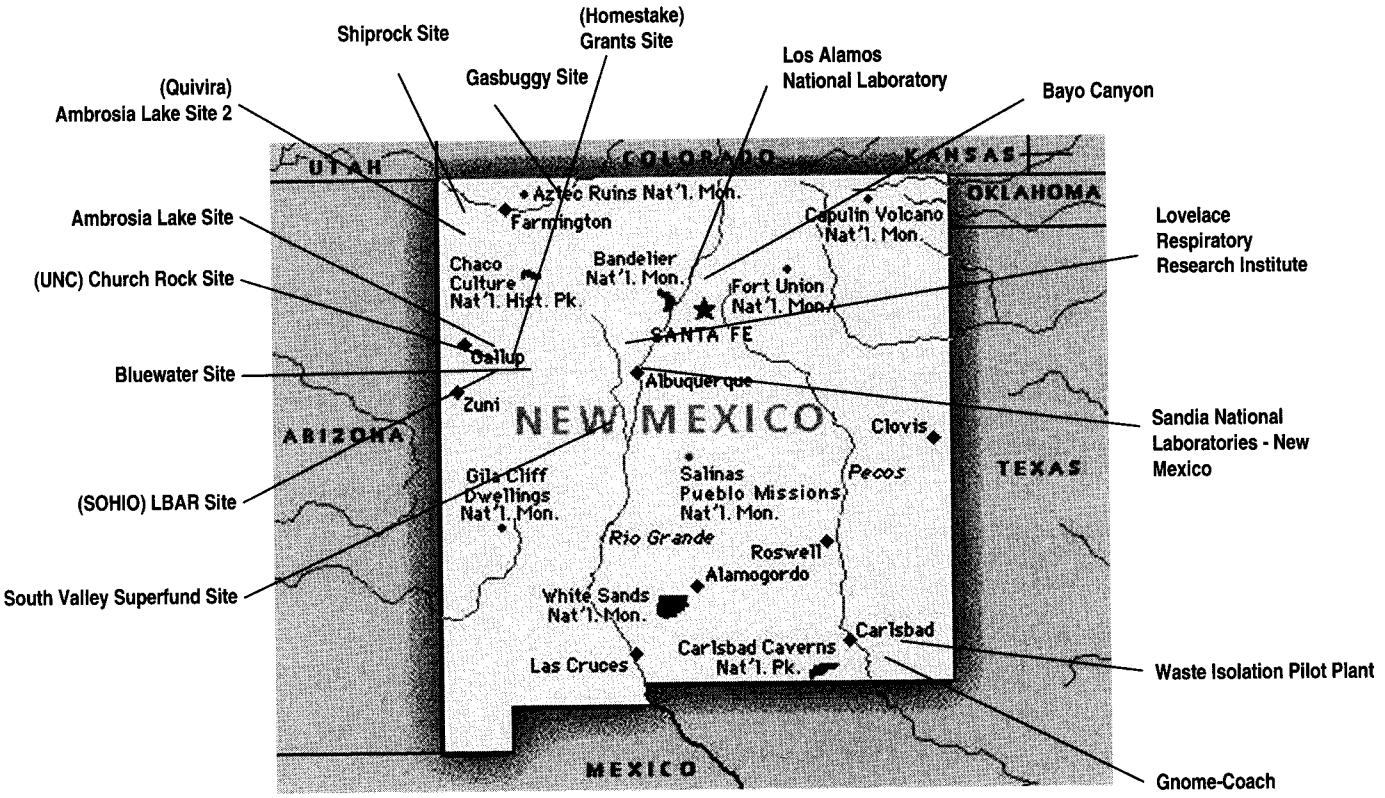
4.0 FUTURE USES

Under the DOE land withdrawal agreement and the military land withdrawal criteria identified in the *National Defense Authorization Act for Fiscal Year 2000* (FY2000 NDAA), this land has been withdrawn from all forms of appropriation under the public land laws. The Department of Defense will determine the future use of the surface area. DOE will impose deed restrictions to prevent access to the test cavities, subsurface soil, and groundwater in perpetuity.

For additional information about the Project Shoal, please contact:

Monica Sanchez
U.S. Department of Energy, Nevada Operations Office
Environmental Restoration Division
232 Energy Way
North Las Vegas, NV 89030-4199
Phone: 702-295-0160
sanchezm@nv.doe.gov

New Mexico



Long-Term Stewardship Site Highlights

Ambrosia Lake Site (page 3)
Major Activities - disposal cell monitoring
Site Size - 116 hectares (288 acres)
Start/End Years - 1998/in perpetuity
Estimated Average Annual Cost FY 2000-2006 - $19,300

Bayo Canyon (page 7)
Major Activities - surveillance and institutional controls
Site Size - 0.6 hectares (1.5 acres)
Start/End Years - 1982/2142
Estimated Average Annual Cost FY 2000-2006 - $1,000

Bluewater Site (page 11)
Major Activities - disposal cell monitoring; groundwater monitoring; access restrictions
Site Size - 1,335 hectares (3,300 acres)
Start/End Years - 1997/in perpetuity
Estimated Average Annual Cost FY 2000-2006 - $20,100

Gasbuggy Site (page 17)
Major Activities - groundwater monitoring; access restrictions for subsurface contamination
Site Size - 259 hectares (640 acres)
Surface Start/End Years - 2006/in perpetuity
Subsurface Start/End Years - 2014/in perpetuity
Estimated Average Annual Cost FY 2000-2006 - $41,000

Gnome-Coach (page 21)
Major Activities - groundwater monitoring; restrictions for access to and use of the subsurface
Site Size - 275 hectares (680 acres)
Surface Start/End Years - 2005/in perpetuity
Subsurface Start/End Years - 2012/in perpetuity
Estimated Average Annual Cost FY 2000-2006 - $38,000

(Homestake) Grants Site (page 25)
Expected Activities - groundwater monitoring; disposal cell monitoring and maintenance; erosion control; institutional controls; inspections
Site Size - 490 hectares (1,200 acres)
Expected Start Date - 2015
Current Landlord - Homestake Mining Company
Expected Future Landlord - U.S. Department of Energy, Grand Junction Office

Los Alamos National Laboratory (page 29)
Major Activities - surveillance and maintenance of engineered units; ground and surface water monitoring; institutional controls
Site Size - 11,000 hectares (28,000 acres)
Start/End Years - 1993/in perpetuity
Estimated Average Annual Cost FY 2000-2006 - n/a (costs begin FY 2007)

Lovelace Respiratory Research Institute (page 41)
Major Activities - groundwater monitoring; institutional controls
Site Size - 55 hectares (135 acres)
Estimated Average Annual Cost FY 2000-2006 - $140,000

(Quivira) Ambrosia Lake Site 2 (page 51)
Expected Activities - groundwater monitoring; disposal cell monitoring and maintenance; institutional controls
Site Size - 810 hectares (2,000 acres)
Expected Start Year - 2015
Current Landlord - Quivira Mining Company
Expected Future Landlord - U.S. Department of Energy, Grand Junction Office

Long-Term Stewardship Site Highlights

Sandia National Laboratories - New Mexico (page 55)
Major Activities - groundwater monitoring; vadose zone monitoring; disposal cell maintenance and monitoring
Site Size - 1,130 hectares (2,820 acres)
Estimated Average Annual Cost FY 2000-2006 - $900,000

Shiprock Site (page 69)
Major Activities - disposal cell monitoring; institutional control enforcement; access restrictions; groundwater monitoring
Site Size - 42 hectares (105 acres)
Start/End Years - groundwater - 2012/in perpetuity; engineered unit - 1996/in perpetuity
Estimated Average Annual Cost FY 2000-2006 - $121,000

(SOHIO) LBAR Site (page 75)
Major Activities - access control; disposal cell monitoring and maintenance; groundwater monitoring
Site Size - 162 hectares (740 acres)
Start/End Years - 2001/in perpetuity
Estimated Average Annual Cost FY 2000-2006 - $33,657

South Valley Superfund Site (page 79)
Site Size - 13 hectares (33 acres)
Current Owner - General Electric
Start Year - 1966
Expected Future Owner - General Electric

(UNC) Church Rock Site (page 81)
Site Area - 259 hectares (640 acres) (exact acreage to be transferred to U.S. Department of Energy for long-term stewardship activities is unknown)
Current Landlord - United Nuclear Corporation
Expected Start/End Years - 2015/in perpetuity
Expected Future Landlord - U.S. Department of Energy, Grand Junction Office

Waste Isolation Pilot Plant (page 85)
Site Area - 124 acres (50 hectares)
Current Landlord - U.S. Department of Energy (DOE)
Expected Start-End Years - 2040/in perpetuity
Expected Future Landlord - DOE

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AMBROSIA LAKE SITE

1.0 SITE SUMMARY

1.1 Site Description and Mission

The Ambrosia Lake Site is the location of a former uranium milling site that operated between 1958 and 1963, and again in the late 1970s and early 1980s. The site also contains a disposal cell for the uranium mill tailings and other process-related wastes that resulted from operations. The site is located on a 116-hectare (288-acre) tract of land in McKinley County in northwest New Mexico, approximately 40 kilometers (25 miles) north of Grants and 114 kilometers (85 miles) northwest of Albuquerque. The immediate area surrounding the Ambrosia Lake Site is sparsely populated. The site is within the Ambrosia Lake Mining District, near the center of the Grants Mineral Belt. Decommissioned uranium milling sites, abandoned underground mines, mine shafts, and ore piles are located near the site.

LONG-TERM STEWARDSHIP HIGHLIGHTS

Major Long-Term Stewardship Activities - disposal cell monitoring
Total Site Area - 116 hectares (288 acres)
Estimated Volume of Residual Contaminants - disposal cell 4 million cubic meters (5.2 million cubic yards)
Long-Term Stewardship Start-End Years - 1998-in perpetuity
Average Annual Long-Term Stewardship Cost FY 2000-2006 - $19,300
Landlord - U. S. Department of Energy, Grand Junction Office

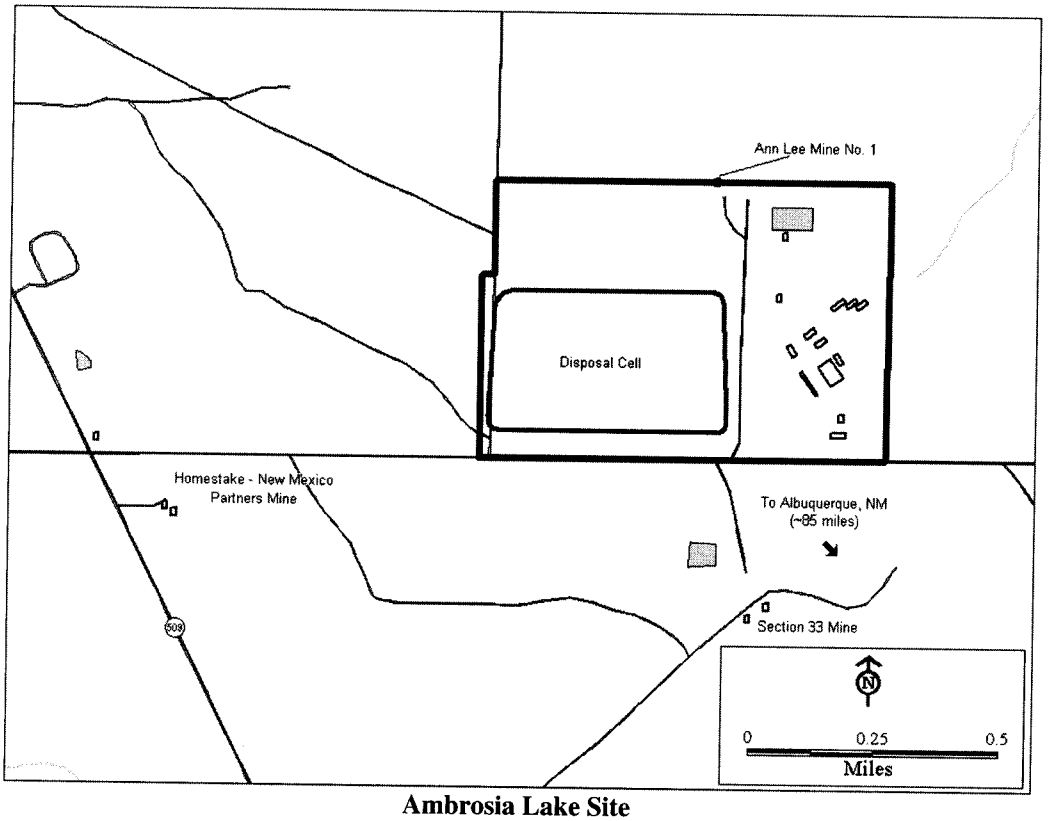
The U.S. Department of Energy's (DOE) current mission at the Ambrosia Lake Site is to perform long-term stewardship activities, including monitoring and maintenance of the disposal cell. The former mill site is subject to Title I of the *Uranium Mill Tailings Radiation Control Act of 1978* (UMTRCA). As such, DOE is responsible for remediation and long-term stewardship activities. DOE completed remediation of the site in 1995.

The historic mission of the Ambrosia Lake Site was to mill uranium for the United States national defense program. Phillips Petroleum Company originally owned and operated the mill, which was built in 1957. Uranium ore was processed at the site between 1958 and 1963. The United Nuclear Corporation purchased the mill in 1963 and operated it for a brief period. In the late 1970s and early 1980s, United Nuclear Corporation operated an ion exchange system, extracting uranium from mine water. Homestake Mining purchased United Nuclear Corporation's interest in 1981. Processing operations at the site ceased in 1982.

1.2 Site Cleanup and Accomplishments

Milling operations at the site created process-related wastes and uranium mill tailings. The tailings originally covered approximately 42 hectares (105 acres). Wind and water erosion spread some of the tailings across a 230-hectare (570-acre) area. After remediation activities were completed in 1995, the contamination was restricted to a single 37-hectare (91-acre) onsite disposal cell containing approximately four million cubic meters (5.2 million cubic yards) of contaminated material.

No groundwater remediation occurred at the Ambrosia Lake Site. The uppermost aquifer is not usable as a drinking or irrigation water resource because of low yield. Consequently, supplemental standards, as defined in Title 40 of the *Code of Federal Regulations* Part 192.22, were applied to the site's groundwater. No groundwater monitoring is required at this site.



Ambrosia Lake Site

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

DOE's Grand Junction Office is responsible for long-term stewardship activities at the Ambrosia Lake Site. DOE manages the site according to a long-term surveillance plan prepared specifically for the Ambrosia Lake Site and approved by the U.S. Nuclear Regulatory Commission (NRC). DOE performs long-term stewardship activities, as required under the NRC general license, to maintain protectiveness and regulatory compliance.

DOE conducts annual inspections at the Ambrosia Lake Site to evaluate the condition of surface features and to perform maintenance, as necessary. Because the uppermost aquifer is considered a "limited use" aquifer, it is not a groundwater resource. Therefore, groundwater monitoring at the Ambrosia Lake Site is not required. The site is not fenced, but access is restricted through the use of warning signs posted every 152 meters (500 feet) along the site boundary. DOE staffs a 24-hour phone line for reporting site concerns. To prevent exposure to the buried waste, drilling and other intrusive activities are prevented within site boundaries through institutional controls. A deed restriction on the adjacent private property to the west prevents mining or drilling. DOE maintains a restrictive easement on adjacent land owned by the Quivera Mining Company to ensure that DOE has perpetual access to the Ambrosia Lake Site.

Site records are kept in permanent storage at the DOE Grand Junction Office in Colorado. The types of records kept include site characterization data, remedial action design, the completion report, long-term monitoring plan, annual inspection reports, and monitoring data. Real property records are maintained at DOE's Albuquerque Office in New Mexico.

2.2 Specific Long-Term Stewardship Activities

Engineered Units

The Ambrosia Lake Site disposal cell is roughly rectangular and measures approximately 762 meters by 488 meters (2,500 feet by 1,600 feet). The cell rises approximately 15 meters (50 feet) above the surrounding terrain and occupies approximately 37 hectares (91 acres) of the 116-hectare (288-acre) site. The disposal cell contains 6,931,000 dry tons of contaminated material, with a total activity of 1,850 curies of radium-226.

> ***STAKEHOLDER INVOLVEMENT***
>
> Community interaction has been minimal since the remedial action was completed. Copies of the annual inspection report for the Ambrosia Lake Site and other sites are distributed to the local library and any stakeholder that requests one. Annual inspection reports are also published on the DOE Grand Junction Office website at www.doegjpo.com.

The cell cover is a multi-component system designed to encapsulate and protect the contaminated materials for 200 to 1,000 years. A low-permeability radon barrier, consisting of compacted clay soils was placed over the compacted tailings. This layer is designed to prevent precipitation from percolating through the contaminated materials and into the underlying soils, and to reduce radon emissions. Erosion protection for the top and side slopes consists of a layer of rock underlain by a layer of granular bedding material. The cell design promotes rapid runoff of precipitation to minimize leachate and deter bio-intrusion. The sole long-term stewardship activity is annual surface inspections of the disposal cell.

2.3 Regulatory Regime

In 1998, the Ambrosia Lake Site came under a general license issued by NRC for custody and long-term care of residual radioactive disposal sites (contained at Title 10 of the *Code of Federal Regulations,* Section 40.27). The purpose of the general license is to ensure that such sites will be cared for in a manner that protects human health and safety and the environment. The general license went into effect when NRC concurred that the site conformed to cleanup standards and formally accepted the site-specific long-term surveillance plan.

Long-term stewardship activities at the Ambrosia Lake Site are governed by several regulations, including the *Uranium Mill Tailings Radiation Control Act of 1978*; the *Atomic Energy Act of 1954,* as amended; EPA Groundwater Protection Standards, including Subparts A, B, and C of Title 40 of the *Code of Federal Regulations* Part 192, and the *National Environmental Policy Act of 1969,* as amended.

2.4 Assumptions and Uncertainties

The scope of long-term stewardship activities is well documented since DOE has been performing long-term stewardship activities since 1998, and the scope is not expected to change dramatically over time.

The engineered unit cap is not expected to be replaced for at least 200 years.

3.0 Estimated Long-Term Stewardship Costs

Long-term stewardship costs for the Ambrosia Lake Site, identified in the table below, are expected to remain relatively constant over the period of the cost estimate and are associated with monitoring and maintaining the disposal cell. The cost estimate is based on the current actual costs of conducting long-term stewardship activities at the Ambrosia Lake Site. The cost estimate reflects the current site agreements and monitoring frequencies.

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	***Amount***	***Year(s)***	***Amount***	***Year(s)***	***Amount***
FY 2000	$4,200	**FY 2008**	$21,100	**FY 2036-2040**	$102,300
FY 2001	$25,000	**FY 2009**	$21,100	**FY 2041-2045**	$102,300
FY 2002	$21,700	**FY 2010**	$20,600	**FY 2046-2050**	$102,300
FY 2003	$20,900	**FY 2011-2015**	$98,100	**FY 2051-2055**	$102,300
FY 2004	$21,100	**FY 2016-2020**	$95,500	**FY 2056-2060**	$102,300
FY 2005	$21,300	**FY 2021-2025**	$95,800	**FY 2061-2065**	$102,300
FY 2006	$20,900	**FY 2026-2030**	$101,200	**FY 2066-2070**	$102,300
FY 2007	$21,200	**FY 2031-2035**	$102,300		

4.0 FUTURE USES

The future use of the site will be restricted to monitoring and maintaining the disposal cell in perpetuity.

For more information about the Ambrosia Lake Site, please contact:

Art Kleinrath, Long-Term Surveillance and Maintenance Program Manager
U.S. Department of Energy ,Grand Junction Office
2597 B3/4 Road, Grand Junction, CO 81503
Phone: 970-248-6037
or visit the Internet website at http://www.doegjpo.com

BAYO CANYON

1.0 SITE SUMMARY

1.1 Site Description and Mission

The Bayo Canyon site, near Los Alamos, New Mexico, was used by U.S. Department of Energy (DOE) predecessor agencies for explosive compression tests on metals. Facilities (radiochemistry laboratory, assembly buildings, personnel buildings, etc.) supporting these tests were also located in the area. The 0.6-hectare (1.5-acre) site is located 40 kilometers (25 miles) northwest of Santa Fe and 99 kilometers (62 miles) northeast of Albuquerque. The site is located in the bottom of Bayo Canyon approximately five kilometers (three miles) east of the City of Los Alamos, on the border of Los Alamos and Santa Fe Counties.

LONG-TERM STEWARDSHIP HIGHLIGHTS

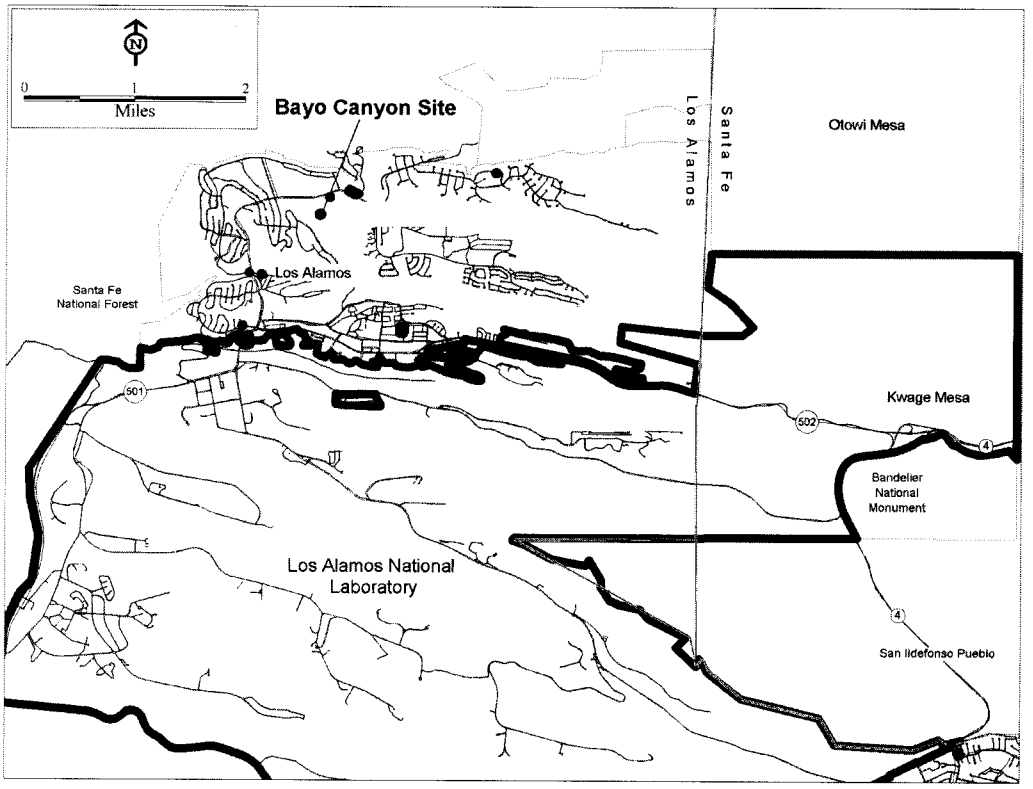
Major Long-Term Stewardship Activities - surveillance and institutional controls
Total Site Area - 0.6 hectares (1.5 acres)
Estimated Volume of Residual Contaminants - unknown
Long-Term Stewardship Start-End Years - 1982-2142
Average Annual Long-Term Stewardship Cost FY 2000-2006 - $1,000
Landlord - U.S. Department of Energy

The site became contaminated with strontium-90, which was a contaminant in some of the materials used in explosive compression tests. The radioactivity was released into the environment by both the explosive tests and the disposal of solid and liquid wastes from the facilities supporting the tests. In 1982, as part of the Formerly Utilized Sites Remedial Action Program, DOE completed remediation of the radioactive contamination at the site. DOE removed a total of 1,160 cubic meters (1,520 cubic yards) of contaminated soil and closed the excavations with clean fill. However, subsurface contamination above the cleanup standards of 100 picocuries per gram (pCi/g) remains in some areas at depths between 2.4 meters (eight feet) and 12.2 meters (40 feet). Six permanent markers were established at the site after the completion of remedial action. Currently, DOE is responsible for long-term stewardship activities, which includes periodically inspecting the site and verifying the continued presence of the markers.

1.2 Site Cleanup and Accomplishments

In 1974, the U.S. Atomic Energy Commission (the predecessor agency to DOE) established a program to evaluate the radiological condition of real property which had supported early atomic energy development efforts. This activity became the Formerly Utilized Sites Remedial Action Program (FUSRAP). Cleanup of the Bayo Canyon site was managed and funded through the DOE Oak Ridge Operations Office.

Due to the past explosive compression tests and disposal activities at Bayo Canyon, approximately four hectares (ten acres) of soil was primarily contaminated with strontium-90. DOE remediated the site by excavating the top one-two meters (three-seven feet) of contaminated soil. The excavated area was backfilled with clean soil; however, residual contamination remains between 2.4 meters and 12.2 meters (8 to 40 feet). Over time, the remaining strontium-90 will decay naturally with a half life of 28.3 years; it is estimated that about 35 percent has decayed since 1982.



Bayo Canyon

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

DOE is responsible for long-term stewardship activities at the Bayo Canyon site. Long-term stewardship activities include maintaining institutional controls, as well as surveillance and maintenance of the markers, to ensure continued protection of human health and the environment. Surface access is not restricted; however, this region is sparsely populated. No drilling or other intrusive activities are allowed within the property unless authorized by DOE.

DOE maintains and updates the specific records and reports required to document long-term stewardship activities at the Bayo Canyon site. The types of records maintained include site characterization data, remedial action design information, the site completion report, inspection reports, and historic monitoring data.

The area where subsurface contamination remains is identified by six site markers. The inscription reads: "Buried Radioactive Materials. No Excavation Prior to 2142 A.D. See County Records. N 21 48 21 W." DOE is responsible for surveillance and maintenance of the Bayo Canyon site to ensure the selected remedy remains protective.

2.2 Regulatory Regime

The primary standard governing long-term stewardship activities at Bayo Canyon is the *Atomic Energy Act of 1954*, as amended.

2.3 Assumptions and Uncertainties

Because the site has been monitored since 1982, long-term stewardship activities at the site are well known and are not expected to change dramatically.

3.0 ESTIMATED LONG-TERM STEWARDSHIP COSTS

The long-term stewardship costs represent periodic inspections and verification of the continued presence of the markers. Costs are estimated to be no more than $1,000 per year and are anticipated to continue until fiscal year 2142 or sooner.

4.0 FUTURE USES

Future use of the site will be limited to monitoring the site until the subsurface contamination has decayed. Public access is not restricted and the land surrounding the site is currently open. These uses are expected to continue in the future.

For additional information about the Bayo Canyon site, please contact:

Ted Taylor, Los Alamos Environmental Restoration Project Manager
U.S. Department of Energy
528 35th Street
Los Alamos, NM 87544
Phone: 505-665-7203
or visit the Internet website at http://erproject.lanl.gov/about_us.html

BLUEWATER SITE

1.0 SITE SUMMARY

1.1 Site Description and Mission

The Bluewater Site is the location of a former uranium milling site that operated from 1953 to 1982. The site has three disposal cells containing contaminated waste and materials remediated from the site and vicinity properties. The site is in west-central New Mexico, approximately 14 kilometers (9 miles) northwest of the City of Grants, and about 2.4 kilometers (1.5 miles) northeast of the village of Bluewater. The land immediately surrounding the Bluewater Site is sparsely populated and the area's predominant land use is grazing. The three disposal cells comprise 156 hectares (386 acres) of the site's 1,335 hectares (3,300 acres).

LONG-TERM STEWARDSHIP HIGHLIGHTS

Major Long-Term Stewardship Activities - disposal cell monitoring; groundwater monitoring; access restrictions
Total Site Area -1,335 hectares (3,300 acres)
Estimated Volume of Residual Contaminants - disposal cell 13.8 million cubic meters (18 million cubic yards); groundwater unknown
Long-Term Stewardship Start-End Years - 1997-in perpetuity
Average Annual Long-Term Stewardship Cost FY 2000-2006 - $20,100
Landlord - U.S. Department of Energy, Grand Junction Office

The current mission of the Bluewater Site is performing long-term stewardship activities, including monitoring and maintenance of the engineered disposal cells and groundwater monitoring. The site is governed by Title II of the *Uranium Mill Tailings Radiation Control Act of 1978* (UMTRCA). As such, the U.S. Department of Energy (DOE) is responsible for long-term stewardship activities at the site but was not responsible for site remediation. Remediation was completed by the owner, and DOE began performing long-term stewardship activities in 1997.

The historic mission of the site was to process uranium for commercial purposes, but some material was sold to the U.S. Atomic Energy Commission (a predecessor agency to DOE) to support national defense missions. The Bluewater Site was initially the site of a carbonate-leach uranium mill built and owned by the Anaconda Copper Company to process ore from nearby mines. The carbonate-leach uranium mill began operations in 1953. The discovery of sandstone uranium ores and the development of the Jackpile and Paguate mines resulted in the construction of an acid-leach mill at the site that began operations in 1957. Most of the uranium mill tailings at the Bluewater Site are from the acid-leach process. Milling operations ceased in 1982. In 1986, the Anaconda Copper Company became the Atlantic Richfield Company (ARCO). ARCO began mill decommissioning activities in 1989, site reclamation in 1991, and encapsulation of the disposal cells in 1995. These cells contain mill tailings, soils, and construction debris contaminated with uranium, radium, and thorium. The site was transferred to DOE for custody and long-term care in 1997.

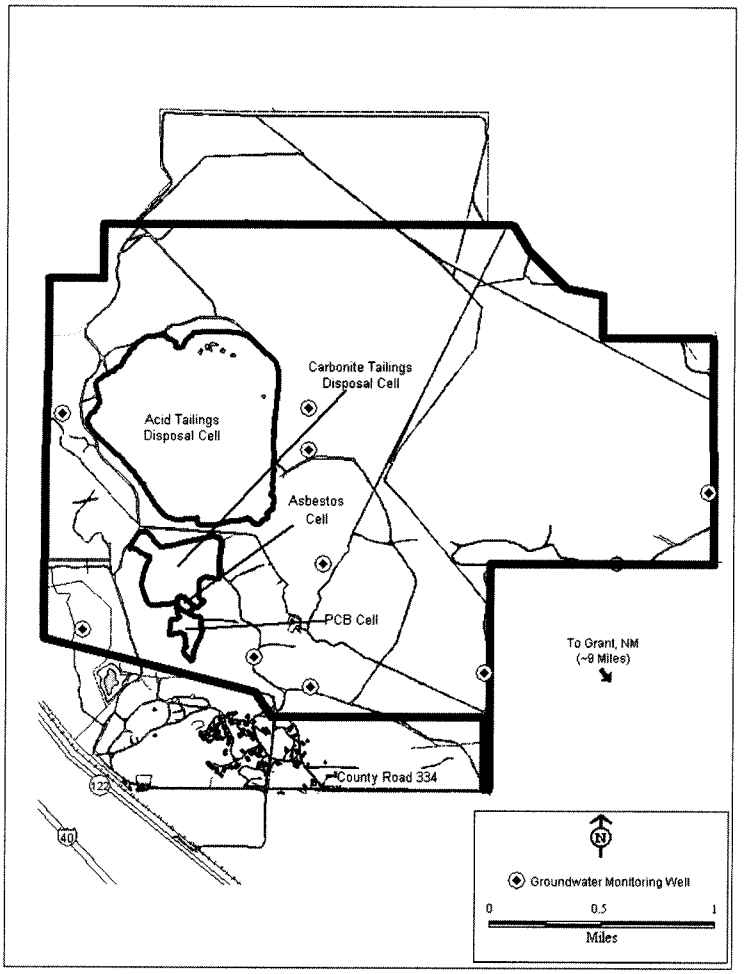
1.2 Site Cleanup and Accomplishments

Between 1991 and the end of 1995, all the radioactive material from the Bluewater Site, including the demolished mill structures and contaminated vicinity properties, was transported to and placed in three onsite disposal cells. The combined volume of the three disposal cells is approximately 13.8 million cubic meters (18 million cubic yards). The tailings were placed in separate disposal cells, based on chemical characteristics resulting from the process used to mill the ore. Wastes generated from the acid-leaching process were segregated from those generated from the carbonate-leaching process to prevent chemical reactions from occurring as a result of mixing acidic and basic compounds. The third disposal cell contains uranium mill tailings and soils mixed with polychlorinated biphenyls (PCBs).

The largest of the three cells, the acid tailings disposal cell, is about 129 hectares (320 acres) in size and contains an estimated 23 million tons of tailings and other contaminated materials having a radioactive content of approximately 11,200 curies of radium-226. This cell has a low-permeability radon barrier ranging in thickness from 31 to 74 centimeters (12 to 29 inches). The radon barrier is covered with a riprap (rock) surface layer 10 to 31 centimeters (4 to 12 inches) thick for erosion control.

The second cell contains the carbonate tailings. It covers approximately 27 hectares (65 acres) and contains an estimated 1.3 million tons of contaminated materials having a radioactive content of approximately 1,130 curies of radium-226. The carbonate tailings disposal cell is covered by a similar radon barrier and a layer of riprap (rock layer) to protect the disposal cell from erosion.

Both of these cells are designed to promote rapid run-off of precipitation and to minimize leachate. All the surrounding disturbed areas have been regraded and reseeded with native species to further minimize erosion.



Bluewater Site

The third and smallest disposal cell is less than 0.41 hectares (one acre) and contains PCB-contaminated uranium mill tailings and soils. The PCB-contaminated material was sealed in 144 drums and placed on a one-meter (three-foot) thick clay liner. Voids between the drums were filled with a soil-cement mixture to prevent long-term subsidence. The PCB disposal cell was then covered with a 91-centimeter (36-inch) thick clay cap, a 46-centimeter (18-inch) thick radon barrier, and a 15-centimeter (6-inch) thick layer of riprap for erosion protection. This disposal cell has been permitted by the U.S. Environmental Protection Agency (EPA) and is in compliance with the *Toxic Substances Control Act of 1976* (TSCA).

After several years of active groundwater treatment, the contaminant levels for uranium, molybdenum, and selenium in the site's groundwater, have not been reduced to background concentration levels. Therefore, the site was granted alternate concentration limits (ACLs), cleanup standards that are based on site-specific considerations, by the U.S. Nuclear Regulatory Commission (NRC). For the alternate concentrations to be approved, evidence must be provided that the ACLs will not have an adverse impact on human health or the environment. The Bluewater Site has complied with the revised contaminant concentration limits and, therefore, no further groundwater remediation is required.

In September 1997, NRC accepted the Bluewater Site under a general license for custody and long-term care of residual radioactive disposal sites.

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

The DOE Grand Junction Office is responsible for all long-term stewardship activities, including monitoring and maintenance, access restrictions, institutional controls, and groundwater monitoring. Other activities include minor maintenance, such as fence repairs and sign replacement. Although DOE is responsible for all long-term stewardship activities, in the event that the PCB disposal cell fails, ARCO will be responsible for corrective action in accordance with the indemnification agreement signed between ARCO and DOE.

STAKEHOLDER INVOLVEMENT

Community interaction has been minimal since the remedial action was completed. Copies of the annual inspection report for the Bluewater Site and other sites are distributed to the local library and any stakeholders requesting them. The report is also published on the DOE Grand Junction Office website at www.doegjpo.com.

Access to the Bluewater Site is controlled with a locked and gated fence along the site perimeter to prevent livestock grazing and discourage unauthorized entry. Stock fences also control access to four utility easements that cross the property. Warning signs are posted every 152 meters (500 feet) along the perimeter of the cells onsite. Purposeful intrusion is not expected to be a problem. However, if intrusion, vandalism, or other issues such as grazing occur, site security will be re-evaluated.

DOE maintains and updates specific records and reports required to document the long-term stewardship activities at the Bluewater Site. DOE submits an annual report to NRC that documents the results of site surveillance, as required by the NRC regulations in Title 10 of the *Code of Federal Regulations* Part 40.28, and Appendix A of Title 10 of the *Code of Federal Regulations*, Part 40, Criterion 12. Site records are kept in permanent storage at the DOE Grand Junction Office in Colorado. The types of records maintained include the site characterization data, remedial action design information, the site completion report, long-term monitoring plans, annual inspection reports, and current and historic monitoring data.

2.2 Specific Long-Term Stewardship Activities

Engineered Units

The three disposal cells will require long-term surveillance and maintenance to ensure continued protection of human health and the environment. Long-term stewardship activities will include annual surface inspections to ensure the continued integrity of the cap and other engineered features. Minor repairs will be conducted on an as-needed basis. In accordance with EPA standards, the covers of all three disposal cells have been designed to last 200 to 1,000 years. However, DOE will be responsible for conducting long-term stewardship activities in perpetuity.

Groundwater

Since 1998, the DOE Grand Junction Office has been conducting annual monitoring of six different wells for uranium, selenium, and molybdenum, and will continue to do so until 2004. After 2004, the groundwater wells will be monitored once every three years in perpetuity. As specified in the site's EPA-issued TSCA permit, annual monitoring for PCBs will occur at four wells until 2017, and then will be discontinued if PCBs have not

been detected. Thus far, no PCBs have been detected in the groundwater.

2.3 Regulatory Regime

ARCO completed site reclamation at the Bluewater Site under Title II of UMTRCA and encapsulated the radioactive waste in an NRC-approved disposal cell. Cleanup and reclamation standards were promulgated by NRC in Title 10 of the *Code of Federal Regulations,* Part 40, Appendix A, and conform with EPA standards specified in Title 40 of the *Code of Federal Regulations,* Part 192.

In September 1997, the site was transferred by NRC under general license to DOE for custody and long-term care (contained at Title 10 of the *Code of Federal Regulations,* Section 40.28). The purpose of the general license is to ensure that such sites will be cared for in a manner that protects human health and safety and the environment. The general license went into effect when NRC concurred that the site conformed to cleanup standards and formally accepted the site-specific long-term surveillance plan.

2.4 Assumptions and Uncertainties

Since the site has been monitored for the past two years, the long-term stewardship activities at the site are well known and are not expected to change dramatically in the future. It is assumed that the caps are not expected to be replaced for a minimum of 200 years.

3.0 Estimated Long-Term Stewardship Costs

The cost estimates, identified in the table below, are based on the actual costs of long-term stewardship activities at this site and other sites cells currently managed by DOE. Long-term surveillance and maintenance costs for the disposal cells at the Bluewater Site average about $20,000 per year for fiscal year (FY) 2000 through FY 2006. The cost of long-term stewardship activities decreases in FY 2004, when the groundwater monitoring frequency is reduced to once every three years. A similar decrease occurs after FY 2017, when monitoring for PCB contamination releases is no longer expected to be required. Contingency costs, such as cap replacement, have not been incorporated into cost estimates.

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	***Amount***	***Year(s)***	***Amount***	***Year(s)***	***Amount***
FY 2000	$41,000	**FY 2008**	$13,000	**FY 2036-2040**	$67,400
FY 2001	$20,800	**FY 2009**	$13,000	**FY 2041-2045**	$67,400
FY 2002	$18,100	**FY 2010**	$17,200	**FY 2046-2050**	$67,400
FY 2003	$17,400	**FY 2011-2015**	$69,600	**FY 2051-2055**	$67,400
FY 2004	$17,600	**FY 2016-2020**	$71,200	**FY 2056-2060**	$67,400
FY 2005	$13,000	**FY 2021-2025**	$63,700	**FY 2061-2065**	$67,400
FY 2006	$13,000	**FY 2026-2030**	$67,400	**FY 2066-2070**	$67,400
FY 2007	$17,700	**FY 2031-2035**	$67,400		

4.0 FUTURE USES

The future use of the site will be restricted to monitoring and maintaining the disposal cell and groundwater in perpetuity.

For more information about the Bluewater Site, please contact:

Art Kleinrath, Long-Term Surveillance and Maintenance Program Manager
U.S. Department of Energy, Grand Junction Office
2597 B3/4 Road, Grand Junction, CO 81503
Phone: 970-248-6037
or visit the Internet website at http://www.doegjpo.com

GASBUGGY SITE

1.0 SITE SUMMARY

1.1 Site Description and Mission

The Gasbuggy Site covers approximately 259 hectares (640 acres) and is located approximately 89 kilometers (55 miles) east of Farmington, New Mexico. The site was the location of a single subsurface nuclear test conducted in December 1967, by the U.S. Atomic Energy Commission (AEC) later known as the U.S. Department of Energy (DOE). AEC conducted the test to determine whether nuclear explosions would stimulate the release of natural gas that was not otherwise recoverable by conventional methods. This project was the first joint government and industry gas stimulation experiment.

The Gasbuggy Site is currently managed by the Department of the Interior. The only current or planned DOE mission at the site is to complete environmental restoration of surface areas and to continue long-term stewardship activities of residual contamination.

LONG-TERM STEWARDSHIP HIGHLIGHTS

Major Long-Term Stewardship Activities - groundwater monitoring; access restrictions for subsurface contamination
Total Site Area - 259 hectares (640 acres)
Estimated Volume of Residual Contaminants - unknown
**Surface Long-Term Stewardship Start-End Years* - 2006-in perpetuity
**Subsurface Long-Term Stewardship Start-End Years* - 2014-in perpetuity
Average Annual Long-Term Stewardship Cost FY 2000-2006 - $41,000
Landlord - U.S. Department of Interior
*For purposes of this report, long-term stewardship activities for the surface will begin when surface remediation is complete in 2006. However, DOE recognizes that subsurface investigation and modeling activities will continue beyond the surface completion date.

1.2 Site Cleanup and Accomplishments

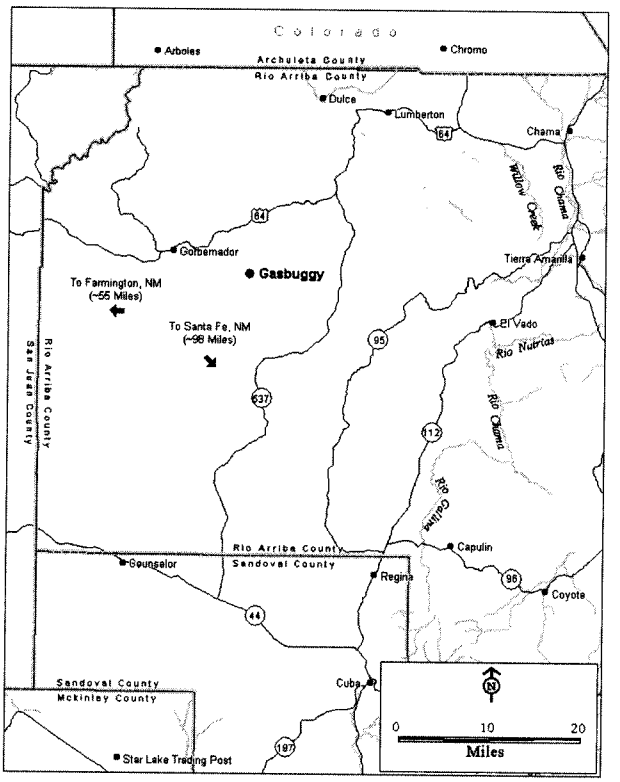
Testing activities at the Gasbuggy Site resulted in surface and subsurface contamination. Surface contamination at the site is the result of gas flaring operations and equipment decontamination and is present at two mud pits, one gas flaring facility, and one shaker pad area. Potential contaminants of concern at the surface include petroleum hydrocarbons from diesel and drilling additives, lead, chromium, and tritium. DOE will continue characterization of the surface areas, and any surface contamination will either be closed in place and covered with an engineered cap or left in place to naturally degrade, depending on the potential risk to human health and the environment. DOE anticipates completing all surface closure activities by 2006.

Subsurface contamination occurs at depths of more than 1,290 meters (4,240 feet). The potential contaminants of concern in the subsurface are mixed fission products, plutonium, uranium, and tritium. DOE assumes that natural gas is the primary contaminant migration pathway at the site. DOE will conduct a natural gas reservoir and subsurface condition analysis to model the subsurface contamination. Subsurface modeling will determine the extent of subsurface contamination and define the areas that will require institutional controls. This information will be utilized, if required, to refine the existing subsurface intrusion restriction boundary. However, DOE does not plan to remediate the subsurface contamination because of the lack of feasible technologies for removing subsurface contamination. DOE expects that modeling activities will be conducted between 2006 and 2011, and that the subsurface closure report for the site will be developed between 2011 and 2014.

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

Surface remediation will be complete and institutional controls, if necessary, will be in place by 2006 for the long-term stewardship of the surface. DOE will continue to investigate and model subsurface contamination, which is not expected to be complete until 2014. Existing subsurface intrusion restrictions will be refined, as necessary, based on the outcome of the investigation and modeling efforts.



Gasbuggy Site

DOE will be responsible for monitoring and maintaining institutional controls over the residual subsurface contamination. Final long-term stewardship requirements for the site will be negotiated with the Department of Interior and the State of New Mexico. DOE will conduct periodic monitoring to analyze for contaminant migration from the test cavity to the groundwater.

DOE maintains the project-specific records at the Nevada Operations Office in Las Vegas. These records include corrective action investigation work plans and reports; corrective action decision documents; health assessments; risk assessments; information submitted by the public; National Environmental Policy Act documents; and the Public Involvement Plan. The DOE Public Reading Facility and the Nevada Division of Environmental Protection Administrative Record are given copies of these documents. Upon the completion of the project, all DOE project files will be transferred to controlled storage at DOE's Nevada Operations Office. Records are retained according to DOE records retention procedures.

2.2 Specific Long-Term Stewardship Activities

Groundwater

DOE will maintain institutional controls in perpetuity over the subsurface to prevent access to the test cavity, groundwater, and associated subsurface contamination in perpetuity. A monument has been placed at the site to mark the location of the test. Institutional controls will continue to restrict subsurface intrusions on the site. DOE will continue to conduct annual groundwater monitoring at the site for at least 100 years after closure of the subsurface in 2014. DOE estimates that repair or replacement of groundwater monitoring wells will be necessary every 25 years. At the end of the post-closure groundwater monitoring period in 2114, the monitoring wells will be plugged and abandoned in place in accordance with State regulations.

> ***STAKEHOLDER INVOLVEMENT***
>
> DOE held meetings with the New Mexico Environmental Department (NMED) in October of 1999. Additional meetings were held with both the NMED and representatives from the Jicarilla Apache Tribe in March 2000. Discussions with stakeholders addressed the site regulatory framework, exit strategy, and the preliminary data quality objectives for the site.

Contaminated surface areas that are left in place to naturally degrade will require annual monitoring of the surface conditions. Areas closed in place with engineered caps will likely require institutional controls to restrict access to the residual contamination. The specific long-term stewardship activities for the surface areas will be detailed in the site closure report and may also include visual inspections, cap monitoring and maintenance, information management, and environmental monitoring activities.

2.3 Regulatory Regime

DOE is responsible for identifying the nature and extent of contamination, determining potential risk to the public and the environment, and performing the necessary corrective actions in compliance with guidelines and requirements under applicable Federal and State standards. Key regulatory drivers include the following:

Resource Conservation and Recovery Act (RCRA): RCRA was the first comprehensive Federal effort to deal with solid and hazardous waste. It regulates the generation, transportation, treatment, storage, and disposal of hazardous waste. At Gasbuggy, RCRA is enforced to protect human health and the environment; conserve energy and natural resources; reduce the amount of generated waste; and ensure that wastes are managed in an environmentally sound manner.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA): CERCLA supplies a system for identifying and providing corrective action to sites where hazardous substances have been released into air, water, groundwater, or land. Provisions of CERCLA include a National Contingency Plan, which establishes procedures for corrective action for hazardous substance releases. Gasbuggy is not regulated under CERCLA; however, the regulations are useful as developmental guidelines.

In addition to Federal regulations, DOE must comply with State regulatory requirements in New Mexico. In most cases, State of New Mexico requirements are based on Federal requirements; however, in specific cases they may be more detailed and stringent than Federal requirements.

Nuclear Regulatory Commission (NRC): NRC regulations establish "free release" criteria. Gasbuggy is not regulated under the NRC; however, the regulations are useful as developmental guidelines.

2.4 Assumptions and Uncertainties

DOE has yet to fully characterize the site. DOE will develop subsurface models and use them to define a contaminant boundary and refine the existing subsurface intrusion restrictions, if necessary.

DOE does not plan to remove subsurface waste in and around the test cavities. Groundwater monitoring will continue annually until subsurface closure is finalized. Post-closure monitoring to detect changes in the subsurface conditions will be conducted, as agreed upon in the site closure reports. The schedule for groundwater monitoring after closure of the subsurface will be defined in the subsurface closure report. DOE assumes that groundwater monitoring will be performed for 100 years (2014-2114).

Current land use designations and subsurface intrusion restrictions will continue into the foreseeable future. However, DOE has not fully characterized the contamination and long-term stewardship activities have not yet been finalized. Therefore, long-term stewardship activities and associated costs may change, depending on final agreements with the State and regulators. DOE will reevaluate and modify the subsurface restrictions, as appropriate, as part of the assessment and/or corrective action activities.

3.0 ESTIMATED LONG-TERM STEWARDSHIP COSTS

The cost profile in the table below applies to the entire Gasbuggy Site. The major long-term stewardship costs are for monitoring activities, data analysis, and repair and replacement of monitoring wells. The spikes in cost are a result of costs associated with repairing or replacing monitoring wells, which were assumed to require maintenance every 25 years.

The long-term stewardship costs for the Gasbuggy Site remain roughly constant at $40,000 annually. The cost increase from $28,000 in FY 2000 to $40,000 in FY 2001 is the result of the costs associated with the new Real Estate Operations Permit (RE-OP) requirements. The additional $21,000 to be incurred in FY 2004 and FY 2009 is for well-casing integrity-testing, which is done at the Gasbuggy Site at the request of the U.S. Bureau of Land Management. DOE projects that the total post-FY 2070 cost will be approximately $4.3 million dollars, which includes the cost of plugging and abandoning the monitoring wells at the end of the post-closure monitoring period (anticipated to be in 2114).

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	***Amount***	***Year(s)***	***Amount***	***Year(s)***	***Amount***
FY 2000	$28,000	**FY 2008**	$40,000	**FY 2036-2040**	$1,243,000
FY 2001	$40,000	**FY 2009**	$61,000	**FY 2041-2045**	$293,000
FY 2002	$40,000	**FY 2010**	$40,000	**FY 2046-2050**	$293,000
FY 2003	$40,000	**FY 2011-2015**	$221,000	**FY 2051-2055**	$293,000
FY 2004	$61,000	**FY 2016-2020**	$294,000	**FY 2056-2060**	$293,000
FY 2005	$40,000	**FY 2021-2025**	$293,000	**FY 2061-2065**	$1,243,000
FY 2006	$40,000	**FY 2026-2030**	$292,000	**FY 2066-2070**	$293,000
FY 2007	$40,000	**FY 2031-2035**	$292,000	**Post FY 2070**	$4,300,000

4.0 FUTURE USES

The anticipated future use for the surface area [259 hectares (640 acres)] is open space. DOE will place deed restrictions on the property to prevent access to the test cavities, subsurface soil, and groundwater in perpetuity.

For additional information about the Gasbuggy Site, please contact:

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GNOME-COACH

1.0 SITE SUMMARY

1.1 Site Description and Mission

The Gnome-Coach site covers approximately 275 hectares (680 acres) and is located approximately 50 kilometers (31 miles) southeast of Carlsbad, New Mexico and approximately eight kilometers (five miles) south of the U.S. Department of Energy's (DOE's) Waste Isolation Pilot Plant (WIPP). The Gnome-Coach site was part of the Plowshare program, which was a series of nuclear and conventional tests conducted by the U.S. Atomic Energy Commission (AEC), a predecessor agency to DOE, to explore peacetime uses of nuclear explosives. Gnome was the location of a single subsurface nuclear test conducted in December 1961 to determine the effects and products of a nuclear explosion in a salt medium. The Gnome test vented radioactivity into the atmosphere, which resulted in AEC canceling a second experiment (the Coach test) that had been scheduled for the site.

LONG-TERM STEWARDSHIP HIGHLIGHTS

Major Long-Term Stewardship Activities - groundwater monitoring; restrictions for access to and use of the subsurface
Total Site Area - 275 hectares (680 acres)
Estimated Volume of Residual Contaminants - unknown
**Surface Long-Term Stewardship Start-End Years* - 2005-in perpetuity
**Subsurface Long-Term Stewardship Start-End Years* - 2012-in perpetuity
Average Annual Long-Term Stewardship Cost FY 2000-2006 - $38,000
Landlord - U.S. Department of Interior
*For purposes of this report, long-term stewardship activities for the surface will begin when surface remediation is complete in 2005. However, DOE recognizes that subsurface investigation and modeling activities will continue beyond the surface completion date.

The Gnome-Coach site is currently managed by the Department of the Interior. The only current or planned DOE mission at the site is to complete environmental restoration of surface areas and to continue long-term stewardship activities of residual contamination.

1.2 Site Cleanup and Accomplishments

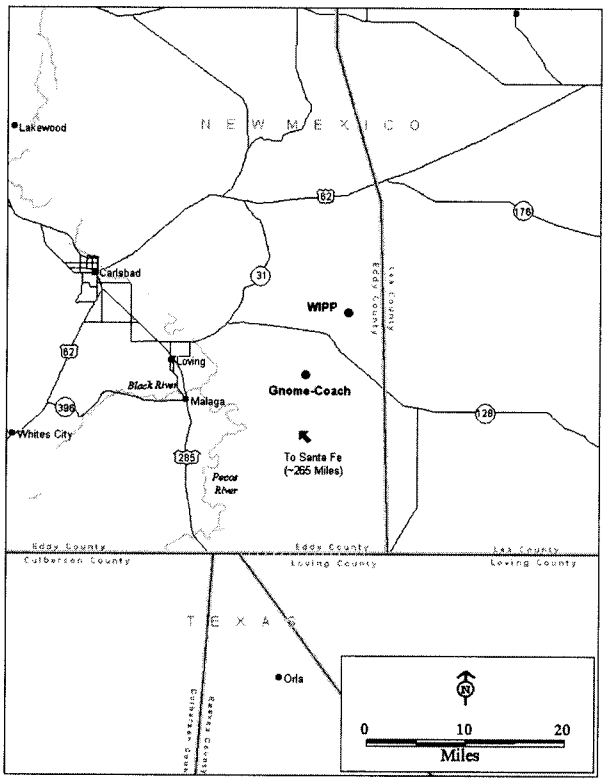
Contamination at the Gnome-Coach site consists of radioactive contamination of the deep bedrock around the test cavity and in a shallow aquifer as a result of a tracer test that DOE conducted shortly after the Gnome test. The potential contaminants of concern for the subsurface are mixed fission products and nuclides. DOE does not plan to remediate the subsurface contamination because of the lack of feasible technologies for removing subsurface contamination. However, DOE will use site assessment activities, such as modeling and characterization data, to determine the extent of subsurface contamination and to define the areas that will require institutional controls. This information will be utilized, if necessary, to refine the existing subsurface intrusion restriction. DOE expects that modeling activities will be conducted between 2006 and 2009 and that the subsurface closure report for the site will be developed between 2010 and 2012.

Surface contamination at the site is the result of drilling activities and equipment decontamination operations and is present in four mud pits, three landfills, and other release sites. Potential contaminants of concern at the surface include petroleum hydrocarbons, metals from diesel and drilling additives, and radionuclides. DOE will continue characterization of the surface areas; if warranted, any surface contamination will either be closed in place and covered with an engineered cap or left in place to naturally degrade, depending on the potential risk to human health and the environment. DOE anticipates completing all surface closure activities by 2005.

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

Surface remediation will be complete and institutional controls, if necessary, will be in place by 2005 for the long-term stewardship of the surface. DOE will continue to investigate and model subsurface contamination, which is not expected to be complete until 2012. Existing subsurface intrusion restrictions will be refined, as necessary, based on the outcome of the investigation and modeling efforts.



Gnome-Coach

DOE will not maintain an active presence at this site but will be responsible for monitoring and maintaining institutional controls over the residual surface and subsurface contamination. Final long-term stewardship requirements for the site will be negotiated with the Department of Interior and the State of New Mexico. DOE will conduct periodic monitoring to ensure that there is no contaminant migration from the test cavity to the groundwater.

DOE maintains the project-specific records at the Nevada Operations Office in Las Vegas. These records include corrective action investigation work plans and reports; corrective action decision documents; health assessments; risk assessments; information submitted by the public; National Environmental Policy Act documents; and the Public Involvement Plan. The DOE Public Reading Facility and the Nevada Division of Environmental Protection Administrative Record are given copies of these documents. Upon the completion of the project, all DOE project files will be transferred to controlled storage at the Nevada Operations Office. Records are retained according to DOE records retention procedures.

2.2 Specific Long-Term Stewardship Activities

Groundwater

DOE will maintain institutional controls over the subsurface to prevent access to the test cavity, groundwater, and associated subsurface contamination in perpetuity. A monument has been placed at the site to mark the location of the test shot cavity. Institutional controls currently include subsurface intrusion restrictions, which may be refined as a result of subsurface modeling results. DOE will continue to conduct annual groundwater monitoring at the site for at least 100 years after closure of the subsurface in 2012. DOE estimates that repair or replacement of groundwater monitoring wells will occur every 25 years. At the end of the post-closure groundwater monitoring period in 2112, the monitoring wells will be plugged and

> ***STAKEHOLDER INVOLVEMENT***
>
> DOE held meetings with the New Mexico Environmental Department (NMED) in October of 1999 and in March 2000. Discussions with stakeholders addressed the site regulatory framework, exit strategy, and the preliminary data quality objectives for the site.

abandoned in place in accordance with State regulations.

Any contaminated surface areas that are left in place to naturally degrade may require annual monitoring of the surface conditions. If areas are closed in place with engineered caps, institutional controls to restrict access to the residual contamination may be required. The specific long-term stewardship activities for the surface areas will be detailed in the site closure report and may also include visual inspections, cap monitoring and maintenance, information management, and environmental monitoring activities.

2.3 Regulatory Regime

DOE is responsible for identifying the nature and extent of contamination, determining potential risk to the public and the environment, and performing the necessary corrective actions in compliance with guidelines and requirements under Federal regulatory drivers, as well as the State-specific regulatory drivers associated with the site location. Key regulatory drivers include the following:

Resource Conservation and Recovery Act (RCRA): RCRA was the first comprehensive Federal effort to deal with solid and hazardous waste. It regulates the generation, transportation, treatment, storage, and disposal of hazardous waste. At the Gnome-Coach site, RCRA is enforced to protect human health and the environment; conserve energy and natural resources; reduce the amount of generated waste; and ensure that wastes are managed in an environmentally sound manner.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA): CERCLA supplies a system for identifying and providing corrective action to sites where hazardous substances have been released into any part of the air, water, groundwater, or land. Provisions of CERCLA include a National Contingency Plan, which establishes procedures for corrective action for hazardous substance releases. The Gnome-Coach site is not regulated under CERCLA; however, the regulations are useful as developmental guidelines.

In addition to Federal regulations, DOE must comply with State regulatory requirements in New Mexico. In most cases, State of New Mexico requirements are based on Federal requirements; however, in specific cases they may be more detailed and stringent than Federal requirements.

Nuclear Regulatory Commission (NRC): NRC regulations establish "free release" criteria. The Gnome-Coach site is not regulated under the NRC; however, the regulations are useful as developmental guidelines.

2.4 Assumptions and Uncertainties

DOE has yet to fully characterize the site. DOE will develop subsurface models and use them to define a contaminant boundary and refine the existing subsurface intrusion restrictions, if necessary.

DOE does not plan to remove subsurface waste in and around the test cavities. Groundwater monitoring will continue annually until subsurface closure is finalized. Post-closure monitoring to detect changes in the subsurface conditions, will be conducted, as agreed upon in the site closure reports for the subsurface. The schedule for groundwater monitoring after closure of the subsurface will be defined in the subsurface closure report. DOE assumes that groundwater monitoring will be performed for 100 years (2012-2112).

Current land use designations and subsurface intrusion restrictions will continue into the foreseeable future. However, DOE has not fully characterized the contamination and long-term stewardship activities have not yet been finalized with the State and regulators. Therefore, long-term stewardship activities and associated costs may change, depending on final agreements. DOE will reevaluate and modify the subsurface restrictions, as appropriate, as part of the assessment and/or corrective action activities.

3.0 ESTIMATED LONG-TERM STEWARDSHIP COSTS

The cost profile, identified in the table below, applies to the entire Gnome-Coach site. The major long-term stewardship costs are for monitoring activities, data analysis, and repair and replacement of monitoring wells. The spikes in cost are a result of costs associated with repairing or replacing monitoring wells, which were assumed to require maintenance every 25 years.

The long-term stewardship costs for the Gnome-Coach site remain roughly constant at $40,000 annually. The cost increase from $28,000 in FY 2000 to $40,000 in FY 2001 is the result of the costs associated with the new Real Estate Operations Permit (RE-OP) requirements. DOE projects that the total post-FY 2070 cost will be approximately $2.7 million dollars, which includes the costs associated with plugging and abandoning groundwater monitoring wells at the end of the monitoring period (anticipated to be in 2112).

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	***Amount***	***Year(s)***	***Amount***	***Year(s)***	***Amount***
FY 2000	$28,000	**FY 2008**	$40,000	**FY 2036-2040**	$517,000
FY 2001	$40,000	**FY 2009**	$40,000	**FY 2041-2045**	$272,000
FY 2002	$40,000	**FY 2010**	$40,000	**FY 2046-2050**	$272,000
FY 2003	$40,000	**FY 2011-2015**	$200,000	**FY 2051-2055**	$272,000
FY 2004	$40,000	**FY 2016-2020**	$272,000	**FY 2056-2060**	$272,000
FY 2005	$40,000	**FY 2021-2025**	$272,000	**FY 2061-2065**	$517,000
FY 2006	$40,000	**FY 2026-2030**	$272,000	**FY 2066-2070**	$272,000
FY 2007	$40,000	**FY 2031-2035**	$273,000	**Post FY 2070**	$2,700,000

4.0 FUTURE USES

The anticipated future use for the surface area (275 hectares, or 680 acres) is open space. DOE will place deed restrictions on the subsurface areas to prevent access to the test cavities, subsurface areas, and groundwater in perpetuity.

For additional information about the Gnome-Coach site, please contact:

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(HOMESTAKE) GRANTS SITE[1]

1.0 SITE SUMMARY

1.1 Site Description and Mission

> ***LONG-TERM STEWARDSHIP HIGHLIGHTS***
>
> *Expected Long-Term Stewardship Activities* - groundwater monitoring; disposal cell monitoring and maintenance; erosion control; institutional controls; inspections
> *Total Site Area* - 490 hectares (1,200 acres)
> *Expected Long-Term Stewardship Start Date* - 2015
> *Current Landlord* - Homestake Mining Company
> *Expected Future Landlord* - U.S. Department of Energy, Grand Junction Office
> *Reason Not Subject to NDAA Requirements* - This site is an UMTRCA Title II site that will not be transferred to the U.S. Department of Energy until 2015.

The (Homestake) Grants Site is the location of a former uranium milling site which operated from 1958 to 1990. The site is located on a 490 hectare (1,200 acre) tract of land in a predominantly rural area of northern New Mexico, north of the town of Grants. The site is privately owned and operated by Homestake Mining Company. As a result of past milling operations, contamination at the site consisted of approximately 20.2 million metric tons (22.3 million tons) of uranium mill tailings, as well as radium, thorium, and uranium in soils and construction debris. Initially, there were two tailings piles which occupied 69 hectares (170 acres) and 16 hectares (40 acres), respectively, as well as two large evaporation ponds on the property. Homestake Mining Company began remediation activities at the site in 1993. Currently, the site contains a 69 hectare (170 acre) disposal cell, which has approximately 19 million metric tons (21 million tons) of contaminated material. The site also contains a smaller, 16-hectare (40-acre) disposal cell which is currently being filled with approximately 2.1 million metric tons (2.3 million tons) of remaining materials, including contaminated equipment and sludge from groundwater treatment operations.

The current mission of the (Homestake) Grants Site is to complete site remediation and permanently dispose the remaining contaminated materials in the second of the site's two engineered disposal cells. The site is subject to Title II of the *Uranium Mill Tailings Radiation Control Act of 1978* (UMTRCA). UMTRCA Title II sites are privately owned and operated sites that were active when UMTRCA was passed, or thereafter. The majority of the uranium produced at these sites was for private sale, but a portion was sold to the U.S. Government. DOE is responsible for long-term stewardship activities at the site, but the site owner is responsible for remediation. DOE expects to begin long-term stewardship activities at the site in 2015. The historic mission of the site was to provide uranium for sale to private industry and the Federal Government.

1.2 Site Cleanup and Accomplishments

Homestake Mining Company has been remediating the site since 1993. The larger of the two tailings piles, approximately 19 million of the 20.2 million metric tons (21 million of the 22.3 million tons), was completely remediated and encapsulated in an engineered disposal unit under an interim cover in 1994. A final cover will

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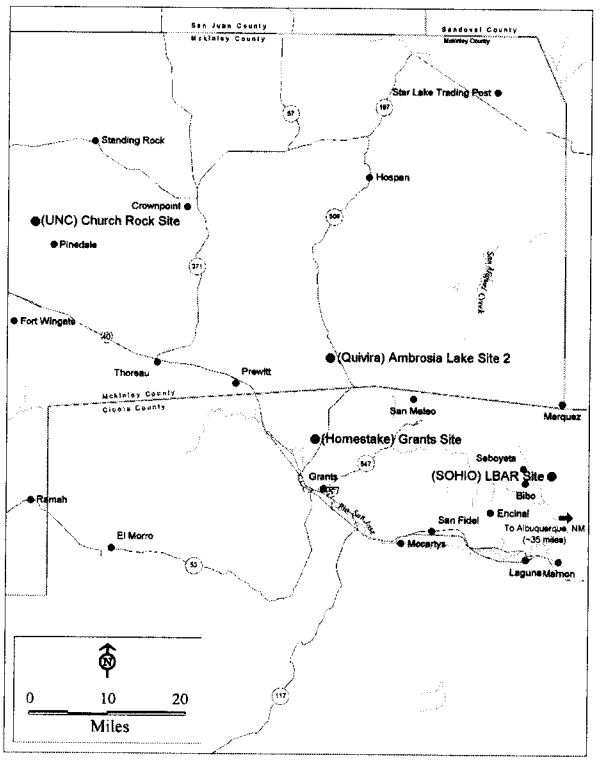
[1]This report is developed in response to a Congressional request in the Fiscal Year (FY) 2000 National Defense Authorization Act (NDAA). As requested by the Act, this report addresses current and anticipated long-term stewardship activities at each site or portion of a site by the end of calendar year 2006 ("Conference Report on S.1059, National Defense Authorization Act for Fiscal Year 2000," *Congressional Record,* August 5, 1999).

Based on current planning, the (Homestake) Grants Site is not expected to be transferred to the U.S. Department of Energy (DOE) for long-term stewardship until 2015, and for this reason the site is not the primary focus of this report. This brief summary of the site cleanup activities is provided for background information and potential future long-term stewardship activities. (See Section 3.2 of Volume I).

not be installed until settlement is complete. However, no additional waste will be added to the large disposal cell. The other tailings pile and the contaminated residues from the evaporation ponds are undergoing remediation and are being encapsulated in the smaller engineered disposal unit. Remediation is expected to be completed with the permanent radon barrier cover installed by 2015. The disposal cells will have a riprap (rocky) surface layer for erosion control. Disturbed areas will be revegetated.



(Homestake) Grants Site

The site is located on top of alluvium (sediments) that overlay two aquifers, one of them shallow, that supply domestic drinking water to the area. Groundwater contamination was observed as early as 1961. The groundwater is contaminated by radionuclides, including radium and uranium. In 1981, the New Mexico Environment Department approved Homestake Mining Company's groundwater discharge plan, which covered groundwater and aquifer restoration activities at the site. In November 1983, Homestake Mining Company entered into a Consent Decree with the U.S. Environmental Protection Agency (EPA) to provide an alternate source of water for subdivisions near the site whose wells were contaminated. In July 1994, the EPA released Homestake Mining Company from providing water to the subdivisions because the groundwater restoration activities, as stipulated in the site's groundwater discharge plan, were successfully completed.

Homestake Mining Company's groundwater corrective actions are expected to continue past the year 2010. The site will require annual groundwater monitoring to ensure the efficacy of the disposal cells and to evaluate the progress and success of groundwater remediation efforts. Groundwater remediation efforts are expected to continue until at least until the second disposal cell is closed. The site has already had some success with remediating the groundwater. The contaminant plume has retreated almost three-fourths of a mile back into the site's boundary as a result of injecting fresh water into the aquifer downgradient of the site. This reverse-gradient water injection process has allowed over eight billion cubic meters (10 billion cubic yards) of contaminated groundwater to be removed and has made the groundwater usable in the downgradient areas.

The site is expected to be transferred to DOE for custody and long-term care in 2015. To transfer the (Homestake) Grants Site to DOE, the Homestake Mining Company must conduct U.S. Nuclear Regulatory Commission (NRC)-approved reclamation of any and all onsite radioactive waste and must make a one-time payment to the U.S. Treasury fully funding inspections and ongoing maintenance under Title II of UMTRCA.

2.0 POTENTIAL LONG-TERM STEWARDSHIP ACTIVITIES

The potential long-term stewardship activities will predominantly involve groundwater monitoring, monitoring and maintenance of the disposal cell, and implementing institutional controls.

3.0 EXPECTED FUTURE USES AND SITE RESPONSIBILITY

Homestake Mining Company is currently responsible for all activities at the (Homestake) Grants Site. After remediation is complete, the site is expected to be transferred to DOE in 2015 for custody and long-term care. The DOE Grand Junction Office will be responsible for long-term stewardship activities at the site. When remediation activities are completed, both disposal cells will have a low-permeability radon barrier with an erosion control layer. Erosion control will be provided for all potentially vulnerable features, and the site will be graded to provide positive drainage. The disposal cells will be similar to other uranium mill tailings disposal cells and will require similar long-term stewardship activities.

Anticipated site-wide long-term stewardship activities include restricting access by fencing and posting warning signs along the site boundary. DOE will repair the fence and replace signs, as necessary. DOE will staff a 24-hour phone line for reporting any site concerns. Drilling and other intrusive activities onsite will be prevented through institutional controls.

DOE assumes that groundwater monitoring will be required on a periodic basis to ensure continued protection of human health and the environment. The precise monitoring requirements will be prescribed in the site-specific long-term surveillance plan that will be developed and approved by the NRC at the time of site transfer.

Site records will be kept in permanent storage at the DOE Grand Junction Office in Colorado. The types of records maintained will include site characterization data, remedial action design information, the site completion report, long-term monitoring plans, annual inspection reports, and current and historic monitoring data.

For more information about the (Homestake) Grants Site, please contact:

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LOS ALAMOS NATIONAL LABORATORY

1.0 SITE SUMMARY

1.1. Site Description and Mission

Los Alamos National Laboratory (LANL) is a multi-program national laboratory with research and development programs in a broad range of scientific and technical fields. LANL is located in Los Alamos and Santa Fe counties, in north-central New Mexico, approximately 100 kilometers (60 miles) north-northeast of Albuquerque and 40 kilometers (25 miles) northwest of Santa Fe. The nearest neighboring communities include the adjacent towns of Los Alamos and White Rock, and the pueblos of San Ildefonso, Jemez, Santa Clara, and Cochiti. The Laboratory was established in 1943 to design, develop, and test nuclear weapons. LANL occupies an area of approximately 11,000 hectares (28,000 acres) and is divided into 47 Technical Areas that are used for scientific and support building sites, experimental areas, waste disposal locations, roads and utilities, and safety and security buffers. The Fenton Hill site (Technical Area-57), a remote site 32 kilometers (20 miles) west of LANL, occupies six hectares (15 acres) in Sandoval County on land leased from the U.S. Forest Service. The LANL complex is managed by the Regents of the University of California, but is a government-owned, U.S. Department of Energy (DOE) site.

LONG-TERM STEWARDSHIP HIGHLIGHTS

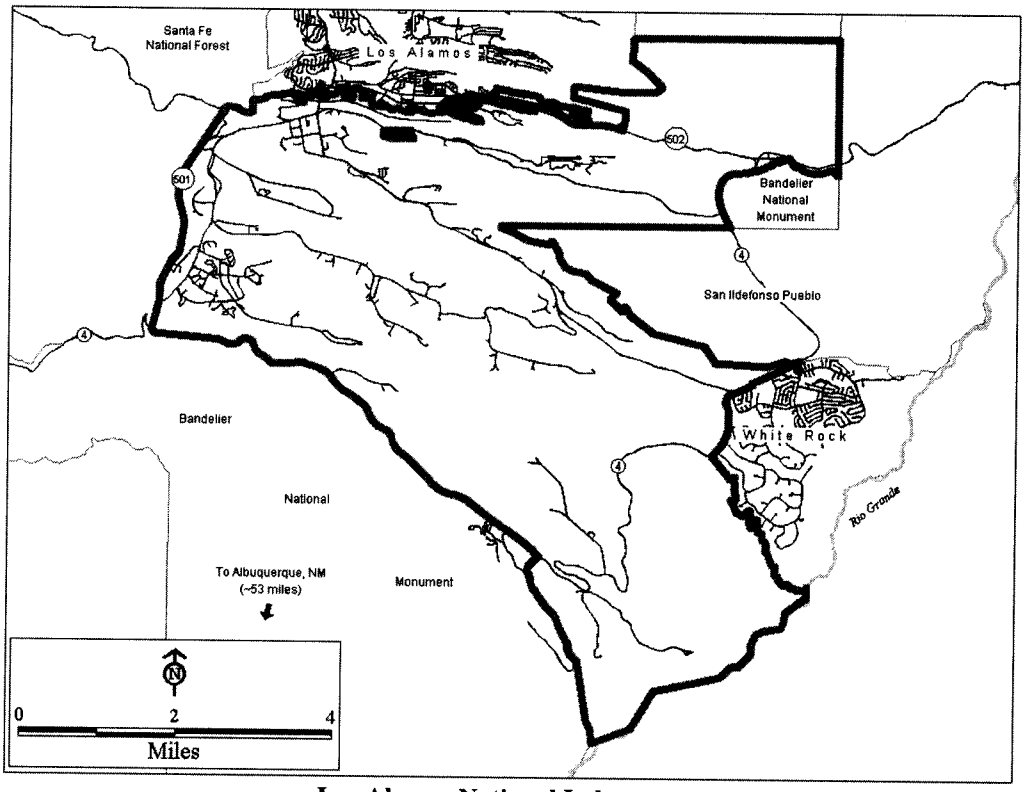
Major Long-Term Stewardship Activities - surveillance and maintenance of engineered units; ground and surface water monitoring; institutional controls
Total Site Area - 11,000 hectares (28,000 acres)
Estimated Volume of Residual Contaminants - 7 million cubic meters (9.1 million cubic yards) (primarily soils and sediments); facilities unknown; groundwater unknown; engineered units 587,800 cubic meters (769,000 cubic yards)
Long-Term Stewardship Start-End Years - 1993-in perpetuity[1]
Average Annual Long-Term Stewardship Cost FY 2000-2006[2] n/a (costs begin FY 2007)
Landlord - U.S. Department of Energy, Office of Defense Programs

Many of the Laboratory's operations required hazardous chemicals and radioactive materials, such as plutonium and uranium. Use of these materials resulted in the contamination of facilities and, in some cases, of the surrounding environment. A major source of environmental contamination was waste that was discharged into the environment or buried in material disposal areas. In addition to hazardous chemicals and radioactive materials, the contaminants of concern include explosive residues, unexploded ordnance, depleted uranium, beryllium, and asbestos. By 2006, LANL plans to have proposed "No Further Action" for approximately 1,500 of its 2,146 potential release sites; however, remediation for the entire site will not be completed until 2013. Approximately 24 sites are anticipated to require site-specific long-term stewardship activities, in addition to the general site-wide long-term stewardship.

Although the Laboratory's current, primary mission remains focused on national security, it has retained and broadened its secondary research mission. Because of its position between academic and industrial research, the Laboratory plays an important role in expediting the development and commercialization of emerging

[1]This date represents completion of the interim measure for the first release site [Material Disposal Area "L" (MDA "L")] that requires long-term stewardship activities.

[2] Long-term stewardship costs are not reported from FY2000 through FY2006 since costs are not available at the release site level. It should also be noted that the costs associated with the long-term stewardship and maintenance of release sites are a minor part of the out year long-term stewardship costs.



Los Alamos National Laboratory

technologies. This secondary mission is expected to continue into the foreseeable future. Concurrently, environmental restoration will continue, in addition to required long-term stewardship activities. The long-term stewardship activities have and will consist of surveillance and maintenance of engineered units, monitoring ground and surface water, and enforcing institutional controls. Additional long-term stewardship activities may be required at certain sites, depending on the selected remedy and the results of post-remediation sampling. The current and expected future landlord for the facility is DOE's Office of Defense Programs. In some cases remediation has been completed at sites allowing for unrestricted use, therefore requiring no long-term stewardship beyond record keeping. In other cases, sites will require long-term stewardship activities after remediation has been completed to industrial land-use standards. Long-term stewardship related activities will begin for these sites as remediation work is completed, which is expected to continue to 2013, at which time site-wide long-term stewardship will begin.

1.2 Site Cleanup and Accomplishments

Of the 2,146 potential release sites identified at LANL, 719 were slated for further investigation or accelerated remediation. These release sites range in size from less than one square meter to tens of hectares, contaminated with various radionuclides, organic solvents, metals, and high explosives. Residual contamination may exist in more than seven million cubic meters (9.1 million cubic yards) of environmental media, primarily soils and sediments. The principal mechanism for potential release of contaminants is surface-water runoff, which can carry potentially contaminated sediments, and erode soil, resulting in exposure of buried waste. Potential release sites are, thus, aggregated according to their respective watershed.

To date, DOE has proposed approximately 1,400 potential release sites to the State regulatory authority, the New

Mexico Environment Department (NMED), for " No Further Action" (NFA). There are three major reasons why potential release sites are classified as NFAs. One reason is that some sites that were thought to be contaminated were found, upon further investigation, to not be contaminated.[3] Consequently, these sites only require keeping records to maintain information or results of investigations, samplings, past actions, and decisions related to these sites. To date, approximately 620 (44%) of the NFAs submitted, have been of this nature. For example, the Solid Waste Management Unit (SWMU) 1-001(h) was a septic tank. Archival information and engineering drawings demonstrated that it received only domestic sewage, and never managed *Resource Conservation Recovery Act* (RCRA) solid or hazardous wastes (thus not meeting the regulatory definition of a SWMU), consequently it was considered a NFA site.

SITE ACCOMPLISHMENTS

- Completed total re-baseline of project based on watershed approach
- Proposed approximately 1,400 potential release sites for No Further Action
- Installed eight regional deep wells for groundwater monitoring purposes
- Completed approximately 100 remedial actions, some of which will require long-term stewardship
- Decontamination and decommissioning of 40 facilities
- Completed documentation requirements leading to potential land transfers

BY 2006 LANL WILL HAVE

- Completed remediation at five major material disposal areas (MDA "M," MDA "P," MDA "R", MDA "H" and the Airport Landfill)
- Disposed of virtually all legacy low-level mixed waste
- Disposed approximately 50 percent of legacy transuranic waste
- Proposed 100 additional potential release sites for No Further Action
- Completed regional deep Well Drilling Program
- Transferred about 2,000 hectares (4,000 acres) of land to outside parties
- Conducted several interim measures at highly contaminated sites, such as 260 Outfall

Secondly, there are also sites where investigators discovered contamination existed at levels that did not warrant remediation, based on the expected land use for the site.[4] For instance, SWMU C-08-010 was a former drum storage area. The RCRA Facility Investigation sampling results from the soil beneath the unit verified that no contaminants had been released to the environment in the past; therefore, no remediation was necessary and none was performed. At some of these NFA sites, no land-use restrictions are required, as the levels of contaminants are appropriate for residential use. However, land use controls are necessary at those sites left at industrial land use levels to ensure continued protection of human health and the environment. Records of past actions, including decisions related to these sites and the sites location, will be maintained. Approximately 630 sites have been submitted for NFA where remediation was not performed based on risk assessment.

The third category of NFAs includes sites where DOE has performed remediation to a regulatory standard based upon a risk analysis and assessment.[5] There have been approximately 150 NFAs submitted for sites after a corrective action was completed. For example, SWMU 00-016 was a former firing range used for small arms target practice by the LANL security force, and later by local residents, from 1947 until 1992. Following treatment and removal of contaminated materials, confirmation samples showed that residual contaminants were

[3] These sites, known as "Administrative NFAs", are submitted in cases where a site identified on paper was found to have never existed in reality, was double counted, there was never any potential for contamination, or where no contamination was found after being investigated.

[4] These sites are known as "Risk Based NFAs".

[5] These sites are known as "Risk Based Corrective Action NFAs".

at levels low enough to pose no unacceptable risks to the public under current or planned future land uses. Of sites requiring remedial action, the majority were cleaned up to industrial land use standards, and will require use restrictions. A small number of privately owned sites were remediated to residential use levels and do not require any long-term stewardship activities other than record keeping. A few sites on public land were remediated for recreational land use and no land use restrictions are necessary. As in all cases, records will be kept to maintain information of past actions and decisions related to these sites.

DOE retains administrative control of all sites on DOE land, regardless of restrictions on use, until ownership transfers. DOE ensures that the appropriate records and controls are in place to prevent an unauthorized action (e.g. construction of a non-industrial facility) from occurring at these sites. These sites are categorized according to watersheds at LANL. Consequently, each site will not be managed individually but rather as an entire watershed for long-term stewardship activities.

Eight major watersheds cross LANL boundaries and drain into an 18-kilometer (11-mile) segment of the Rio Grande between the Otowi Bridge and Frijoles Canyon. These eight watersheds represent the environmental systems through which any contamination from potential release sites will migrate in sediments, surface water, soils, and alluvial groundwater. The runoff from the eight watersheds flows downstream to the Rio Grande River, some of it crossing the Pueblo of San Ildefonso. Sediment contamination in Upper and Lower Los Alamos Canyon, and Pueblo Canyon has been evaluated. Evaluation of sediment contamination in the other six watersheds is underway, but has not been completed at the time of this report. Contaminated sites in these eight watersheds will be remediated, as required in accordance with LANL's RCRA permit and DOE Orders. Neighboring Pueblos will continue to be involved in the decisions impacting their sovereign lands.

DOE is in the process of characterizing the soil and, consequently the specific area and volume of contamination is not yet determined. The contaminants of concern are diverse and include high explosives, RCRA, and *Toxic Substances Control Act* contaminants, as well as radioactive waste (low-level, transuranic, and mixed waste). Areas of soil contamination will either be covered by a regulator-approved engineered barrier, undergo excavation and offsite disposal, or undergo some other form of remediation, as required. Generally, the site is using the U.S. Environmental Protection Agency's (EPA) target incremental risk range of 10^{-4} to 10^{-6} to derive cleanup levels for non-radioactive carcinogens and a target hazard index value of 1 for non-carcinogens (i.e., the probability of injury, disease, or death from exposure to a hazard or a combination of hazards). Radiological contamination will be remediated to levels equivalent to, or less than, the 100 millirem per year dose limit as determined by a as-low-as-reasonably-achievable analysis. In some areas of the site, residual metal, organic, or radiological contamination will remain in the soil and may require some form of institutional control.

There are approximately 26 material disposal areas (MDAs) contaminated with radionuclides, metals, and organics from past operations at LANL. MDAs are primarily unlined pits dug in the volcanic tuff that constitute the bulk of the mesas on which the Laboratory sits; however, there are also shaft fields, trenches, absorption beds, and several canyon wall dumps. In a number of cases, there are multiple pits, shafts, and trenches associated with a specific MDA. For instance, MDA "G" has 34 pits, 4 trenches, and 218 vertical shafts. A shaft field is comprised of a series of shafts drilled into the ground at varying depths into which waste is placed. The primary contaminants of potential concern are radionuclides, high explosives, volatile organic compounds, and metals. Waste is no longer being accepted into the MDAs, except for MDA "G", which is still an active disposal area. The monitoring and surveillance of the sites that have not been remediated serves as interim stewardship until a long-term remedy can be selected, designed, and constructed. Currently, the technical approach for remediating the MDAs is being developed by LANL, DOE, and the regulator as part of an MDA Implementation Plan based on the DOE/EPA "plug in" approach. DOE currently assumes that the majority of LANL's MDAs will be left intact and closed with an engineered cap; however, it is possible that some of the smaller ones will be excavated. DOE estimates that less than 10 percent of the waste in the MDAs will be excavated and disposed of offsite. Several of the MDAs are assumed to require long-term surveillance, monitoring, and maintenance. If any of the

MDAs that will be remediated prior to 2006 (e.g., MDA "P") are clean closed, no restrictions on the use of the property are anticipated to be required. However, most of the MDAs may require institutional controls, such as access restrictions, and several may also require interim measures that will need to be monitored until such time as final remedies are selected.

Currently, DOE is in the process of characterizing the groundwater. Radioactive contaminants have been detected in the alluvial groundwater within the site's boundaries. However, DOE assumes that no groundwater remediation of the alluvial system will be necessary because there is no current or projected use of the site's alluvial groundwater. Sitewide groundwater is being monitored to determine its quality in the regional aquifer. There will be at least 32 monitoring wells drilled into the deep regional aquifer. Eight of the 32 wells have already been installed. Additional wells will be added to better define groundwater conditions. The well drilling program is anticipated to be completed by 2006. Drilling of monitoring well R-25 near the Weapons Engineering Tritium Facility revealed the presence of high-explosive constituents in the regional aquifer at concentrations that are not compliant with EPA Health Advisory guidance values for drinking water. However, testing of nearby water supply wells showed that these compounds are not present in drinking water obtained from the wells. If groundwater remediation is determined to be necessary, it will take place in accordance with plans approved by the State of New Mexico Environment Department. Monitoring the local water supply has revealed levels of strontium-90 below the maximum concentration levels identified in the *Safe Drinking Water Act*. The EPA primary drinking water standard for strontium-90 is currently 8 picocuries per liter (pCi/L).

Facilities at LANL are primarily contaminated with radionuclides, high explosives, volatile organic compounds (VOCs), and metals. Most of the site's 149 surplus facilities will be demolished; the remaining few will be decontaminated for industrial re-use. Some of the 149 surplus facilities are contaminated. The material from demolished facilities will be taken to appropriately permitted facilities. Two waste management facilities, the Waste Characterization, Reduction, and Repackaging Facility; and the Radioactive Materials Research, Operations, and Demonstration Facility will undergo decontamination and decommissioning by 2017, but final closure has not yet been determined. Approximately 40 facilities have completed decontamination and decommissioning. A number of other facilities have had work done to minimize the potential for further contamination and extreme risk to human health. Most contaminated facilities are in controlled access areas.

DOE will complete RCRA corrective actions, facility decommissioning, and RCRA closures by 2013. The site expects to continue its current missions and complete remediation at onsite locations to cleanup levels suitable for industrial, commercial, or recreational use. Any land that is released will be remediated to cleanup levels consistent with anticipated future land use and after consultation with regulators and stakeholders. DOE estimates it will convey or transfer about 2,000 hectares (4,000 acres) to the County of Los Alamos and the San Ildefonso Pueblo. Approximately 10 parcels of land, or portions of the parcels, are expected to be transferred by November 2007.

STAKEHOLDER INVOLVEMENT

Los Alamos National Laboratory provides information to the public about activities specified in the Baseline Report, incorporates public involvement efforts into existing activities performed by the Community Relations Office, and coordinates them with the Albuquerque Operations Office and the Los Alamos Area Office. DOE holds periodic public meetings as the situation warrants. Several community groups are involved, such as the Citizens Advisory Board (Los Alamos), groups from each of the four Accord Pueblos, and others. The Citizens Advisory Board holds monthly meetings and rotates meeting locations in communities in northern New Mexico. The other stakeholder groups meet on a semi-regular basis or as issues arise.

In addition to current achievements, there are other areas of accomplishment that will be realized by 2006. Of the 2,146 potential release sites, another 100 will be completed by 2006, bringing the number proposed for No Further Action to 1,500. Four of the material disposal areas (landfills) are also planned for completion by 2006. If any of these material disposal areas are "clean

closed" as discussed in Section 2.1, there will be almost no discernible long-term stewardship activities. As stated later in Section 2.1, the deep well drilling program will be complete by 2006, allowing LANL to more fully develop the conceptual site groundwater model. LANL will have also disposed of virtually all legacy low-level mixed waste and approximately 50 percent of legacy transuranic waste currently stored above ground by 2006.

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

In addition to the long-term stewardship activities that will take place after the completion of the remediation and legacy waste projects, as described above, there are also long-term stewardship related activities currently occurring and others that will begin prior to the completion of site corrective action within a watershed. For example:

- LANL has begun implementing and planning efforts for long-term stewardship activities, such as the long-term surveillance and monitoring efforts needed for the Material Disposal Areas that have covers as a proposed remedy.
- Site-wide monitoring is in place at existing wells in order to establish the continued safety of drinking water supplies.
- Active partnering with the regulatory authorities is ongoing to ensure their concerns are addressed well in advance of completion of the projects.
- Release sites where interim measures have been used will be monitored until such time as final Corrective Measure Implementation are completed. Other release sites where remedial actions have been completed are routinely inspected to determine that there has been no change to their condition.

DOE is expected to maintain ownership of most of the site once remediation is complete and, therefore, will be responsible for performing long-term stewardship activities. Once all remediation is complete in 2013, those areas of the Laboratory property that are not transferred to other entities for industrial use, or are already subject to long-term stewardship activities, will likely be transferred to DOE's Defense Programs for long-term surveillance and maintenance.

The long-term stewardship activities will include monitoring ground and surface water, maintaining engineered controls (e.g., landfill and MDA cap covers, etc.), enforcing access restrictions, and maintaining institutional controls. DOE is planning long-term stewardship activities through 2070; however, long-term stewardship activities may extend beyond this date. The duration will be adjusted as requirements are better defined.

Institutional controls could consist of deed restrictions, which may include prohibiting onsite groundwater use and residential development on DOE property. DOE will maintain a permit program that will control excavation, penetration, or other use of residually contaminated areas. Notices will be filed with the original acquisition records. As required by Federal law, information regarding the residual contamination location and risk will be filed with other entities under a plan currently under development. To assure that the Federal Government meets its environment, safety, and health obligations, DOE will retain, in the conveyance and transfer instruments, the no-cost right to enter in and upon the lands being provided to the County (and its designee) and Pueblo. Entry rights will be retained for the purpose of conducting environmental monitoring and analysis (including the installation, maintenance, and removal of monitoring stations) of flora, fauna, soils, water, and air; environmental restoration; and cultural and archeological surveys and mitigation.

Several Technical Areas are surrounded by fences with locked gates. Some areas have guards posted to regulate access. DOE will continue to control access, as well as maintain and repair fences, as needed, for as long as necessary.

Currently, DOE is responsible for long-term record-keeping associated with environmental contamination at the site. Site records are kept in permanent storage at the Los Alamos Environmental Restoration Project Office's Records Processing Facility and at LANL's archives, and real property records are retained at the LANL site. The types of records maintained include site characterization data, remedial action design information, monitoring plans, monitoring results, and action completion reports.

2.2 Specific Long-Term Stewardship Activities

Soil

Areas with residual contamination may require surveillance and monitoring indefinitely. For example, PRS 16-021, the 260 Outfall, will be excavated in FY 2002 to remove a source of groundwater contamination found at R-25. This interim action will support the ultimate goals of the Corrective Measure Study/Corrective Measure Implementation that is being completed at the site. Deed restrictions, such as prohibiting soil excavation, may remain in place for all areas exceeding residential cleanup levels.

For properties being transferred, DOE may enter a deed notice with the County Clerk's office for areas beyond site boundaries that have residual contamination, and any key information regarding the contamination and the site's history will be attached to the deed or transfer instrument.

Groundwater

There will be at least 32 deep regional monitoring wells installed at LANL. DOE will conduct long-term surveillance and maintenance for the vadose zone and groundwater in accordance with plans approved by the administrative authority, the State of New Mexico Environment Department. The groundwater will be monitored for the presence and concentration of contamination for as long as necessary. Current baseline plans are that monitoring will be required for 36 years, during which samples will be taken quarterly, for both radionuclides and non-radionuclides. After the first 36-year period, monitoring may be reduced to annual monitoring if approved by the regulator.

Surface Water/Sediments

Long-term surveillance and maintenance will consist of monitoring surface water stations by watershed throughout LANL and surrounding areas. As for groundwater, baseline plans are that monitoring will be required for 36 years, during which samples will be taken quarterly or following precipitation, for both radionuclides and non-radionuclides. After the first 36-year period, monitoring may be reduced if approved by the regulator.

Engineered Units

Although remediation of the Los Alamos Airport Landfill will be completed before 2006, none of the major MDAs, with the exception of MDA "P," MDA "M," MDA "H" and possibly MDA "V," will be remediated by 2006. Before the establishment of a formal environmental restoration project in 1989, several of the inactive MDAs were covered by some form of protective barrier, such as soil or asphalt (see table on the next page). Other MDAs either have completed interim measures or will complete interim measures before 2006, which will be monitored until such time as final remedies are selected. For example, an ISV interim measure on one of the absorption beds in MDA "V" was completed in FY 2000 and will be monitored until a final remedy for the entire MDA is selected later. Another example is MDA "L" at Technical Area-54. A pilot program involving installation of monitoring wells to extract an organic vapor plume was performed back in 1993-1994. These wells will likely continue to be monitored until the Corrective Measure Implementation is done for the rest of the MDA. A passive vapor extraction system may be employed prior to completion of the Corrective Measure

Implementation as well. In accordance with an approved plan by the regulatory agency, DOE will monitor and maintain the MDAs to ensure continued protection of human health and the environment before and, if necessary, after implementation of a final remedy. These MDAs may require institutional controls, such as access restrictions.

MDA "G" (also known as Area G) is the primary active waste management facility for LANL, and is located on Mesita del Buey. The disposal area consists of approximately 32 hectares (80 acres), of which 15 hectares (37 acres) has been in active use since 1958. Waste management activities at Area G are varied and include engineered units that will require use restrictions indefinitely, as well as facilities that will be removed entirely thereby requiring no long-term stewardship, except record keeping. Areas requiring land-use restrictions include low-level waste disposal cells and shafts and a monofill disposal cell (a disposal cell containing a single waste type) for radioactively contaminated asbestos. The latter includes a soil-covered asphalt pad containing stacks of waste drums (which will be entirely removed, without any residual contamination expected, before 2006) and temporary tension domes used to store drums of transuranic waste and low-level radioactive mixed waste (currently planned to be removed by 2013). As each unit within the Area G landfills is filled, it is covered with clean soil to prevent any airborne migration of wastes. Surveillance and monitoring are routinely performed on these closed units. The Area G units where waste remains will be monitored and maintained in perpetuity to ensure their continued protectiveness. As with all other closed landfills, the Area G landfills will be evaluated periodically to determine if this manner of waste management continues to be appropriate.[6] Once closed, according to an approved closure plan, the landfill will be monitored and maintained in perpetuity.

Material Disposal Areas Which May Require Long-Term Stewardship Activities			
Names of the Cells with Interim Caps	***Type of Interim Cover***	***Size Hectares (Acres)***	***Volume Cubic Meters (Cubic Yards)***
A	Soil	0.51 (1.25)	6,292 (8,230)
B	Soil/ Asphalt	2.44 (6.03)	21,240 (27,781)
C	Soil	4.97 (12.3)	145,905 (190,837)
D	Soil	0.01 (0.03)	237 (310)
E	Soil	0.56 (1.4)	unknown
F	Soil	0.56 (1.4)	unknown
G	Active	26 (65)	321,000 (420,000)
H	Soil/ Concrete	0.12 (0.3)	unknown
J	Soil	1.07 (2.65)	73,000 (95,000)
K	Soil	0.4 (1.0)	12,335 (16,133)
L	Asphalt	1.04 (2.58)	unknown
N	Soil	0.11 (0.28)	unknown

[6] Additional details regarding Area G can be found in the *Site-Wide Environmental Impact Statement for Continued Operation of the Los Alamos National Laboratory (SWEIS)*, Volume II, Part I. There is also a *1998 Performance Assessment* that describes closure and post-closure requirements for the existing Area G. Both of these documents are available at the LANL Reading Room. The SWEIS is also available on DOE's website.

Material Disposal Areas Which May Require Long-Term Stewardship Activities			
Names of the Cells with Interim Caps	*Type of Interim Cover*	*Size Hectares (Acres)*	*Volume Cubic Meters (Cubic Yards)*
Q	Soil	0.08 (0.2)	unknown
S	Soil	0.00093 (0.0023)	31 (40)
T	Soil	0.89 (2.21)	unknown
U	Soil	0.008 (.02)	510 (667)
V	Soil	0.36 (0.88)	4,248 (5,556)
W	Concrete	<0.0004 (0.001)	0.3 (0.4)
X	Soil	0.02 (0.05)	unknown
Y	Soil	0.1 (0.2)	3,000 (4,000)
Z	Open	0.2 (0.4)	unknown
AA	Soil	0.6 (1.4)	unknown
AB	Soil	0.18 (0.45)	28 (37)

Facilities

Depending on sampling results after final decontamination and decommissioning of the facilities, minimal institutional controls may be necessary. Deed restrictions or use limitations may be placed on areas with residual contamination.

2.3 Regulatory Regime

Long-term stewardship activities at LANL are governed primarily by RCRA and DOE Orders. Also, the neighboring Pueblos have authority to address impacts to their lands by LANL operations.

2.4 Assumptions and Uncertainties

Characterization of potential contamination is occurring in some areas, while remediation is occurring in other areas. The most significant areas have completed some characterization, but final remedies have not been determined. The possibility exists that contaminated environmental media not yet identified will be discovered in the future as a result of routine operations, maintenance activities, or decontamination and decommissioning activities at the LANL site. Upon discovery of a new contaminant source by DOE, the State of New Mexico Environment Department, or EPA, that source will be evaluated and appropriate response actions taken in accordance with RCRA. Currently, DOE assumes that no groundwater remediation of the alluvial system will be necessary because there is no current or projected use of the site's alluvial groundwater. Not all remedial approaches described in this summary have been finalized and/or approved.

Future decisions regarding remedial action will continue to involve the State of New Mexico Environment Department, EPA, Pueblos, and the public as appropriate. DOE has made assumptions regarding the most likely paths forward in order to plan and budget activities. More information on these assumptions and the risks associated are documented in the project baseline. If these assumptions prove to be incorrect then there is a

potential for increased cost and duration of the project.

DOE estimates it will convey or transfer about 2,000 hectares (4,000 acres) to the County of Los Alamos and the San Ildefonso Pueblo. Approximately 10 parcels of land, or portions of the parcels, are expected to be transferred by November 2007.

3.0 ESTIMATED LONG-TERM STEWARDSHIP COSTS

Estimated costs for long-term stewardship activities for the LANL site are identified in the table below. Long-term stewardship costs are related to surveillance and maintenance of engineered units, groundwater and surface water monitoring, and enforcing institutional controls. Cost estimates reflect LANL's current estimates based on site agreements and monitoring frequencies; however, these estimates will likely change by 2007. Contingency costs, such as cap replacement, have not been incorporated into the cost estimate. For purposes of this report, long-term stewardship costs are shown until FY 2070; however, it is anticipated that long-term stewardship activities will be required in perpetuity.

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	***Amount***	***Year(s)***	***Amount***	***Year(s)***	***Amount***
FY 2000	$n/a	**FY 2008**	$194,000	**FY 2036-2040**	$3,100,000
FY 2001	$n/a	**FY 2009**	$451,000	**FY 2041-2045**	$3,500,000
FY 2002	$n/a	**FY 2010**	$540,000	**FY 2046-2050**	$3,500,000
FY 2003	$n/a	**FY 2011-2015**	$2,700,000	**FY 2051-2055**	$3,500,000
FY 2004	$n/a	**FY 2016-2020**	$2,700,000	**FY 2056-2060**	$2,300,000
FY 2005	$n/a	**FY 2021-2025**	$2,700,000	**FY 2061-2065**	$1,700,000
FY 2006	$n/a	**FY 2026-2030**	$2,500,000	**FY 2066-2070**	$1,400,000
FY 2007	$143,000	**FY 2031-2035**	$1,800,000		

4.0 FUTURE USES

The site development plan anticipates the continued use of land for LANL's nuclear stewardship mission for the next 30 years. Current projections of land and facility requirements indicate that LANL will need to retain most of its 112-square kilometer (43-square mile) site (aside from the 2,000 hectares (4,000 acres) of transferred land) either for structures, roads, utilities, or firing sites, and/or for a buffer area used for environmental research. The site will continue to be zoned for industrial use. Transferred land will be used for industrial, commercial, residential, or recreational uses.

For additional information about the Los Alamos National Laboratory site, please contact:

Ted Taylor, Los Alamos Environmental Restoration Project Manager
U.S. Department of Energy
528 35th Street
Los Alamos, NM 87544
Phone: 505-665-7203
or visit the Internet website at http://erproject.lanl.gov/about_us.html

LOVELACE RESPIRATORY RESEARCH INSTITUTE

1.0 SITE SUMMARY

1.1 Site Description and Mission

> ***LONG-TERM STEWARDSHIP HIGHLIGHTS***
>
> *Major Long-Term Stewardship Activities* - groundwater monitoring; institutional controls
> *Total Site Area* - 55 hectares (135 acres)
> *Estimated Volume of Residual Contaminants* - groundwater 747,000 cubic meters (978,000 cubic yards); soil unknown
> *Portions Requiring Long-Term Stewardship as of 2006* - 3
> *Average Annual Long-Term Stewardship Cost FY 2000-2006* - $140,000
> *Landlord* - Private

The Lovelace Respiratory Research Institute (LRRI), formerly the Inhalation Toxicology Research Institute, conducts research for the U.S. Department of Energy (DOE) on the health effects of inhaling airborne contaminants (radioactive and other energy-related pollutants). The Institute is located on Kirtland Air Force Base in north-central New Mexico, approximately 16 kilometers (10 miles) southeast of downtown Albuquerque, New Mexico. The site, which occupies 55 hectares (135 acres), is located on land that the U.S. Air Force leases to DOE under a cooperative agreement. This lease continues through 2002 and has an option to renew. Since LRRI's establishment in 1960, the Institute has been operated for DOE by the non-profit Lovelace Biomedical and Environmental Research Institute. The LRRI site was established to conduct research on the human health consequences of inhaling airborne radioactive materials. Due to research in this and in a variety of other areas, environmental contamination at the LRRI site was caused by diesel fuel spills, disposal in a pair of small concrete-lined holding ponds to evaporate liquid low-level radioactive waste, and disposal in earthen lagoons to collect sewage. In 1997, DOE completed remediation of the contaminated areas to industrial use standards.

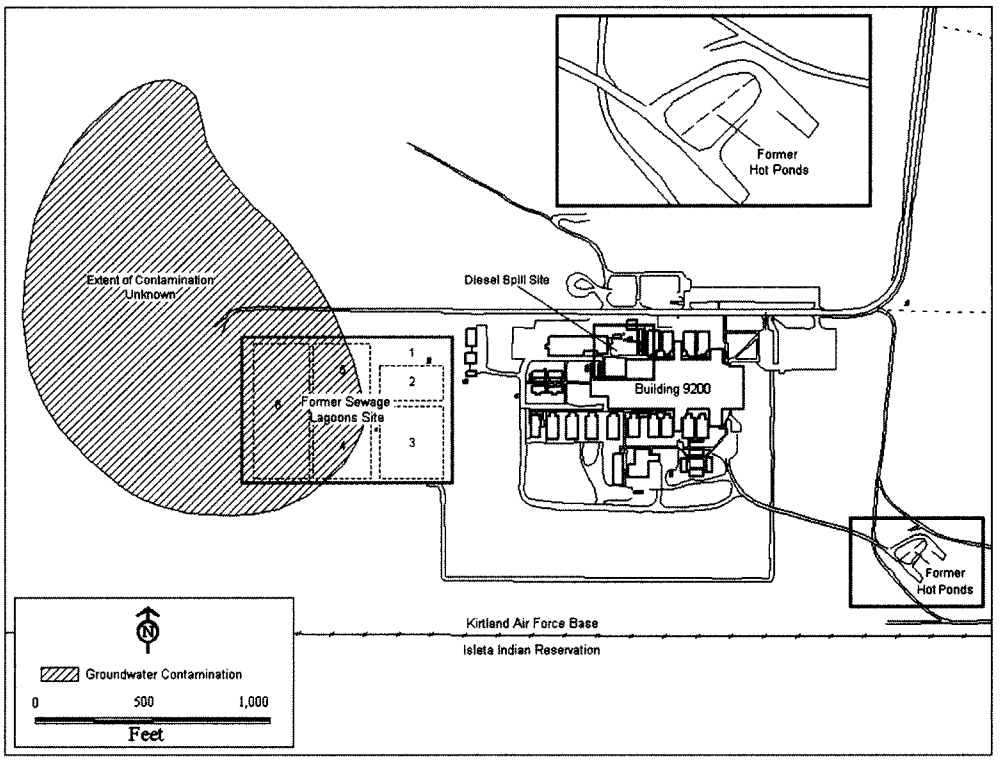
Currently, DOE is responsible for performing long-term stewardship activities, such as monitoring groundwater and maintaining institutional controls, to ensure protection of human health and the environment. The historic mission of LRRI was to conduct biomedical research for DOE and others, primarily to evaluate the short and long-term human effects of inhaled pollutants and airborne materials encountered in the general environment or the workplace. In the mid-1970s, the research program was expanded to investigate the potential health effects of airborne chemicals released from coal combustion and gasification plants, solar collectors, and light-duty diesel engines. Beginning in the 1980s, the program shifted to more basic research on the human respiratory tract and its response to inhaled toxins.

1.2 Site Cleanup and Accomplishments

Since 1990, DOE has been addressing the environmental contamination caused by LRRI's research activities. The primary environmental issues at the site include the cleanup of areas contaminated with radioactive and hazardous substances; management of hazardous, radioactive, and sanitary wastes generated onsite; and dispositioning of materials in inventory.

Contaminated soil was excavated and disposed at the commercial offsite disposal facility, Envirocare of Utah. Residual soil contamination is due to low levels of radioactivity from strontium and cesium. The areas with residual soil contamination are currently suitable, based on risk analyses, for industrial land use purposes. These areas will be available for unrestricted use, from a risk standpoint, once the radionuclides decay sufficiently, estimated to be in the year 2030.

Groundwater at LRRI is contaminated by several constituents, including sulfate and naphthalene. The selected



Lovelace Respiratory Research Institute

remedy, monitored natural attenuation, is expected to reduce contaminant levels in groundwater below cleanup standards.

DOE owns all onsite facilities and structures. To date, there have been no formal decontamination and decommissioning investigations of facilities and/or structures. Decontamination and decommissioning of several buildings is currently being planned.

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

DOE's Office of Environmental Management is currently responsible for performing long-term stewardship activities, which include monitoring groundwater and enforcing institutional controls. It is not possible at this time to determine how long groundwater monitoring will be required; however, it is estimated to be necessary through 2010. The LRRI site will continue to monitor groundwater on a quarterly or bi-annual basis until contaminant concentrations are below cleanup levels.

LRRI is located well within the entrances of Kirtland Air Force Base. Since the Air Force Base controls entry onto the site, a certain measure of access restrictions is realized due solely to LRRI's location at the extreme southern end of the base. Due to the remoteness of the location and small size of the contaminated areas, no engineering controls, such as fences or signs, are in place or are required at LRRI, with the exception of the diesel fuel spill site located on the grounds of the main LRRI facility. Since the main facility is enclosed by fences and is expected to remain so, the diesel fuel spill site, simply by its location, will continue to be fenced as well.

Land use is anticipated to remain industrial for the foreseeable future. Institutional controls, such as land use restrictions, will continue to ensure that the industrial designation remains for the contaminated portion. Since the facility is on Kirtland Air Force Base and leased by DOE, any construction must be approved by both parties.

DOE maintains and updates the specific records and reports required to document long-term stewardship activities at the LRRI site. Site records are kept in permanent storage at DOE's Albuquerque Operations Office. The types of records maintained include site characterization data, remedial action design information, assessment reports, closure reports, and groundwater monitoring data. The records are available for review upon request.

STAKEHOLDER INVOLVEMENT

Due to the remoteness, small size and minimal risk levels associated with LRRI, there has been little interaction with the community at large related to cleanup or long-term stewardship activities at the site. However, the southern boundary of LRRI abuts the northern boundary of the Isleta Pueblo. Consequently, there is a very close working relationship between LRRI and the officials from the Isleta Pueblo.

2.2 Assumptions and Uncertainties

DOE assumes that its regulator, the New Mexico Environment Department, will ultimately approve closeout and completion of all work done to date, including the proposal to address contaminated groundwater through natural attenuation. However, it cannot be determined at this time how long monitoring will be required. There is a possibility that active remediation of the groundwater will be required. Depiction of the location of the groundwater for the sewage lagoon and diesel spill sites are only estimates based on monitoring data. These plume locations have not been delineated. The data indicate that the plumes are contained within the monitoring area.

2.3 Estimated Site-Wide Long-Term Stewardship Costs

Long-term stewardship costs are related to groundwater sampling and analysis, as well as maintenance and extension of the monitoring wells. DOE will continue to monitor groundwater on a quarterly or bi-annual basis until contaminant concentrations are below cleanup levels. These activities are anticipated to be required at least until 2010. The long-term stewardship costs exclude contingency costs, such as well replacement. No long-term stewardship costs are attributed to maintaining the industrial land designation for residually contaminated soils. This function is considered part of maintaining the facility itself and not a long-term stewardship cost.

Site Long-Term Stewardship Cost by Fiscal Year (Constant Year 2000 Dollars)					
Year(s)	***Amount***	***Year(s)***	***Amount***	***Year(s)***	***Amount***
FY 2000	$140,000	**FY 2008**	$140,000	**FY 2036-2040**	$0
FY 2001	$140,000	**FY 2009**	$140,000	**FY 2041-2045**	$0
FY 2002	$140,000	**FY 2010**	$140,000	**FY 2046-2050**	$0
FY 2003	$140,000	**FY 2011-2015**	$0	**FY 2051-2055**	$0
FY 2004	$140,000	**FY 2016-2020**	$0	**FY 2056-2060**	$0
FY 2005	$140,000	**FY 2021-2025**	$0	**FY 2061-2065**	$0
FY 2006	$140,000	**FY 2026-2030**	$0	**FY 2066-2070**	$0
FY 2007	$140,000	**FY 2031-2035**	$0		

3.0 PORTION OVERVIEW

The LRRI site consists of three portions that will require some long-term stewardship activities as of 2006. For purposes of this report, a "portion" is defined as a geographically contiguous and distinct area (which may involve residually contaminated facilities, engineered units, soil, groundwater, and/or surface water/sediment) for which cleanup, disposal, or stabilization will have been completed and long-term stewardship activities will be required as of 2006.

The LRRI site consists of three portions: (1) the Sewage Lagoon, (2) the Diesel Spill Site, and (3) the Hot Ponds. Each portion is listed in Table 3-1, with accompanying discussion of cleanup and long-term stewardship activities in Sections 3.1 through 3.3.

Long-Term Stewardship Information		
Portion	***Long-Term Stewardship Start Year***	***Long-Term Stewardship End Year***
Sewage Lagoon	1998	2030*
Diesel Spill Site	1994	2010**
Hot Ponds	1997	2030

** This date pertains only to the soil. The groundwater monitoring requirements may be considerably shorter or longer, depending on the monitoring results.*
*** For the purposes of this report, an end date of 2010 is projected for groundwater monitoring requirements. However, it may be considerably shorter or longer, depending on the monitoring results.*

3.1 Sewage Lagoon Portion

The Sewage Lagoon Portion is located immediately west of the main LRRI facility and consisted of six sewage lagoons. This area is considered one portion because it is a discrete area with a release of a particular group of contaminants. Elevated levels of cesium-137 and strontium-90 were found in the former lagoon residual soils.

SEWAGE LAGOON PORTION HIGHLIGHTS

Major Long-Term Stewardship Activities - groundwater monitoring; institutional control
Portion Size - 6 hectares (15 acres)
Estimated Volume of Residual Contaminants - groundwater 736,000 cubic meters (963,000 cubic yards); soil unknown
Long-Term Stewardship Start-End Years - 1998-2030
Average Annual Long-Term Stewardship Costs FY 2000-2006 - $70,000

Between 1963 and 1992, liquid sanitary sewage was discharged to lagoons consisting of six cells within a four-hectare (10-acre area). Lagoons 1, 2 and 3 had asphalt berms and were lined with polyethylene over a compacted bottom. Lagoon 4 had no synthetic liner but was constructed with a compacted bottom and asphalt berms. Lagoons 5 and 6 were constructed with impermeable clay bottoms and concrete berms. These lagoons were used to treat all sewage and wastewater generated from the LRRI facilities. DOE took the lagoons out of service in May of 1992, when LRRI began using the city sewer system. However, due to past operations, both soil and groundwater were contaminated.

3.1.1 Soil

The total area of residually contaminated soil in this portion is 2.8 hectares (7 acres). Contaminants of concern consist of cesium-137 and strontium-90. Remediation consisted of excavating the contaminated soil and dried

sludge and disposing of it offsite at Envirocare of Utah. The excavated area was cleaned up to industrial use levels. Slight residual radiological contamination remains; however, the exact volume has not been determined. The highest post-remediation concentration of cesium-137 was 28 millirems/year, found in Lagoon 1. The highest post-remediation concentration of strontium-89/90 was 25 millirems/year, also found in Lagoon 1. Due to the residual contamination, institutional controls will be required to ensure land use remains industrial until the year 2030. Through natural decaying of the radionuclides, all lagoons are expected to achieve levels of 15 millirem/year by 2030, which would allow for unrestricted use from a risk standpoint.

The radiological contaminated area of the soil was remediated pursuant to DOE Orders 5400.5 (Radiation Protection of the Public and the Environment) and 5820.2A (Radioactive Waste Management, currently known as the DOE Order 435.1 Radioactive Waste Management), as well as Federal regulations (Title 10 of the *Code of Federal Regulations*, Part 834 and Part 20). The sludge portion was remediated pursuant to the State of New Mexico regulations.

Soil Long-Term Stewardship Activities

The LRRI facility is located at the southern edge of the Kirtland Air Force Base. Due to the remoteness of the Sewage Lagoon Portion and low degree of risk, no fences or signs are in place or planned for this area. The area will be limited to industrial use for the foreseeable future. Land use controls necessary to ensure the current industrial land use for the soil will be maintained by the facility as part of its operations. Therefore, no additional DOE funds are required for the soil long-term stewardship.

3.1.2 Groundwater

The contaminated groundwater covers approximately six hectares (15 acres) on the Sewage Lagoon Portion and has several contaminants above New Mexico Water Quality Control standards. The plume has not yet been delineated; therefore, the exact volume of contaminated groundwater is unknown. However, for the purposes of this report, the volume is estimated to be 736,000 cubic meters (963,000 cubic yards).

The groundwater contamination associated with this portion is regulated by a discharge permit issued by the New Mexico Environment Department in October 1997. The remedy selected for this area is monitored natural attenuation. The required semi-annual monitoring and reporting are conducted pursuant to the terms of the permit. Monitoring will continue until the State approves termination of the monitoring, either because all contaminants are below the New Mexico Water Quality Control standards or a waiver is granted.

The groundwater contaminants of concern include nitrate, chloride, sulfate, total dissolved solids, and fluoride. Nitrate and chloride are currently below New Mexico Water Quality Control standards in all 11 monitoring wells. Sulfate and total dissolved solids concentrations are below the standard for all but two wells. Fluoride concentrations are above the standard in four wells; however, results from the up-gradient well indicates that the observed fluoride concentrations may be at or near natural levels. The anticipated levels for remediation to meet the New Mexico Water Quality Control Commission Standards include nitrate at 10 parts per million, chloride at 250 parts per million, sulfate at 600 parts per million, total dissolved solids at 1,000 parts per million, and fluoride at 1.6 parts per million.

Groundwater Long-Term Stewardship Activities

Groundwater monitoring for this portion will continue as long as required by the State of New Mexico to ensure natural attenuation is working properly. It is not possible to predict the length of time that groundwater monitoring will be required. For the purposes of this report, an end date of 2010 is projected for groundwater monitoring requirements. However, it may be considerably shorter or longer, depending on the monitoring

results.

3.1.3 Estimated Long-Term Stewardship Costs for Sewage Lagoon

Long-term stewardship costs associated with this portion are related to groundwater sample collection, analysis, reports, and well maintenance. These costs are calculated to be $70,000 per year from fiscal year (FY) 2000 through FY 2010, based on the anticipated length of groundwater monitoring.

Long-Term Stewardship Costs (Constant Year 2000 Dollars)							
FY 2000 - FY 2010	*FY 2011 - FY 2020*	*FY 2021 - FY 2030*	*FY 2031 - FY 2040*	*FY 2041 - FY 2050*	*FY 2051 - FY 2060*	*FY 2061 - FY 2070*	*Estimated Total*
$770,000	$0	$0	$0	$0	$0	$0	$770,000

3.2 Diesel Spill Site Portion

The Diesel Spill Site Portion is approximately a 0.1-hectare (0.3-acre) area, located within the fenced portion of the main LRRI facility. This is a discrete site with a particular history of release or contaminants (i.e., diesel oil products) and is being remediated pursuant to the regulations of specific State regulatory entities--the New Mexico Environment Department Groundwater Quality Bureau and the New Mexico Water Quality Control Commission. Consequently, the Diesel Spill Site is considered one portion.

DIESEL SPILL SITE PORTION HIGHLIGHTS

Major Long-Term Stewardship Activities - groundwater monitoring
Portion Size - 0.1 hectares (0.3 acres)
Estimated Volume of Residual Groundwater Contaminants - 11,000 cubic meters (15,000 cubic yards)
Long-Term Stewardship Start-End Years - 1994-2010
Average Annual Long-Term Stewardship Costs FY 2000-2006 - $70,000

The Diesel Spill Site consisted of contaminated surrounding soils and groundwater due to leaks of diesel fuel from underground tanks and fuel lines. The underground storage tanks were removed from the area by 1993. The contaminated soils were remediated through excavation and bioremediation. All excavated soil was placed in a local permitted landfill offsite. The soil was removed and, therefore, no long-term stewardship activities are required. However, groundwater beneath the area was found to be contaminated and requires long-term monitoring.

3.2.1 Groundwater

The contaminated groundwater covers approximately 0.1 hectares (0.3 acres). The groundwater associated with the Diesel Spill Site Portion contains a specific category of contaminant (i.e., diesel products) and is regulated by the New Mexico Environment Department Groundwater Quality Bureau and the New Mexico Water Quality Control Commission. The plume has not yet been delineated; therefore, the exact volume of contaminated groundwater is unknown. However, for the purposes of this report, the volume is estimated to be 11,000 cubic meters (15,000 cubic yards).

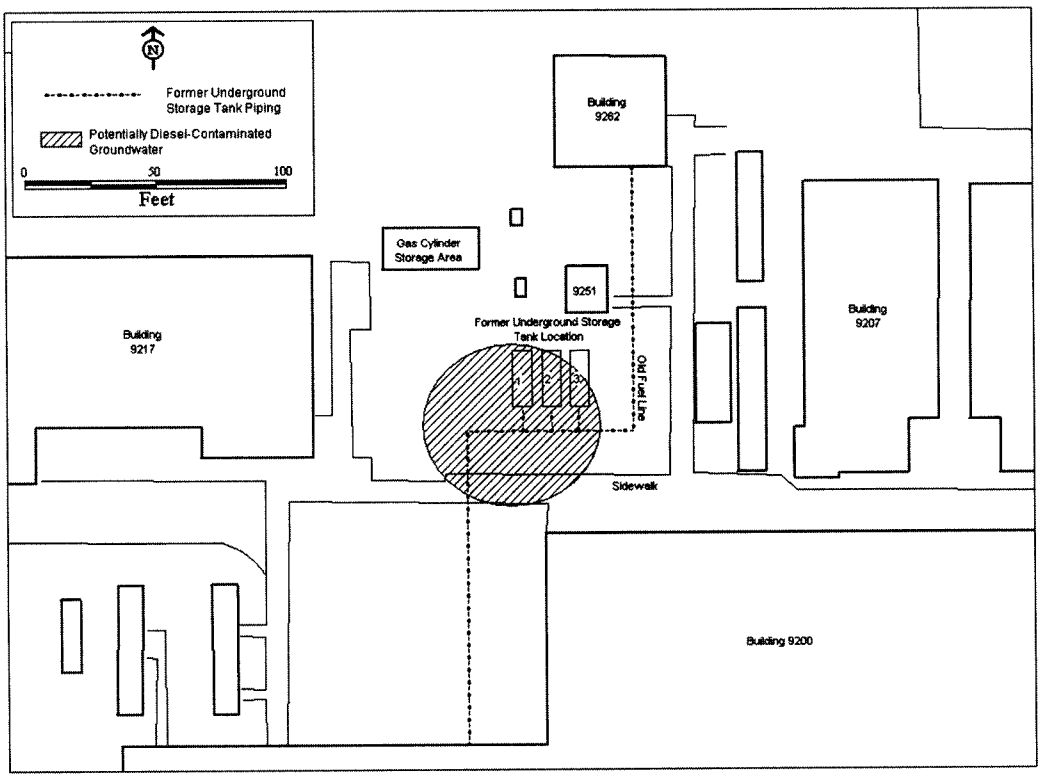
The only groundwater contaminant noted in this portion is naphthalene. The concentrations have varied since monitoring began in 1994 from no contamination detected to 130 parts per billion. The targeted cleanup level for naphthalene is 30 parts per billion. The last exceedance of the 30 parts per billion standard was 46 parts per billion--in the second quarter of 1999. Due to the relatively low concentrations of a single contaminant, monitored natural attenuation was selected as the remedy.

Groundwater monitoring has been performed pursuant to New Mexico Environment Department Underground Storage Tank Bureau and New Mexico Environmental Improvement Board regulations. Monitoring is performed quarterly at five wells and will continue until eight consecutive quarters are observed with no contamination or until a waiver is granted by the regulator, the New Mexico Environment Department.

Groundwater Long-Term Stewardship Activities

Groundwater monitoring for this portion will continue as long as required by the State of New Mexico to ensure natural attenuation is working properly. At a minimum, monitoring involves eight consecutive quarters of sampling. However, it is not possible to predict the length of time these long-term stewardship activities will be required. For the purposes of this report, it is assumed that contamination will drop below regulatory standards or a waiver will be granted by 2010. However, it may be considerably shorter or longer, depending on the monitoring results.

Access to the Diesel Spill Site Portion, as with the facility itself, is restricted by a locked gate and fence. Land use controls limiting the area to industrial use will remain in place for the foreseeable future.



Diesel Spill Site Portion

3.2.2 Estimated Long-Term Stewardship Costs for Diesel Spill Site

Long-term stewardship costs associated with this portion are related to groundwater sample collection, analysis, reports, and well maintenance. These costs are calculated to be $70,000 per year from FY 2000 through FY

2010, based on the anticipated length of groundwater monitoring.

Long-Term Stewardship Costs (Constant Year 2000 Dollars)							
FY 2000 - FY 2010	*FY 2011 - FY 2020*	*FY 2021 - FY 2030*	*FY 2031 - FY 2040*	*FY 2041 - FY 2050*	*FY 2051 - FY 2060*	*FY 2061 - FY 2070*	*Estimated Total*
$770,000	$0	$0	$0	$0	$0	$0	$770,000

3.3 Hot Ponds Portion

The Hot Ponds Portion is a 0.2-hectare (0.5-acre) area, located about 0.16 kilometer (0.1 mile) east of the LRRI facility. The Hot Ponds Portion is considered one portion because it is a discrete geographic area with a specific function -- to serve as radioactive liquid waste evaporation ponds -- and because of similar remediation strategy and long-term stewardship activities.

HOT PONDS PORTION HIGHLIGHTS

Major Long-Term Stewardship Activities - institutional control enforcement
Portion Size - 0.2 hectares (0.5 acres)
Estimated Volume of Residual Soil Contaminants - unknown
Long-Term Stewardship Start-End Years - 1997-2030
Average Annual Long-Term Stewardship Costs FY 2000-2006 - n/a

The Hot Ponds area included two small concrete-lined evaporative sumps (commonly referred to as the "Hot Ponds"), two metals buildings, and an assortment of support equipment. The sumps were used as holding ponds for liquid low-level radioactive waste from 1963 to 1985. One of the buildings was used for compaction of radioactive materials. The other building housed the mechanical equipment used for operation of the sumps.

3.3.1 Soil

Approximately 0.04 hectare (0.1 acre) of soil was contaminated with cesium-137 and strontium-90. The amount of cesium-137 and strontium-90 is 28 millirems/year and 13 millirems/year, respectively. Remediation was completed in 1997 and consisted of removing and disposing of the two sumps, both of the buildings, and a significant amount of the concrete and surrounding soil as low-level radioactive material at Envirocare of Utah. Based on risk assessments, remediation has reduced the potential dose (due to residual radioactive contamination of the soil with cesium-137 and strontium-90) to below-acceptable limits for the current industrial use scenario. Through natural decaying of the radionuclides, the Hot Ponds area is expected to achieve levels of 15 millirem/year by about 2030. This would allow the area to be used without radiological restrictions.

The area has been restored to a natural terrain and revegetated with native grasses. The soils were remediated in accordance with DOE Order 5400.5 (Radiation Protection of the Public and the Environment) and DOE Order 5820.2A (Radioactive Waste Management, currently known as DOE Order 435.1).

Soil Long-Term Stewardship Activities

Since 1997, long-term stewardship activities have been required at the Hot Ponds site. Long-term stewardship activities consist of maintaining land use restrictions until the end of the long-term stewardship period, which is anticipated to be 2030.

Due to the remoteness of the site and the low level of risk, there are no fences or signs at the Hot Ponds area.

3.3.2 Estimated Long-Term Stewardship Costs for Hot Ponds

The only cost associated with long-term stewardship activities for this portion is for maintaining the existing industrial use of the land. Since this is a facility function, and maintaining land use restrictions is part of facility operations, no additional DOE long-term stewardship funds are required.

4.0 FUTURE USES

Land use is anticipated to remain industrial for the foreseeable future. Institutional controls, such as land use restrictions, will be maintained to ensure that the industrial designation continues for contaminated areas.

For additional information about the Lovelace Respiratory Research Institute site, please contact:

Dave Bourne, Project Manager
U.S. Department of Energy, Albuquerque Operations Office
Box 5400
Albuquerque, NM 87185
Phone: 505-845-4032

(QUIVIRA) AMBROSIA LAKE SITE 2[1]

1.0 SITE SUMMARY

1.1 Site Description and Mission

The (Quivira) Ambrosia Lake Site 2 is the location of a former uranium milling site that operated from 1957 to 1985. The site contains a disposal cell for the uranium mill tailings and other process-related wastes resulting from operations. The site is located in the town of Ambrosia Lake, New Mexico, north of the town of Grants. The Quivira Mining Company owns the site and operated the 810-hectare (2,000-acre) mill. Extraction of uranium from mine water still continues. The site contains a 141.6-hectare (350-acre) engineered disposal cell used to dispose of byproduct material that resulted from processing uranium ores from nine mines, now-closed. The byproduct material consists primarily of uranium mill tailings and radioactive soil and rock that remained after the uranium ore was processed.

LONG-TERM STEWARDSHIP HIGHLIGHTS

Expected Long-Term Stewardship Activities - groundwater monitoring; disposal cell monitoring and maintenance; institutional controls
Total Site Area - 810 hectares (2,000 acres)
Current Landlord - Quivira Mining Company
Expected Long-Term Stewardship Start Year - 2015
Expected Future Landlord - U.S. Department of Energy, Grand Junction Office
Reason Not Subject to NDAA Requirements - This site is an UMTRCA Title II site that will not be transferred to the U.S. Department of Energy until 2015

The current mission of the (Quivira) Ambrosia Lake Site 2 is to complete its remediation activities and to close the site. The (Quivira) Ambrosia Lake Site 2 is subject to Title II of the *Uranium Mill Tailings Radiation Control Act of 1978* (UMTRCA). UMTRCA Title II sites are privately owned and operated sites that were licensed when UMTRCA was passed, or thereafter. The majority of the mining and milling conducted at these sites was for private sale, but a portion was sold to the U.S. Government. DOE is responsible for long-term stewardship activities at the site, but the owner, Quivira Mining Company, is responsible for remediation. The site is expected to be transferred to DOE in 2015. The area to be transferred is expected to include approximately 810 hectares (2,000 acres). Once the site is transferred to DOE, the only site mission will be the long-term monitoring and maintenance of the disposal cell.

The historic mission of the site was to process uranium ore from the nine mines located adjacent to the site. In 1989, the Rio Algom Mining Company purchased the nine mines from the Quivira Mining Company. The mill was shut down in 1985 due to economic reasons.

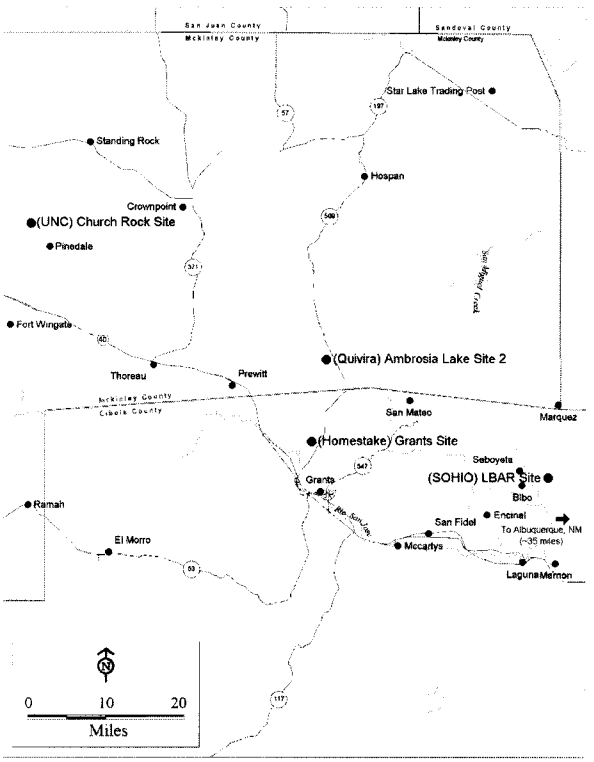
1.2 Site Cleanup and Accomplishments

The Quivira Mining Company is in the process of remediating the site and disposing the estimated 30.1 million metric tons (33.2 million tons) of contaminated uranium mill tailings and other material in its 142-hectare (350-

[1]The report is developed in response to a Congressional request in the Fiscal Year (FY) 2000 National Defense Authorization Act (NDAA). As requested by the Act, this report addresses current and anticipated long-term stewardship activities at each site or portion of a site by the end of calendar year 2006 ("Conference Report on S.1059, National Defense Authorization Act for Fiscal Year 2000," *Congressional Record,* August 5, 1999).

Based on current planing, the (Quivira) Ambrosia Lake Site 2 is not expected to be transferred to the U.S. Department of Energy (DOE) for long-term stewardship until 2015, and for this reason the site is not the primary focus of this report. This brief summary of the site cleanup activities is provided for background information and potential future long-term stewardship activities. (See Section 3.2 of Volume I).

acre) disposal cell. The groundwater is contaminated by radionuclides, including radium and uranium. The Quivira Mining Company is conducting active groundwater remediation. Alternate concentration limits (ACLs), cleanup standards based on site-specific considerations, for uranium have been proposed to the U.S. Nuclear Regulatory Commission (NRC), the site regulator. For the ACLs to be approved, evidence must be provided that the ACLs will not adversely impact human health or the environment. Remediation must be complete before the site can be transferred to DOE to perform long-term stewardship activities. Transfer of the site is expected to occur in 2015.



(Quivira) Ambrosia Lake Site 2

2.0 POTENTIAL LONG-TERM STEWARDSHIP ACTIVITIES

The potential long-term stewardship activities will predominantly involve groundwater monitoring, monitoring and maintenance of the disposal cell, and implementing institutional controls.

3.0 EXPECTED FUTURE USES AND SITE RESPONSIBILITY

Quivira Mining Corporation is responsible for all activities that take place at the (Quivira) Ambrosia Lake Site 2. Once the site's license is transferred to DOE to perform long-term stewardship activities in 2015, activity at the site is expected to be restricted to long-term monitoring and maintenance of the disposal cell and, possibly, groundwater monitoring.

Upon transfer, the DOE Grand Junction Office will be responsible for long-term stewardship activities at the site. When remediation activities are completed, the site's onsite disposal cell will contain approximately 30.1 million

metric tons (33.2 million tons) of uranium mill tailings and contaminated material. The disposal cell will have a low-permeability radon barrier and a rock surface layer for erosion control. Erosion control will be provided for all potentially vulnerable features, and the site will be graded to provide positive drainage. Disturbed areas will be revegetated. This disposal cell will be similar to other uranium mill tailings disposal cells and will need similar long-term stewardship activities.

Anticipated site-wide long-term stewardship activities include restricting access by fencing and posting warning signs along the site boundaries. DOE will repair the fence and replace signs, as necessary. DOE will staff a 24-hour phone line for reporting any site concerns. Drilling and other intrusive activities within site boundaries will be prevented through institutional controls.

Groundwater at the site is known to be contaminated as a result of the site's historical uranium processing activities. The extent of groundwater contamination that will be present at the time of site transfer cannot be reasonably estimated at this time, but future remediation by DOE is not required. DOE assumes that groundwater monitoring will be required on a periodic basis to demonstrate compliance with the ACLs. The precise monitoring requirements will be prescribed in the site-specific long-term surveillance plan that will be developed and approved by NRC at the time of site transfer.

Site records will be kept in permanent storage at the DOE Grand Junction Office in Colorado. The types of records maintained include site characterization data, remedial action design information, the site completion report, long-term monitoring plans, annual inspection reports, and current and historic monitoring data.

For more information about the (Quivira) Ambrosia Lake Site 2, please contact:

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Maintenance Program Manager
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Phone: 970-248-6037
or visit the Internet website at http://www.doegjpo.com

Richard Turtil, Project Manager
Uranium Recovery and Low-Level Waste Branch
U.S. Nuclear Regulatory Commission
Mail Stop T7J8
Washington, DC 20555-001
Phone: 301-415-6721
or visit the Internet website at http://www.nrc.gov

SANDIA NATIONAL LABORATORIES-NEW MEXICO

1.0 SITE SUMMARY

1.1 Site Description and Mission

The Sandia National Laboratories-New Mexico is a multi-program national laboratory with research and development programs in a broad range of scientific and technical fields. It is located in Bernalillo County, New Mexico, 10.4 kilometers (6.5 miles) east of downtown Albuquerque. The laboratory consists of five technical areas and several remote areas covering 1,130 hectares (2,820 acres) in the eastern half of the 307-square kilometer (118-square miles) Kirtland Air Force Base (KAFB). The base is situated on two broad mesas bisected by the Tijeras Arroyo and is bound by the Manzano Mountains to the east and the Rio Grande to the west.

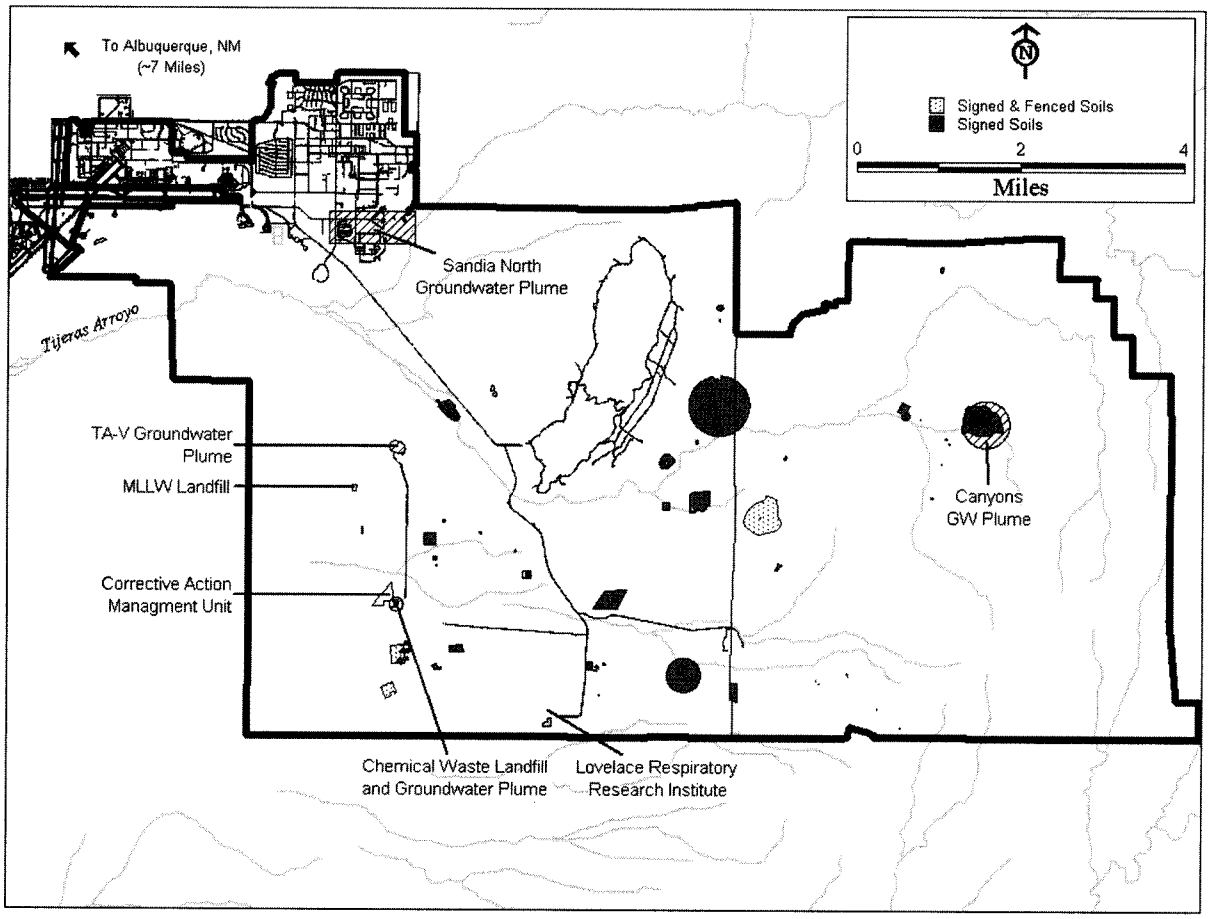
LONG-TERM STEWARDSHIP HIGHLIGHTS

Major Long-Term Stewardship Activities - groundwater monitoring; vadose zone monitoring; disposal cell maintenance and monitoring
Total Site Area - 1,130 hectares (2,820 acres)
Estimated Volume of Residual Contaminants - unknown
Portions Requiring Long-Term Stewardship as of 2006 - 5
Average Annual Long-Term Stewardship Cost FY 2000-2006 - $900,000
Landlord - U.S. Department of Energy, Office of Defense Programs

As part of the U.S. Department of Energy's (DOE) national laboratory complex, the Sandia National Laboratories was established in the 1940s as part of the Manhattan Project, which produced the first nuclear weapons. In 1949, American Telephone & Telegraph (AT&T) Corporation took over the management of the laboratory. AT&T managed Sandia for 44 years. Today, Sandia-New Mexico managed by the Lockheed Martin Corporation for the Department of Energy. Sandia-New Mexico has evolved into one of the country's largest technical resources.

The original mission of Sandia National Laboratories -- providing engineering design for all non-nuclear components of the nation's nuclear weapons -- continues today, but Sandia-New Mexico now also performs a wide variety of national security R&D work. Mission changes have resulted in a decline in weapons research and development and an increase in work on nuclear safeguards and security, environmental sciences, biomedical systems engineering, advanced manufacturing technology, electronics, information and computational technology, transportation infrastructure and energy technology, and technology transfer to private industry in support of U.S. industrial competitiveness. New activities include the Medical Isotope Production Program and the Neutron Generator Production Facility. DOE's Office of Defense Programs is the landlord of Sandia National Laboratories-New Mexico (also referred to as Sandia-New Mexico) and is expected to continue to use the property in support of its ongoing missions.

DOE estimates that all identified environmental restoration sites at Sandia-New Mexico will have been remediated, and associated waste from the Chemical Waste Landfill will be disposed of in a Corrective Action Management Unit (CAMU) disposal cell or at an offsite location by 2005. Wastes from other areas will be disposed of offsite. Much of the site is expected to be available for industrial use with safeguards and security remaining in place. Some risk-based future land use designations may include recreational use, although there will be controlled access for some parcels of land, such as the landfills and CAMU. Disposal of all historical waste, waste generated within permit regulatory limits, and closure or planned closure of excess waste management facilities will be completed. The waste management mission is operated under the Office of Defense Programs.



Sandia National Laboratories - New Mexico

1.2 Site Cleanup and Accomplishments

Sandia-New Mexico contains about 200 solid waste management units, covering 293 hectares (724 acres). The 200 units include: landfills, large surface spill sites, explosive test sites, burn sites, and small surface spill sites. Contaminated soils will be remediated using excavation, followed by recontouring and revegetation. The site will dispose of waste generated by environmental restoration activities either offsite or onsite in a CAMU disposal cell, which became operational in 1998. It is anticipated that a chemical waste landfill, a mixed waste landfill, and a CAMU disposal cell, (encompassing approximately 3-4 hectares (7-10 acres)) will remain onsite. The disposal cell will contain volatile organic and metal waste generated by environmental restoration. Access to these areas will remain restricted. Beginning in 1999, waste

SITE CLEANUP ACCOMPLISHMENTS

- Submitted documentation to State Regulator for completion of 175 release sites recommending No Further Action
- Transferred waste management activities to DOE's Office of Defense Programs
- Completed and operated the Corrective Action Management Unit
- Completed excavations for Gas Cylinder Pit at Site 6, Site 1 Radioactive Waste Landfill, and Site 2 Chemical Waste Landfill

ANTICIPATED SITE CLEANUP ACCOMPLISHMENTS AS OF 2006

- All sites approved by the regulator for no further action by 2006

operations at the Sandia National Laboratories were transferred to the DOE's Office of Defense Programs, the site's landlord. The transfer was made in order to reduce the overall life-cycle costs of waste operations and to make waste generators financially responsible for the waste produced.

2.0 SITE-WIDE LONG-TERM STEWARDSHIP ACTIVITIES

2.1 Long-Term Stewardship Activities

The Sandia Environmental Restoration (ER) Project is currently responsible for all long-term stewardship activities. DOE expects that all land, except for the onsite disposal facilities, will be released for reuse by the Office of Defense Programs. The disposal facilities will remain under restricted access. The remaining land, which will be used by DOE, will be designated as either industrial or recreational (approximately 774 hectares (1,910 acres) of industrial-use land and 113 hectares (279 acres) of recreational-use land).

The Sandia-New Mexico site is located entirely within KAFB. Because KAFB has an ongoing mission, it is not expected that property transfer from Sandia-New Mexico will be an issue for many years. In the interim, KAFB, by its nature, has security controls, including perimeter fences, controlled access through gates, and security patrols, which provide controls for the Laboratory. In addition to general controls described above, Sandia will apply other controls, such as signs, fencing and deed restrictions to specific parcels of land.

Sandia ER Project records are part of the Sandia Records Management System. The Sandia system includes a dedicated ER records center. It is a state-of-the-art system utilizing optical scanners and sophisticated inventory software. This system manages and controls all records and stores them pursuant to applicable Federal records retention regulations. Records can be retrieved upon receipt of a properly executed request. These records include workplans, No Further Action Proposals, characterization data, maps, and regulatory correspondence/decisions.

2.2 Long-Term Stewardship Technology Development and Deployment

In 1994, with the adoption of fast-track field approaches and other programmatic efficiency measures, DOE concluded that there were very few critical technology needs required to achieve successful ER Project closure. Consequently, the ER Project has relied almost entirely on proven and accepted methods, and existing technologies. Exceptions have occurred, such as a recently developed arid region landfill cap design, which is being planned for deployment at the Chemical and Mixed Waste Landfills and on the CAMU disposal cell. The cap design is being reviewed by the regulatory authority, the New Mexico Environmental Department. The ER Project has and continues to review its technology needs and stays current with new developments. Technology needs include cost-effective monitoring and surveillance techniques and monitored natural attenuation protocols.

> ***STAKEHOLDER INVOLVEMENT***
>
> The local Citizens Advisory Board is quite active and will participate in the development of the long-term stewardship plan through a series of workshops.

2.3 Assumptions and Uncertainties

DOE assumes that groundwater monitoring will need to be performed in perpetuity (estimated in this report through 2070). The volume of contaminated groundwater is only an estimate based on available data and does not reflect a concerted effort to fully define the extent of contamination.

There continue to be uncertainties in:

- the time it will take for groundwater to achieve standards

- future land use
- how long-term stewardship policy could change because of stakeholder input
- funding in the event of a major scope increase
- disposition of active sites and associated funding requirements

2.4 Estimated Site-Wide Long-Term Stewardship Costs

Estimated costs for long-term stewardship activities for the Sandia-New Mexico site are identified in the table below. These costs are driven by groundwater sampling costs. There are also costs associated with well maintenance, staff and management, site inspections, sign and fence maintenance, sample collection and analysis, and cell cover maintenance. While activities and costs are relatively constant, some fluctuation occurs due primarily to well maintenance, destruction, reinstallation costs, and anticipated changes in sampling requirements.

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	***Amount***	***Year(s)***	***Amount***	***Year(s)***	***Amount***
FY2000	$0	**FY2008**	$900,000	**FY2036-2040**	$5,100,000
FY2001	$0	**FY2009**	$1,100,000	**FY2041-2045**	$4,900,000
FY2002	$1,000,000	**FY2010**	$900,000	**FY2046-2050**	$4,600,000
FY2003	$700,000	**FY2011-2015**	$4,900,000	**FY2051-2055**	$5,600,000
FY2004	$900,000	**FY2016-2020**	$4,900,000	**FY2056-2060**	$5,800,000
FY2005	$900,000	**FY2021-2025**	$5,500,000	**FY2061-2065**	$5,200,000
FY2006	$1,000,000	**FY2026-2030**	$5,800,000	**FY2066-2070**	$5,500,000
FY2007	$900,000	**FY2031-2035**	$5,000,000		

3.0 PORTION OVERVIEW

The Sandia-New Mexico Site consists of six portions that will require some long-term stewardship activities as of 2006. For purposes of this report, a "portion" is defined as a geographically contiguous and distinct area (which may involve residually contaminated facilities, engineered units, soil, groundwater, and/or surface water/sediment) for which cleanup, disposal, or stabilization will have been completed and long-term stewardship activities will be required as of 2006.

The remaining sections discuss "portions" of the Sandia-New Mexico Site that will require long-term stewardship activities before 2006.

Long-Term Stewardship Information		
Portion Name	***Long-Term Stewardship Start Year***	***Long-Term Stewardship End Year***
Groundwater Portion	2000	indefinite
Mixed Waste Landfill Portion	2002	indefinite

Long-Term Stewardship Information		
Portion Name	***Long-Term Stewardship Start Year***	***Long-Term Stewardship End Year***
Chemical Waste Landfill Portion	2002	indefinite
CAMU Portion	2002	indefinite
Signed and Fenced Soil Portion	2003	indefinite
Signed Soils Portion	2003	indefinite

3.1 Groundwater Portion

The water table at the Sandia-New Mexico site is typically at 150 meters (500 feet) below the surface. In the foothills and mountainous areas, it may be much closer to the surface. To date, four potential contaminant plumes have been identified: the Chemical Waste Landfill, Technical Area 5, the Canyons Area, and Sandia North. The Chemical Waste Landfill, Technical Area 5, and Sandia North all have trichloroethelene (TCE) contamination, with current concentrations that range from zero to four times the regulatory standard.

GROUNDWATER PORTION HIGHLIGHTS

Major Long-Term Stewardship Activities - groundwater monitoring; institutional and engineered controls
Portion Size - 0.8 hectare (2 acres)
Estimated Volume of Residual Contaminants - groundwater unknown
Long-Term Stewardship Start-End Years - 2000 - indefinite
Average Annual Long-Term Stewardship Costs FY 2000-2006 - $84,100

3.1.1 Groundwater

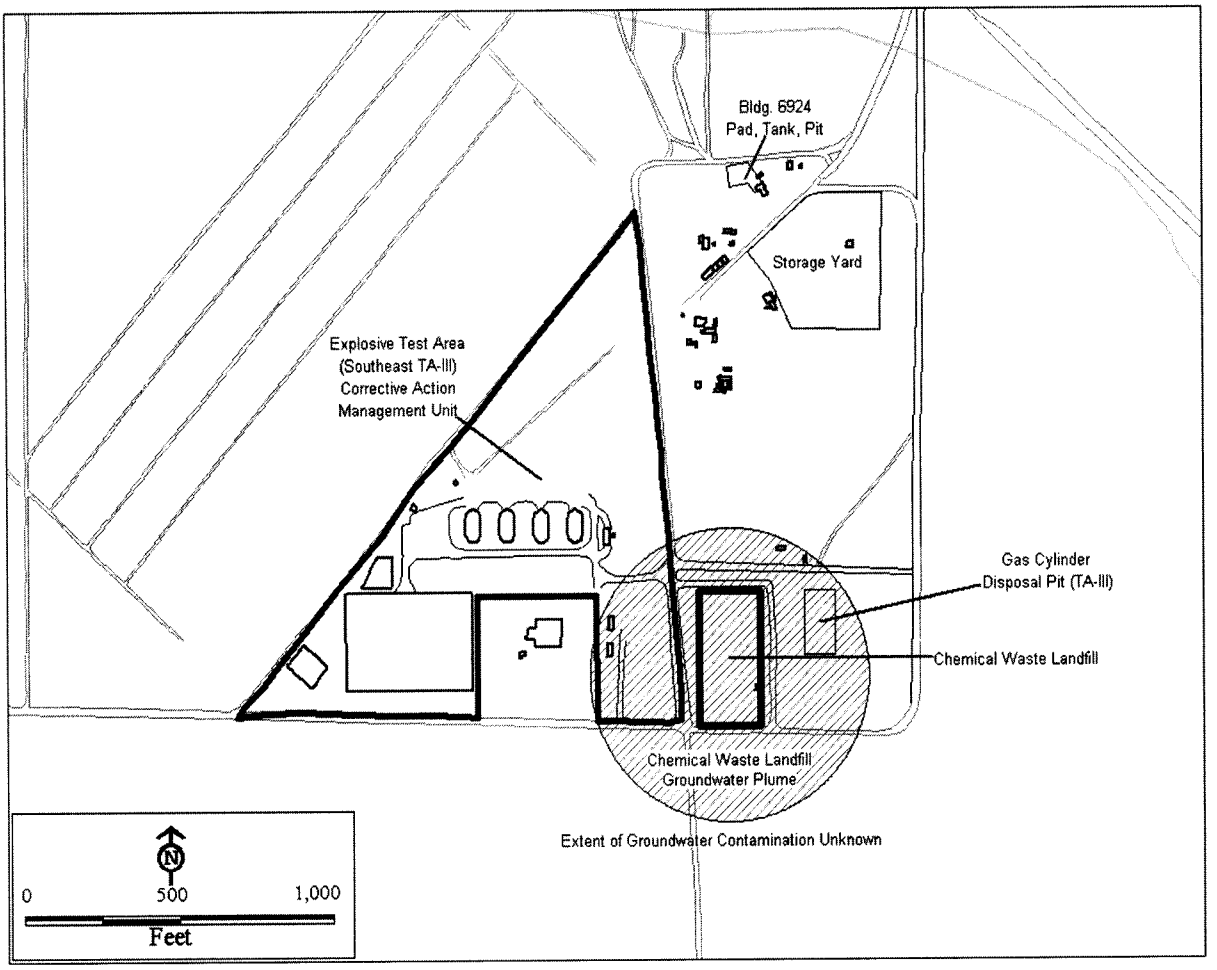
The source of the Chemical Waste Landfill plume is the waste disposed in the landfill itself, including TCE. At the Chemical Waste Landfill, contaminants are being excavated but monitoring will continue. The source of the Technical Area 5 plume is not clearly understood and could have originated from a variety of laboratory sources. A maximum of 23 parts per billion of TCE has been found in a volume of 347,000 cubic meters (453,704 cubic yards) of groundwater. Similarly, the Sandia North plume is not well understood and could have originated from a variety of sources. A maximum of nine parts per billion of TCE has been found in a volume of 1,980,000 cubic meters (2,592,593 cubic yards) of groundwater. For the Canyons area, nitrate is the primary contaminant and has been found at levels two-and-half times the regulatory standard. Twenty-five parts per million of nitrate have been found in an unknown volume of groundwater (because of fractured flow in the Canyons Test Area, it is not possible to estimate a plume size). The Canyons will be included in the "signed" portion.

Negotiations are currently underway with the New Mexico Environment Department to separate 121 hectares (300 acres) of groundwater and surface sites for the purpose of regulatory action and closure. Because the time frame required for remediation of surface sites can be many times shorter than that for groundwater, DOE believes it makes regulatory sense to separate the two issues.

Groundwater Long-Term Stewardship Activities

Because the length of time required for groundwater monitoring cannot be determined, DOE assumes that monitoring would continue until at least 2070, when it is believed the target cleanup levels of five parts per billion for TCE and 10 parts per million for nitrate will be met. Until that time or beyond, if necessary, groundwater restrictions could also be imposed. Land use controls could also be imposed for surface land. The

New Mexico Environment Department may also institute some type of control on the groundwater use in the Southwest. Engineered controls at the well heads of each monitoring well include a set of steel pipes to protect the well. Locking caps also protect the wells against unauthorized intrusion.



Groundwater, Chemical Waste Landfill, Corrective Action Management Unit

3.1.2 Estimated Long-Term Stewardship Costs for Groundwater

The costs for this portion are largely made up of sampling and analysis, and the maintenance, destruction, and reinstallation of monitoring wells. Costs are generally constant, with the exception of increases due to periodic major well maintenance or replacement, and anticipated decreases in sampling and analysis requirements.

Long-Term Stewardship Costs (Constant Year 2000 Dollars)							
FY2000 - FY2010	***FY2011 - FY2020***	***FY2021 - FY2030***	***FY2031 - FY2040***	***FY2041 - FY2050***	***FY2051 - FY2060***	***FY2061 - FY2070***	***Estimated Total***
$1,700,000	$2,400,000	$3,800,000	$2,700,000	$2,100,000	$4,000,000	$3,200,000	$19,900,000

3.2 Mixed Waste Landfill Portion

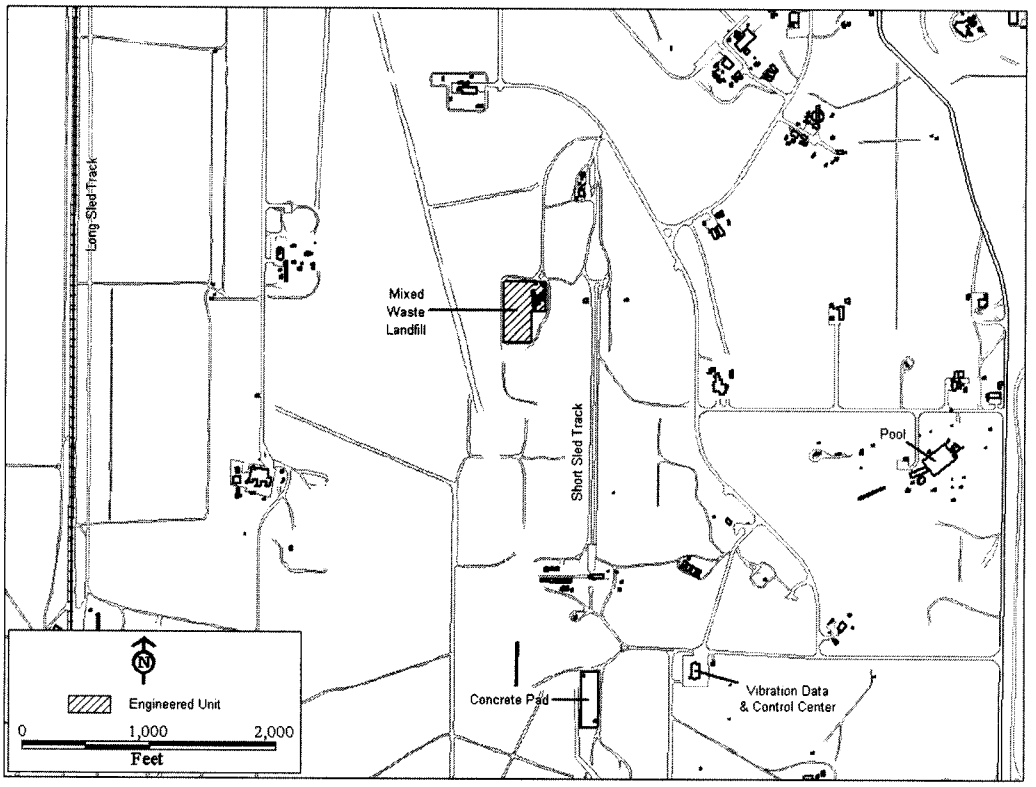
The 1.1-hectare (2.6-acre) Mixed Waste Landfill is located in the southwest part of Sandia-New Mexico, about 210 meters (700 feet) from the KAFB border. It is a discrete unit containing (mixed waste). The proposed remedy is capping in place.

MIXED WASTE LANDFILL PORTION HIGHLIGHTS

Major Long-Term Stewardship Activities - engineered unit monitoring, groundwater monitoring, institutional and engineered controls
Portion Size - 1.1 hectares (2.6 acres)
Estimated Volume of Residual Contaminants - engineered units 2,832 cubic meters (3,704 cubic yards)
Long-Term Stewardship Start-End Years - 2002 - indefinite
Average Annual Long-Term Stewardship Costs FY 2002-2006 - $120,000

3.2.1 Engineered Units

The Mixed Waste Landfill contains an estimated 2,832 cubic meters (3,704 cubic yards) of a variety of metals (lead, beryllium, etc.) and other solid materials contaminated with radionuclides, such as tritium and depleted uranium, lead shielding, shipping casks, construction and demolition materials. The radionuclides vary from short-lived (e.g., tritium and cobalt-60) to long-lived (e.g., depleted uranium). Unlike the Chemical Waste Landfill, the mixed waste in this cell is not proposed to be excavated because of worker safety issues and the lack of appropriate places to dispose of some of the waste if it were extracted. The landfill is expected to be covered with an alternative landfill cover (i.e., not a standard *Resource Conservation and Recovery Act* cover) constructed with local soils and vegetation.



Mixed Waste Landfill

Engineered Units Long-Term Stewardship Activities

The proposed remedy for this site includes an engineered landfill cover and a special monitoring system. Because of the nature of these contaminants and the public concern surrounding the landfill, there will undoubtedly be some type of land use restrictions or other constraints on any potential use of the land. There will also be signs and fences, a security plan, and a series of periodic inspections. Additionally, the site is secured by the security system inherent with KAFB (locked gates, fences, guards, etc.) and a series of site inspections. The frequency of the inspections has not yet been negotiated with the regulators.

The amount of time required for long-term stewardship activities cannot be determined at this time because the short-lived radionuclides of concern in the landfill, such as tritium, will have decayed to an insignificant activity level in the next 40-50 years, but the long-lived radionuclides, such as depleted uranium, will essentially exist in perpetuity. The ultimate long-term stewardship requirements will include inputs from local citizens.

3.2.2 Estimated Long-Term Stewardship Costs for Mixed Waste Landfill

In general, the costs for the Mixed Waste Landfill are associated with the sampling and analysis of the monitoring wells and the vadose monitoring system. The cost estimates include additional amounts for well maintenance, extension, destruction or installation every five years.

Long-Term Stewardship Costs (Constant Year 2000 Dollars)							
FY2000 - FY2010	***FY2011 - FY2020***	***FY2021 - FY2030***	***FY2031 - FY2040***	***FY2041 - FY2050***	***FY2051 - FY2060***	***FY2061 - FY2070***	***Estimated Total***
$1,100,000	$1,100,000	$1,100,000	$1,200,000	$1,200,000	$1,200,000	$1,200,000	$8,100,000

3.3 Chemical Waste Landfill Portion[1]

The 0.8 hectare (1.9-acre) Chemical Waste Landfill is 3.2 kilometers (two miles) south of the Mixed Waste landfill and is a discrete unit with a containing chemical hazardous waste, with a slight amount of low-level radioactive waste. The expected remedy is excavation, onsite disposal, and capping.

CHEMICAL WASTE LANDFILL PORTION HIGHLIGHTS

Major Long-Term Stewardship Activities - engineered unit monitoring; groundwater monitoring; institutional and engineered controls
Portion Size - 0.8 hectare (1.9 acres)
Estimated Volume of Residual Contaminants - engineered units 31,000 cubic meters (40,000 cubic yards)
Long-Term Stewardship Start-End Years - 2002-indefinite
Average Annual Long-Term Stewardship Costs FY 2002-2006 - $240,000

3.3.1 Engineered Unit

The Chemical Waste Landfill contains 31,000 cubic meters (40,000 cubic yards) of a wide variety of hazardous wastes, both liquid and solid, along with low-level radioactive waste (typically tritium) and high explosives (exploded and unexploded). Tritium concentrations are so low that the tritium-containing soil has been approved for placement in CAMU by the regulators.

[1] Map is shown on page 60.

Engineered Unit Long-Term Stewardship Activities

Following excavation, an engineered cap consisting of local soils and vegetation will be put in place. In conjunction with the cap, a sophisticated monitoring system, including vadose zone and groundwater monitoring, will be put into operation. There will be land use controls or other methods to constrain the land for industrial use only. Signs and fences will delineate the perimeter of the site to prevent intrusion. Because the length of time that long-term stewardship activities will be required cannot be determined, DOE assumes the long-term stewardship activities could last until at least 2070.

3.3.2 Estimated Long-Term Stewardship Costs for the Chemical Waste Landfill

In general, the costs for the Chemical Waste Landfill are associated with the sampling and analysis of the monitoring wells. Costs for Fiscal Year (FY) 2002 include baseline analyses costs; following that year, costs remain fairly constant.

Long-Term Stewardship Costs (Constant Year 2000 Dollars)							
FY2000 - FY2010	***FY2011 - FY2020***	***FY2021 - FY2030***	***FY2031 - FY2040***	***FY2041 - FY2050***	***FY2051 - FY2060***	***FY2061 - FY2070***	***Estimated Total***
$2,000,000	$2,200,000	$2,200,000	$2,200,000	$2,200,000	$2,200,000	$2,200,000	$15,200,000

3.4 Corrective Action Management Unit (CAMU) Portion[1]

The 7.3-hectare (18-acre) CAMU is a discrete unit adjacent to the Chemical Waste Landfill, constructed to process and contain waste primarily from the Chemical Waste Landfill. It is the first permitted CAMU in the DOE complex.

CORRECTIVE ACTION MANAGEMENT UNIT PORTION HIGHLIGHTS

Major Long-Term Stewardship Activities - engineered unit monitoring; groundwater monitoring; institutional and engineered controls
Portion Size - 7.3 hectares (18 acres)
Estimated Volume of Residual Contaminants - engineered units 31,000 cubic meters (40,000 cubic yards) when closed
Long-Term Stewardship Start-End Years - 2002-indefinite
Average Annual Long-Term Stewardship Costs FY 2002-2006 - $240,000

3.4.1 Engineered Unit

The disposal cell of the CAMU will have an engineered cap and sophisticated vadose zone monitoring system to detect cell failure, if it occurs. Currently, the CAMU consists of a Bulk Waste Staging Area to contain contaminated soil before it is treated, a Temporary Unit to store contained liquid waste and debris, two treatment pads, and a containment cell. Waste accepted into the CAMU consists of volatile organic contaminants (VOCs) and metal-contaminated soil. Prior to acceptance into the CAMU containment cell, soils will be treated by thermal desorption (for VOCs) and soil washing (for metals) to reduce contamination to regulatory limits. Soils containing very small amounts of tritium will also be contained in the CAMU. Once all soil has been treated and placed in the CAMU containment cell, the bulk waste staging area, temporary units, and treatment pads will be removed, leaving only the covered containment cell. The containment cell has a capacity of 31,000 cubic meters (40,000 cubic yards). It is roughly 61x91x5 meters (200x300x17 feet).

[1] Map is shown on page 60.

Engineered Unit Long-Term Stewardship Activities

This site will require some type of land use restriction or other control to ensure the land is available only for industrial use. It will also require a variety of signs and fences. The length of time that long-term stewardship activities will be required cannot be determined. Therefore, it was assumed that activities could last until at least 2070.

3.4.2 Estimated Long-Term Stewardship Costs for the Corrective Action Management Unit

After the FY2002 costs, which contain baseline analyses, the annual costs of the CAMU are relatively constant and are made up primarily of sampling and analysis.

Long-Term Stewardship Costs (Constant Year 2000 Dollars)							
FY2000 - FY2010	***FY2011 - FY2020***	***FY2021 - FY2030***	***FY2031 - FY2040***	***FY2041 - FY2050***	***FY2051 - FY2060***	***FY2061 - FY2070***	***Estimated Total***
$2,000,000	$2,200,000	$2,200,000	$2,200,000	$2,200,000	$2,200,000	$2,200,000	$15,200,000

3.5 Signed and Fenced Soils Portions[2]

There are about 200 solid waste management units on more than 53 hectares (132 acres) at Sandia-New Mexico. Of these, it is currently estimated that 15 units will be left with residual contamination and will require signs and fences for safety reasons. These 15 sites are located at various places throughout Sandia-New Mexico. Twelve of the remaining sites are mine shafts and three are firing sites.

SIGNED AND FENCED SOILS PORTION HIGHLIGHTS

Major Long-Term Stewardship Activities - institutional controls
Portion Size - more than 53 hectares (132 acres)
Estimated Volume of Residual Contaminants - soil not determined
Long-Term Stewardship Start-End Years - 2003-indefinite
Average Annual Long-Term Stewardship Costs FY 2003-2006 - $4,000

3.5.1 Soil

The areal extent of contamination at each site is well known due to extensive characterization efforts. The volume of each site is not determined or used in remediation or risk assessment efforts. Risk assessment is a function of Contaminants of Concern (COC), areal extent, and pathways and is not related to volume. Sites in this category were remediated but were not cleaned up to background levels. Risk assessments were performed and residual contamination was found to be at levels that required both signing and fencing. Many of the sites that are fenced are former mines that have general safety concerns as opposed to contaminant risk concerns.

Soil Long-Term Stewardship Activities

Each site to be signed and fenced will have extensive characterization data which will include the COC and their concentrations. COC may include metals, organics and radionuclides. The COC may be numerous and could vary widely from site to site.

The length of time long-term stewardship activities will be required cannot be determined. These sites require

[2]Map is shown on page 56.

fencing primarily for safety reasons. The ultimate determination on the length of time for long-term stewardship activities will be determined by the regulators and local citizenry. DOE anticipates that long-term stewardship activities could be required until at least 2070.

3.5.2 Estimated Long-Term Stewardship Costs for Signed and Fenced Soil

Costs are associated with routine inspections of the sites, a small amount of repair work, and maintaining appropriate institutional controls.

Long-Term Stewardship Costs (Constant Year 2000 Dollars)							
FY2000 - FY2010	***FY2011 - FY2020***	***FY2021 - FY2030***	***FY2031 - FY2040***	***FY2041 - FY2050***	***FY2051 - FY2060***	***FY2061 - FY2070***	***Estimated Total***
$26,000	$30,000	$30,000	$30,000	$30,000	$30,000	$30,000	$206,000

3.6 Signed Soils Portion[3]

There are about 200 solid waste management units covering 293 hectares (724 acres) at Sandia-New Mexico. It is currently estimated that about 84 units will be left with residual contamination that will require signage as part of their long term stewardship. The 200 units include: landfills, large surface spill sites, explosive test sites, burn sites, and small surface spill sites.

SIGNED SOILS PORTION HIGHLIGHTS

Major Long-Term Stewardship Activities - institutional controls
Portion Size - 293 hectares (724 acres)
Estimated Volume of Residual Contaminants - soil not determined
Long-Term Stewardship Start-End Years - 2003-indefinite
Average Annual Long-Term Stewardship Costs FY 2003-2006 - $4000

3.6.1 Soil

The areal extent of contamination at each site is well known due to extensive characterization efforts. The volume of each site is not determined or used in remediation or risk assessment efforts. Sites in this category were remediated but were not cleaned up to background levels. Risk assessments were performed and residual contamination was found to be at levels that required only signage. Fences are not required because there are no acute safety concerns.

Soil Long-Term Stewardship Activities

Each site to be signed will have extensive characterization data which will include the COC and their concentrations. COC may include metals, organics and radionuclides. The COC may be numerous and could vary widely from site to site. There may be some level of constraint on the use of this land. This may involve some type of land use restriction or other vehicle. The length of time that long-term stewardship activities will be performed is not known at this time. The ultimate decision will be made by the regulators and the local citizenry. DOE anticipates that long-term stewardship activities may be required until at least 2070.

3.6.2 Estimated Long-Term Stewardship Costs for Signed Soils

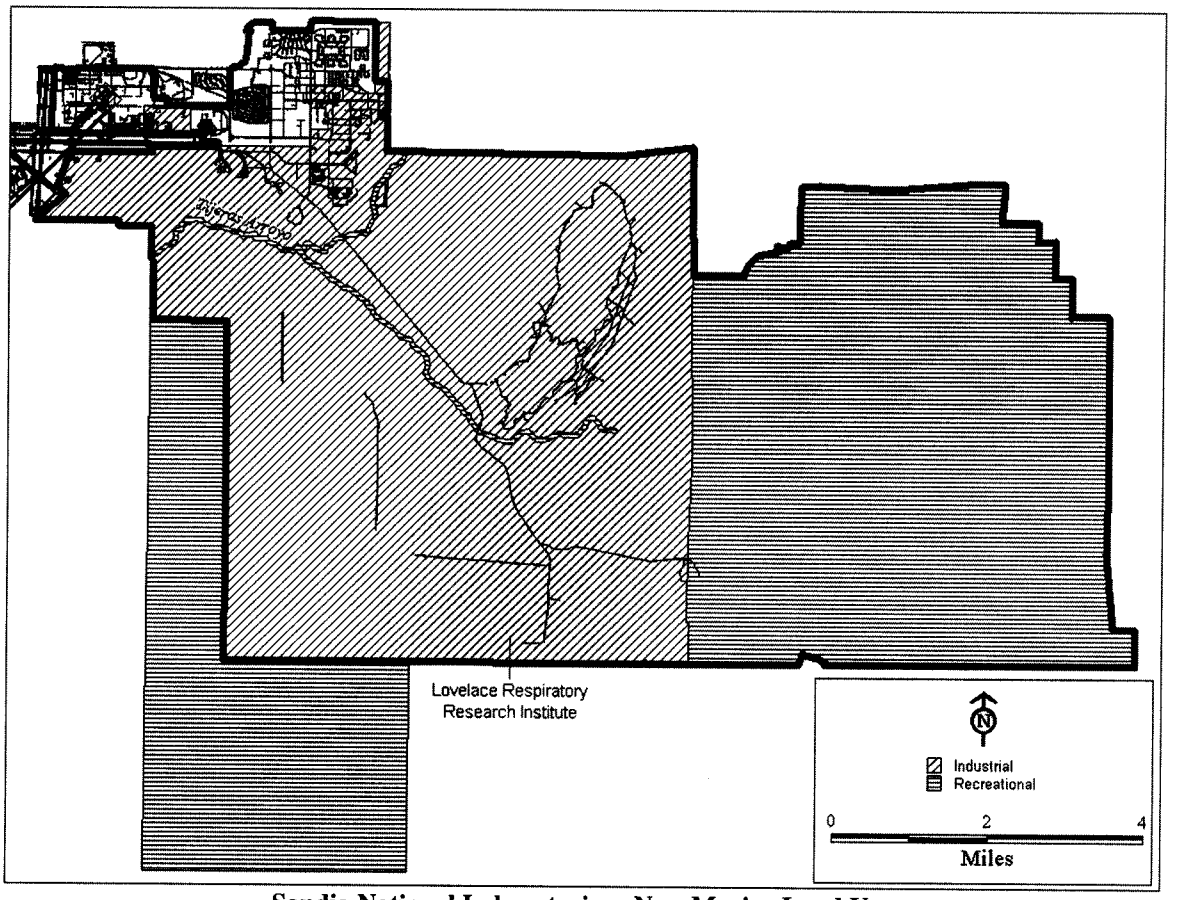
Costs associated with these sites are related to routine inspections and a small amount of maintenance.

[3]Map is shown on page 56.

Long-Term Stewardship Costs (Constant Year 2000 Dollars)							
FY2000 - FY2010	*FY2011 - FY2020*	*FY2021 - FY2030*	*FY2031 - FY2040*	*FY2041 - FY2050*	*FY2051 - FY2060*	*FY2061 - FY2070*	*Estimated Total*
$26,000	$30,000	$30,000	$30,000	$30,000	$30,000	$30,000	$206,000

4.0 FUTURE USE

DOE assumes that the Sandia-New Mexico mission will continue into the foreseeable future, and current institutional controls will remain in place. Therefore, the Future Land-Use Working Group, in collaboration with all major stakeholders including the U.S. Air Force, U.S. Forest Service, regulatory authorities, and the Citizens Advisory Board, has proposed future land use designations for Sandia to be Industrial for high density building/worker areas, and Recreational for more remote areas. These designations are being used to establish risk-based cleanup standards and do not necessarily reflect actual current usage. For example, recreational use does not mean the land is presently available to the public. It means that it could reasonably be made available for such use in the future. If land uses are significantly changed, it may be necessary for the Federal Government to include land use controls restrictions for certain sites if they do not meet acceptable risk-based standards for the proposed use(s).



Sandia National Laboratories - New Mexico Land Use

For more information about the Sandia National Laboratories - New Mexico, please contact:

John Cormier, Stewardship Project Manager
U.S. Department of Energy, Kirtland Area Office
P.O. Box 5800
Albuquerque, NM 87185
Phone: (505) 845-5956
or visit the Internet website at http://www.sandia.gov

SHIPROCK SITE

1.0 SITE SUMMARY

1.1 Site Description and Mission

The Shiprock Site is the location of the former Shiprock uranium milling site, which operated from 1954 to 1968. The site now contains a disposal cell for the uranium mill tailings and other contaminated materials produced from mill operations. The site is located on a 42-hectare (105-acre) tract of Navajo Nation land, south of the San Juan River and approximately two kilometers (one mile) south of the town of Shiprock in San Juan County, New Mexico.

LONG-TERM STEWARDSHIP HIGHLIGHTS

Major Long-Term Stewardship Activities - disposal cell monitoring; institutional control enforcement; access restrictions; groundwater monitoring
Total Site Area - 42 hectares (105 acres)
Estimated Volume of Residual Contaminants - disposal cell 2.1 million cubic meters (2.8 million cubic yards); groundwater 1 million cubic meters (1.2 million cubic yards)
Long-Term Stewardship Start-End Years - groundwater - 2012-in perpetuity, engineered unit - 1996-in perpetuity
Average Annual Long-Term Stewardship Cost FY 2000-2006 - $121,000
Landlord - U.S. Department of Energy, Grand Junction Office

As a result of past milling operations, contamination at the site consisted of uranium mill tailings; radium, thorium, and uranium in soils; and construction debris. Initially, two piles of tailings covered approximately 30 hectares (70 acres). The former raffinate pond area, which was used to contain spent liquids from the milling process, and a few buildings were located to the west of the piles. The U.S. Department of Energy (DOE) completed surface remediation activities at the site in November 1986. Remediation included construction of an onsite disposal cell. The 31-hectare (77-acre) disposal cell has a rock-covered top and side slopes designed to shed precipitation. Groundwater beneath the site remains contaminated from past processing activities.

The current mission of the Shiprock Site is performing long-term stewardship activities, including monitoring and maintaining the disposal cell and groundwater remediation. The site is governed by Title I of the *Uranium Mill Tailings Radiation Control Act of 1978* (UMTRCA). As such, although the land is owned by the Navajo Nation, DOE is responsible for remediation and performing long-term stewardship activities at the site.

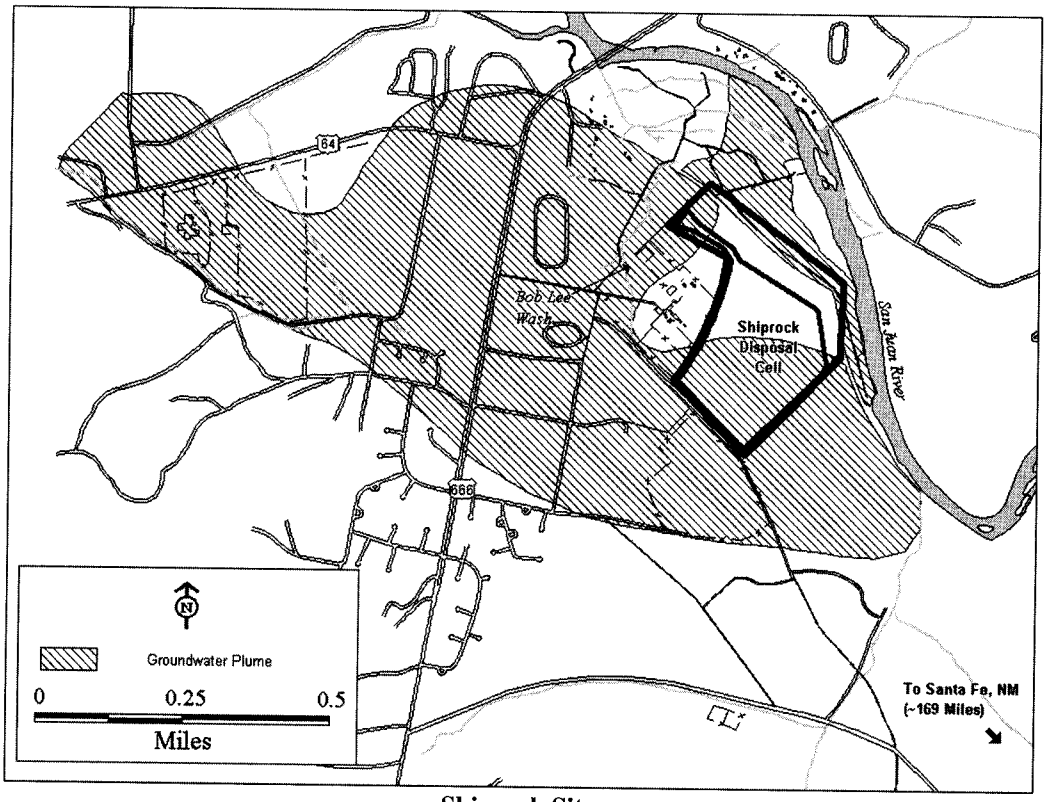
The historic mission of the site was to provide uranium for the U.S. Government national defense program. Kerr-McGee built the mill at the Shiprock Site in 1954 and operated it until 1963. Vanadium Corporation of America then purchased the mill and operated it until 1968. Before and during the milling operations, the site was leased from the Navajo Nation. When the lease expired in 1973, full control of the site reverted to the Navajo Nation. In 1983, DOE and the Navajo Nation entered into an agreement for site cleanup.

1.2 Site Cleanup and Accomplishments

The milling operations at the Shiprock Site caused both surface and subsurface (i.e., groundwater) contamination. Residual uranium mill tailings, which typically contain toxic heavy metals, and radioactive thorium and radium, were the source of the contamination. Because these tailings were generally piled without covers or containers, they were easily spread by wind and water, resulting in both soil and groundwater contamination.

Approximately 2.1 million cubic meters (2.8 million cubic yards) of contaminated materials were disposed in a 31-hectare (77-acre) engineered disposal cell. The disposal cell was covered with a radon barrier and a rock erosion protection layer to meet U.S. Environmental Protection Agency (EPA) standards for longevity, radon

control, and groundwater protection. In accordance with EPA standards, the cover is designed to remain effective for 200 to 1,000 years. After completing surface remedial actions at the site in 1986, DOE received concurrence in May 1991 from the U.S. Nuclear Regulatory Commission (NRC) that the site conformed to cleanup standards (Title 40 of the *Code of Federal Regulations,* Part 192).



Shiprock Site

Approximately 1 million cubic meters (1.2 million cubic yards) of groundwater are contaminated with materials from processing ores to recover vanadium and uranium. Specifically, the identified contaminants of concern include cadmium, net gross alpha, nitrate, radium, selenium, and uranium. The groundwater plume is approximately 50 hectares (130 acres) and extends offsite. Groundwater characterization activities are in progress, so no remediation strategy has yet been implemented. DOE is proposing to use a combination of active remediation and natural flushing to remediate contaminated groundwater. DOE expects that the floodplain aquifer should flush clean within 75 years, after which monitoring will continue in perpetuity.

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

In September 1996, the long-term care of the disposal site was assigned to DOE's Grand Junction Office. Under the provisions of the site-specific long-term surveillance plan, DOE conducts annual inspections of the site to evaluate the condition of surface features, performs site maintenance, as necessary, maintains institutional controls, and monitors the disposal cell. Annual inspections of the disposal site are conducted to detect progressive change caused by slow-acting natural processes and to identify potential problems before extensive maintenance, repairs, or corrective actions are needed. DOE does not plan to conduct significant maintenance

at the Shiprock Site. However, DOE will perform custodial maintenance or repair, as needed or determined from site inspections.

The permanent surveillance features at the Shiprock Site include survey and boundary monuments, erosion control markers, site markers, and entrance and perimeter signs. In addition, DOE staffs a 24-hour phone line for reporting any site concerns. The Navajo Nation has provided DOE a perpetual right of access to the site. The locked security fence, which is maintained by DOE, prevents unauthorized access to the property. No drilling or other intrusive activities are allowed within the property unless authorized by DOE.

DOE maintains and updates the specific records and reports required to document the long-term stewardship activities at the Shiprock Site. DOE submits an annual report to the NRC that documents the results of the long-term surveillance plan, as required by NRC regulations in Title 10 of the *Code of Federal Regulations*, Part 40, Appendix A, Criterion 12. Site records are kept in permanent storage at the DOE Grand Junction Office in Colorado, and real property records are retained at the DOE Albuquerque Office in New Mexico. The types of records maintained include site characterization data, remedial action design information, the site completion report, long-term monitoring plans, annual inspection reports, and current and historic monitoring data.

2.2 Specific Long-Term Stewardship Activities

Engineered Units

The site contains one disposal cell, which requires long-term surveillance and maintenance to ensure continued protection of human health and the environment. Long-term stewardship activities for the disposal cell include annual inspections, vegetation control through herbicide application, fence repairs, and sign replacements, as needed. The long-term stewardship activities at the disposal cell started in 1996 and is expected to last in perpetuity.

Groundwater

Long-term stewardship activities for the groundwater are anticipated to begin in 2012, after remediation is complete. DOE expects that groundwater monitoring will be required in perpetuity to ensure continued compliance with remediation standards and to demonstrate the integrity of the disposal cell.

STAKEHOLDER INVOLVEMENT

Since the surface remedial action was completed, community interaction has been extensive. Frequent meetings with various agencies of the Navajo Nation and their representatives have been held. Copies of the annual inspection report for the Shiprock Site and other sites are distributed to the local library and to stakeholders that request them. The report is also published on the DOE Grand Junction Office website at www.doegjpo.com.

2.3 Regulatory Regime

In 1996, NRC issued a general license to the Shiprock Site for custody and long-term care of residual radioactive disposal sites (contained at Title 10 of the *Code of Federal Regulations,* Section 40.27). The purpose of the general license is to ensure that such sites will be cared for in a manner that protects human health and safety and the environment. The general license went into effect when NRC concurred that the site conformed to cleanup standards and formally accepted the site-specific long-term surveillance plan.

Several other regulations govern long-term stewardship activities at the Shiprock Site, including the *Uranium Mill Tailings Radiation Control Act of 1978*; the *Atomic Energy Act of 1954,* as amended; EPA Groundwater Protection Standards, including Subparts A, B, and C of Title 40 of the *Code of Federal Regulations,* Part 192 - *Standards for Cleanup of Land and Buildings Contaminated with Residual Radioactive Materials from Inactive*

Uranium Processing Sites; a cooperative agreement between DOE and the State of New Mexico; a cooperative agreement between DOE and the Navajo Nation; and the *National Environmental Policy Act of 1969,* as amended.

2.4 Assumptions and Uncertainties

Because the site has been monitored since 1996, the long-term stewardship activities at the site are well known and are not expected to change dramatically. However, long-term stewardship activities associated with groundwater monitoring may change slightly because remediation has not yet been completed. DOE assumes that groundwater monitoring will continue indefinitely or until cleanup levels are achieved and the cell demonstrates infiltration control. Caps are not expected to need replacement for a minimum of 200 years.

3.0 Estimated Long-Term Stewardship Costs

Estimated long-term stewardship costs for the Shiprock Site are identified in the table below. Cost estimates are based on historical costs incurred while conducting actual surveillance and maintenance activities. Cost estimates reflect the current site agreements and monitoring frequencies. Contingency costs, such as cap replacement, have not been incorporated into the cost estimates. Costs from fiscal years (FY) 2001 through 2006 include prorated costs associated with decommissioning unnecessary monitoring wells at similar sites. The cost increase in FY 2012 is related to the transfer of groundwater from active remediation to long-term surveillance. For purposes of this report, long-term stewardship costs are shown until FY 2070; however, it is anticipated that long-term stewardship activities will be required in perpetuity.

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	***Amount***	***Year(s)***	***Amount***	***Year(s)***	***Amount***
FY 2000	$57,400	**FY 2008**	$39,700	**FY 2036-2040**	$297,000
FY 2001	$144,000	**FY 2009**	$39,600	**FY 2041-2045**	$295,700
FY 2002	$152,500	**FY 2010**	$39,700	**FY 2046-2050**	$297,000
FY 2003	$136,100	**FY 2011-2015**	$2,786,200	**FY 2051-2055**	$295,700
FY 2004	$153,500	**FY 2016-2020**	$268,200	**FY 2056-2060**	$297,000
FY 2005	$101,100	**FY 2021-2025**	$273,400	**FY 2061-2065**	$295,700
FY 2006	$102,800	**FY 2026-2030**	$294,900	**FY 2066-2070**	$297,000
FY 2007	$39,900	**FY 2031-2035**	$295,700		

4.0 Future Uses

Future use of the site will be limited to monitoring and maintaining the disposal cell and monitoring the groundwater in perpetuity. Public access to the disposal site will be restricted indefinitely.

For more information about the Shiprock Site, please contact:

Art Kleinrath, Long-Term Surveillance and Maintenance Program Manager
U.S. Department of Energy, Grand Junction Office
2597 B3/4 Road, Grand Junction, CO 81503
Phone: 970-248-6037
or visit the Internet website at http://www.doegjpo.com

(SOHIO) LBAR SITE

1.0 SITE SUMMARY

1.1 Site Description and Mission

The SOHIO Western Mining Company's (SOHIO) LBAR Site is the location of a former uranium milling site that operated from 1977 to 1981. The site is located in a remote area of Cibola County, New Mexico, east of the town of Cebolleta and north of the Laguna Reservation. Albuquerque resides about 35 miles east of the site. The 162-hectare (400-acre) former mill site is licensed by the U.S. Nuclear Regulatory Commission (NRC) to SOHIO, a subsidiary of Kennecott Energy, and includes a 40-hectare (110-acre) disposal cell. Contamination of the site resulted from previous uranium milling operations that created process-related wastes and uranium mill tailings. Approximately 535,000 cubic meters (700,000 cubic yards) of uranium mill tailings are disposed of in the onsite disposal cell.

LONG-TERM STEWARDSHIP HIGHLIGHTS

Major Long-Term Stewardship Activities - access control; disposal cell monitoring and maintenance; groundwater monitoring
Total Site Area - 162 hectares (400 acres)
Estimated Volume of Residual Contaminants - engineered units 535,000 cubic meters (700,000 cubic yards)
Long-Term Stewardship Start-End Years - 2001-in perpetuity
Average Annual Long-Term Stewardship Cost FY 2000-2006 - $33,657
Landlord - U.S. Department of Energy, Grand Junction Office (beginning 2001)

The current mission at the (SOHIO) LBAR Site is the remediation and disposal of mill tailings and the operation of the site groundwater compliance monitoring program by SOHIO. The former mill site is subject to Title II of the *Uranium Mill Tailings Radiation Control Act of 1978* (UMTRCA). As such the U.S. Department of Energy (DOE) is responsible for any long-term stewardship activities. DOE expects the (SOHIO) LBAR Site to be transferred to DOE in 2001. Once the site is transferred, the only site mission will be the long-term surveillance and maintenance of the disposal cell and groundwater monitoring. The historic mission of the site was the mining and milling of uranium for commercial sale.

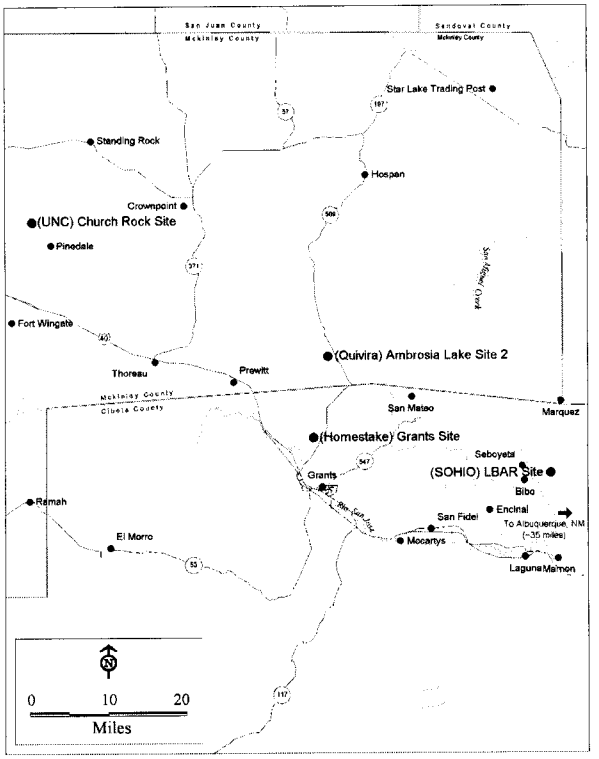
1.2 Site Cleanup and Accomplishments

NRC has approved the reclamation plan for the SOHIO LBAR Site, and SOHIO is conducting reclamation and remediation of the site. Reclamation of the site included construction of a disposal cell and a diversion channel to protect the tailings impoundment from future sedimentation. The cell is designed to control radon emission and prevent erosion, water infiltration, and leaching of the contaminants from the cell. The cover of the cell is designed to remain effective for 200 to 1,000 years in accordance with U.S. Environmental Protection Agency (EPA) regulations.

SOHIO also is conducting groundwater compliance monitoring. In March 1999, NRC approved SOHIO's license amendment request to allow the use of alternate concentration limits (ACLs), cleanup standards based on site-specific considerations. For the alternate concentrations to be approved, evidence must be provided that the ACLs will not adversely impact human health or the environment. NRC determined that allowing the use of ACLs, rather than the EPA's standard maximum concentration limits for contaminated groundwater, will not cause significant health or environmental impacts.

In 1999, all groundwater concentrations monitored onsite, with the exception of uranium and selenium in several wells, met the established groundwater background values for the site. Due to the natural attenuation capability of the formations through which the acidic groundwater plume will move, residual amounts of uranium and

selenium will be reduced to background levels that will not pose any greater health risk than that assigned to the maximum concentration limits for groundwater protection, according to NRC. In addition, groundwater use from the First Tres Hermanos Sandstone and Mancos Shale that underlie the site is unlikely because of the low volume available in these units and the already poor background water quality. Groundwater used in the area is taken from deeper aquifers with better quality water and higher, sustainable well yields. Additional corrective actions will have little effect on dewatering of the tailings or removal of contaminants and, therefore, will have little impact on the groundwater quality.



(SOHIO) LBAR Site

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

Because of the nature of the contaminants present on the site, residual contamination will remain onsite after remediation is complete. Upon transfer of the site to DOE, DOE will be responsible for performing long-term stewardship activities for the groundwater and disposal cell at the (SOHIO) LBAR Site. Site-wide long-term stewardship activities include maintaining and repairing the fence that surrounds the disposal cell to restrict access. Drilling and other intrusive activities on the property are restricted to prevent the inadvertent release of contaminants.

Prior to transfer, DOE will prepare a draft long-term surveillance plan for the (SOHIO) LBAR Site. Approval of the draft plan by NRC is required prior to termination of the license and transfer of the site to DOE. Site records for the site will be maintained in permanent storage at the DOE Grand Junction Office. The types of records to be maintained include the characterization data, remedial action design, completion report, long-term monitoring plan, annual inspection reports, and monitoring data. In addition, DOE will submit an annual report to NRC that summarizes, describes, and evaluates all surveillance and maintenance actions in accordance with the approved long-term surveillance plan and NRC regulations (Title 10 of the *Code of Federal Regulations*, Part 40).

2.2 Specific Long-Term Stewardship Activities

Groundwater

As a result of historic milling operations, groundwater on the site is contaminated by radionuclides, such as radium and uranium. The areal extent of this contamination is defined in corporate documents. Due to the natural attenuation capability of the formations through which the acidic groundwater plume will move,

STAKEHOLDER INVOLVEMENT

When the (SOHIO) LBAR Site comes under a general is license by the NRC and transferred to DOE, copies of the annual site inspection report will be distributed to the local library and any stakeholders requesting them. The report also will be published on the DOE Grand Junction Office website at www.doegjpo.com.

residual amounts of uranium and selenium will be reduced to background levels without active remediation. In addition, groundwater use from the First Tres Hermanos Sandstone and Mancos Shale is unlikely because of the low volume available in these areas and the already poor background water quality. DOE will continue to monitor groundwater to verify natural attenuation, to demonstrate the integrity of the disposal cell in isolating the encapsulated wastes, and to verify compliance with the site's ACLs. Groundwater monitoring will be conducted annually and is expected to continue in perpetuity.

Engineered Units

One 40-hectare (110-acre), unlined, 11e.(2) byproduct material disposal cell is present on the (SOHIO) LBAR Site. DOE estimates the total volume of uranium mill tailings; soil contaminated with uranium, radium, and thorium; and construction debris contained in the cell to be 535,000 cubic meters (700,000 cubic yards), weighing approximately one million tons. Once remediation is complete, the disposal cell will be capped with a soil and rock cap. The cap will require annual inspections to evaluate the condition of surface features. In addition, DOE will be responsible for performing maintenance and vegetation control, as necessary. A fence will surround the cell to restrict access in perpetuity.

2.3 Regulatory Regime

Following NRC concurrence that cleanup standards have been met, the site will be accepted under a general license by NRC for DOE's custody and long-term care of residual radioactive disposal sites (contained at Title 10 of the *Code of Federal Regulations,* Section 40.28). The purpose of the license is to ensure that such sites will be cared for in a manner that protects human health and safety and the environment. The license also means the NRC formally accepts the site-specific long-term surveillance plan.

The long-term stewardship activities at the site will be governed by several other regulations, including the *Uranium Mill Tailings Radiation Control Act of 1978* (UMTRCA); the *Atomic Energy Act of 1954,* as amended; a cooperative agreement between DOE and the State of New Mexico; and the *National Environmental Policy Act of 1969,* as amended.

2.4 Assumptions and Uncertainties

DOE expects the (SOHIO) LBAR Site to be transferred to DOE to perform long-term stewardship activities in 2001. However, the exact date of the transfer depends on the completion of remedial activities being conducted by SOHIO. Cleanup levels will be achieved before the site is transferred to DOE for long-term stewardship activities. Groundwater monitoring will be conducted to verify continued compliance with cleanup levels. Groundwater monitoring may or may not continue indefinitely, depending upon site-specific circumstances and hydrology, and whether or not until the cell demonstrates infiltration control.

3.0 Estimated Long-Term Stewardship Costs

For the site to be transferred to DOE, SOHIO must make a one-time payment to the U.S. Treasury fully funding inspections and anticipated maintenance at the site. Therefore, there will be no additional cost to the U.S. Government for the long-term stewardship of (SOHIO) LBAR Site. Long-term stewardship cost estimates, identified in the table below, are based on the actual cost of long-term stewardship activities at this site and the other disposal cells currently managed by DOE. Costs will primarily be associated with annual groundwater monitoring, monitoring of the cell performance, and institutional controls.

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	***Amount***	***Year(s)***	***Amount***	***Year(s)***	***Amount***
FY 2000	$17,400	**FY 2008**	$35,100	**FY 2036-2040**	$170,500
FY 2001	$41,600	**FY 2009**	$35,000	**FY 2041-2045**	$170,400
FY 2002	$36,100	**FY 2010**	$34,300	**FY 2046-2050**	$170,500
FY 2003	$34,900	**FY 2011-2015**	$163,500	**FY 2051-2055**	$170,400
FY 2004	$35,300	**FY 2016-2020**	$159,200	**FY 2056-2060**	$170,500
FY 2005	$35,500	**FY 2021-2025**	$159,700	**FY 2061-2065**	$170,400
FY 2006	$34,800	**FY 2026-2030**	$168,700	**FY 2066-2070**	$170,500
FY 2007	$35,300	**FY 2031-2035**	$170,400		

4.0 FUTURE USES

The site will be a permanent uranium mill tailings repository. Public access to the disposal cell will be restricted in perpetuity. Cattle grazing will likely be permitted on the site, but not in the area of the disposal cell.

For more information about the (SOHIO) LBAR Site, contact:

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U.S. Department of Energy, Grand Junction Office
2597 B3/4 Road, Grand Junction, CO 81503
Phone: 970-248-6037
or visit the Internet website at http://www.doegjpo.com

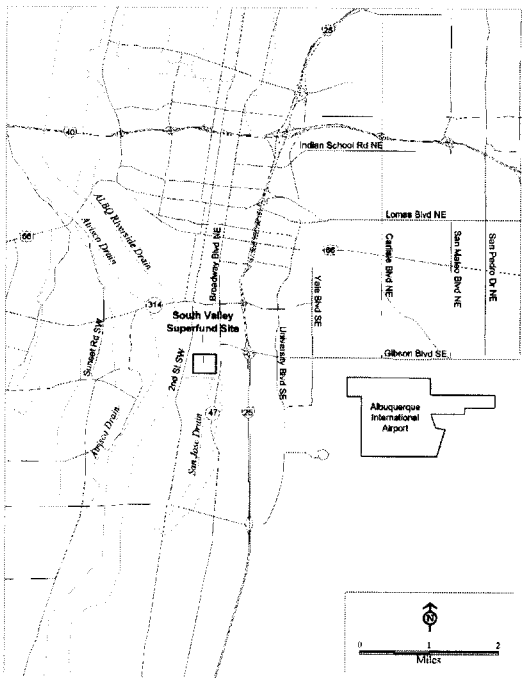
SOUTH VALLEY SUPERFUND SITE

This report is developed in response to a Congressional request in the Fiscal Year (FY) 2000 National Defense Authorization Act (NDAA). As requested by the Act, this report addresses current and anticipated long-term stewardship activities at each site or portion of a site by the end of calendar year 2006 ("Conference Report on S.1059, National Defense Authorization Act for Fiscal Year 2000," *Congressional Record,* August 5, 1999).

SITE HIGHLIGHTS

Total Site Area - 13 hectares (33 acres)
Current Owner - General Electric
Long-Term Stewardship Start Year - 1996
Expected Future Owner - General Electric
Reason Not Subject to NDAA Requirements - DOE is not expected to be responsible for long-term stewardship activities at the site.

While DOE once owned the South Valley Superfund Site located in New Mexico, the site is now owned by General Electric. DOE is not expected to be responsible for long-term stewardship activities at the site. (See Section 2.1.2 of Volume I).



South Valley Superfund Site

For additional information about the South Valley Superfund Site, please contact:

David Bourne, Project Manager
U.S. Department of Energy, Albuquerque Operations Office
Environmental Restoration Division
Box 5400
Albuquerque, NM 87185-5400
Phone: 505-845-4032

(UNC) CHURCH ROCK SITE[1]

1.0 SITE SUMMARY

1.1 Site Description and Mission

> ***LONG-TERM STEWARDSHIP HIGHLIGHTS***
>
> *Total Site Area* - 259 hectares (640 acres) (exact acreage to be transferred to U.S. Department of Energy for long-term stewardship activities is unknown)
> *Current Landlord* - United Nuclear Corporation
> *Expected Long-Term Stewardship Start-End Years* - 2015-in perpetuity
> *Expected Future Landlord* - U.S. Department of Energy, Grand Junction Office
> *Reason Not Subject to NDAA Requirements* - This site is not expected to be transferred to DOE until 2015.

The (UNC) Church Rock Site is the location of a former State-licensed uranium milling site that operated from June 1977 to May 1982. The site will contain a disposal cell for the uranium mill tailings and other process-related waste generated during operations. The site is located in McKinley County, New Mexico, approximately 27 kilometers (17 miles) northeast of Gallup. The site is owned by UNC. The area in the vicinity of the site is sparsely populated, and the land is used for grazing. The closest residence to the site is 2.4 kilometers (1.5 miles) to the north. The border of the Navajo Nation lies one half mile to the north of the Church Rock site. The 259-hectare (640-acre) site includes an ore processing mill on about 10 hectares (25 acres) and an unlined tailings pond on about 40 hectares (100 acres).

Contamination of the site resulted from previous uranium and milling operations. The milling operations created process-related wastes and uranium mill tailings. Approximately 3.5 million tons of uranium mill tailings, including debris from demolished mill structures, are expected to be disposed of in an engineered disposal cell. The site includes a tailings impoundment consisting of a north cell, central cell, and south cell, two lined evaporation ponds comprising 6.9 hectares (17 acres) that are being used for groundwater treatment, a reclaimed borrow pit, and the former mill and buildings area. Each evaporation pond has a capacity of 28,400 cubic meters (37,100 cubic yards). The site is not expected to be transferred to DOE to perform long-term stewardship activities until 2015. The amount of land to be eventually transferred to DOE is unknown at this time.

Currently, there is no DOE mission at this site, which is undergoing active remediation and reclamation. The site is governed by Title II of the *Uranium Mill Tailings Radiation Control Act of 1978* (UMTRCA). As such, DOE is responsible for performing long-term stewardship activities, but the owner (UNC) is responsible for remediation. The historic mission of the site was to process uranium ore.

1.2 Site Cleanup and Accomplishments

In July 1979, approximately 352,000 cubic meters (460,500 cubic yards) of tailings and pond water were released to the Rio Puerco river as a result of a dam breach in the tailings pond area. The site damage was repaired;

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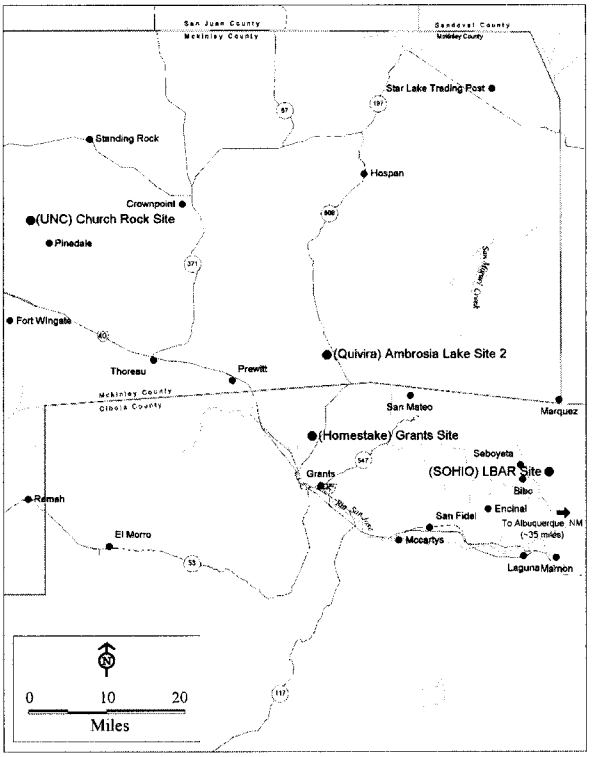
[1]This report is developed in response to a Congressional request in the Fiscal Year (FY) 2000 National Defense Authorization Act (NDAA). As requested by the Act, this report addresses current and anticipated long-term stewardship activities at each site or portion of a site by the end of calendar year 2006 ("Conference Report on S.1059, National Defense Authorization Act for Fiscal Year 2000," *Congressional Record,* August 5, 1999).

Based on current planning, the (UNC) Church Rock Site is not expected to be transferred to the U.S. Department of Energy (DOE) for long-term stewardship until 2015, and for this reason the site is not the primary focus of this report. This brief summary of the site cleanup activities is provided for background information and potential future long-term stewardship activities. (See Section 3.2 of Volume I).

however, attention was focused on groundwater contamination resulting from tailings seepage. Consequently, UNC implemented a groundwater pumping system that withdrew groundwater from the aquifers underlying the site and sent it to an onsite borrow pit for evaporation. UNC also conducted tailings neutralization from late 1979 to early 1982. Offsite migration of radionuclides and chemical constituents from uranium milling byproduct materials on the site into the groundwater, surface water, and air remain a concern. The primary contaminants of concern affecting the groundwater are metals, including arsenic, and radioactive substances, such as radium-226/228 and gross alpha, nitrates, sulfates, and dissolved solids. The (UNC) Church Rock Site was listed on the U.S. Environmental Protection Agency's (EPA) National Priorities List September 8, 1983. Although mill operations were under a State license (as a U.S. Nuclear Regulatory Commission (NRC) "Agreement State"), NRC took over licensing for decommissioning and site remediation because the State of New Mexico elected to terminate its Agreement State status.



(UNC) Church Rock Site

UNC is conducting a groundwater restoration project at the site, which involves extraction and treatment of groundwater by enhanced evaporation in two lined evaporation ponds. Groundwater treatment at the site has been ongoing since 1989, and cleanup of groundwater by extraction and evaporation has been conducted since 1993. EPA has indicated that the groundwater pump-and-treat system is to be re-evaluated after completion of the *Comprehensive Emergency Response, Compensation, and Liability Act* (CERCLA) five-year review of the site.

Site reclamation activities have been completed. UNC completed decommissioning of the mill and placed an interim cover on the mill tailings site in November 1993. The final tailings remediation was completed in 1995, and the final drainage channels were completed in 1996. The radon cap cover for the cell was completed in 1996, with the exception of the groundwater evaporation ponds. Reclamation of the evaporation ponds will not be conducted until the groundwater corrective action plan for the site is deemed by EPA and NRC to be complete. Once approval is granted by EPA and NRC, the evaporation ponds will be dried up and buried onsite.

2.0 POTENTIAL LONG-TERM STEWARDSHIP ACTIVITIES

The potential long-term stewardship activities will predominantly involve groundwater monitoring, monitoring and maintenance of the disposal cell, and implementing institutional controls. Cleanup levels will be achieved before the site is transferred to DOE to perform long-term stewardship activities. Groundwater monitoring will be conducted to verify continued compliance with cleanup levels. Groundwater monitoring may or may not continue indefinitely, based on site specific circumstances and hydrology, or until the cell demonstrates infiltration control.

3.0 EXPECTED FUTURE USE AND SITE RESPONSIBILITY

UNC is conducting remediation and monitoring and maintenance activities at the site. The site is anticipated to be transferred to DOE in 2015, at which time DOE will be responsible for performing long-term stewardship activities. Portions of the site surface (where remediation has already been completed) are currently used for livestock grazing by local residents, including members of the Navajo Nation. DOE is uncertain of how much of the site will ultimately be transferred to DOE for long-term custody. Land use on the acreage that will be transferred to DOE will depend on the cleanup levels that are achieved. However, access to the disposal cell will be restricted in perpetuity.

The final step in the decommissioning process for the (UNC) Church Rock Site will be to obtain regulatory approval from EPA and NRC for groundwater reclamation. At that time, the evaporation ponds will be dried up and buried and the site turned over to DOE to perform long-term stewardship activities. Groundwater monitoring requirements for the site after transfer to DOE will be determined at the time of site transfer.

The disposal cell will require long-term surveillance and maintenance to ensure that it continues to meet EPA standards. UNC is currently required to conduct environmental monitoring consisting of particulate, radon, and ambient gamma exposure monitoring. Surveillance and maintenance activities for the disposal cell will be specified in the long-term surveillance plan. NRC acceptance of the long-term surveillance plan is one of the final steps to site transfer.

Upon NRC acceptance of the site under a general license for custody and long-term care (in accordance with Title 10, Code of Federal Regulations Part 40, Section 40.28) and transfer of the site to DOE, DOE will control land use within the established site boundaries. DOE will perform long-term stewardship activities services as required by the long-term surveillance plan to maintain protectiveness and regulatory compliance. Access will be restricted by fencing and posting warning signs, as necessary, along the site boundary. Drilling and other intrusive activities will be prevented within site boundaries through institutional controls. Once the site is transferred, DOE will conduct annual inspections to ensure the integrity of cell covers and other engineered features, and to ensure that institutional controls remain effective and the site complies with applicable requirements.

UNC is required to submit groundwater monitoring reports and other environmental monitoring reports to NRC on a semiannual basis. Documentation is also required to be maintained onsite. The information repository for the (UNC) Church Rock Site is the Gallup, New Mexico, Public Library. When licensed and transferred to DOE, the annual inspection report will be available to the public.

For more information about the (UNC) Church Rock Site, please contact:

Art Kleinrath
Long-Term Surveillance and Maintenance
Program Manager
U.S. Department of Energy, Grand Junction Office
2597 B3/4 Road, Grand Junction, CO 81503
Phone: 970-248-6037
or visit the Internet website at http://www.doegjpo.com

Richard W. Weller, Project Manager
Uranium Recovery and Low-Level Waste Branch
U.S. Nuclear Regulatory Commission
Mail Stop T7J8
Washington, DC 20555-001
Phone: 301-415-7287
or visit the Internet website at http://www.nrc.gov

WASTE ISOLATION PILOT PLANT[1]

1.0 SITE SUMMARY

1.1 Site Description and Mission

> ***LONG-TERM STEWARDSHIP HIGHLIGHTS***
>
> *Total Site Area* - 124 acres (50 hectares)
> *Current Landlord* - U.S. Department of Energy (DOE)
> *Expected Long-Term Stewardship Start-End Years* - 2040-in perpetuity
> *Expected Future Landlord* - DOE
> *Reason Not Subject to NDAA Requirements* - DOE will not initiate any long-term stewardship activities until 2040.

The Waste Isolation Pilot Plant (WIPP) is the world's first underground repository for the permanent disposal of transuranic radioactive waste (TRU) resulting from the research and production of nuclear weapons. The WIPP site is located in the remote Chihuahuan Desert of Southeastern New Mexico, 26 miles east of Carlsbad, occupying approximately 28 square kilometers (16 square miles). WIPP is neither a "cleanup" nor "closure" site. It is the only TRU waste disposal site in the nation. Current facilities at WIPP include disposal rooms that have been mined 655 meters (2,150 feet) underground in a 610-meter (2,000-foot) thick salt formation. The salt formation has been stable for more than 200 million years.

In 1979, Congress authorized WIPP to demonstrate the safe disposal of radioactive waste from defense activities of the Federal Government. Radioactive waste that is accepted at WIPP includes TRU waste and TRU mixed waste. TRU waste is radioactive waste, contaminated with alpha-emitting transuranic radionuclides with atomic numbers greater than 92 (that is, plutonium and other elements with atomic numbers higher than that of uranium), having half-lives longer than 20 years, and with concentrations greater than 100 nanocuries per gram of waste. TRU mixed waste is TRU waste that also contains hazardous materials regulated by the *Resource Conservation and Recovery Act* (RCRA). TRU waste consists primarily of tools, gloves, clothing and other such items contaminated with trace amounts of radioactive elements, mostly plutonium.

Consistent with Congressional authorization, the current mission of WIPP is to provide permanent disposal for TRU waste from defense activities. Various scientific studies were completed to demonstrate that WIPP will provide permanent isolation of the waste in a safe and environmentally acceptable manner. Compliance with the applicable laws and regulations was demonstrated and documented and submitted to the U.S. Environmental Protection Agency (EPA) and the State of New Mexico. WIPP received a "certification of compliance" from EPA on May 13, 1998, which authorizes it to dispose of the defense-generated TRU waste. WIPP accepted its first shipment of non-mixed TRU waste on March 26, 1999. The State of New Mexico issued a Part B permit under RCRA on October 27, 1999, which authorizes the disposal of mixed TRU waste (subject to certain conditions and effective on November 26, 1999).

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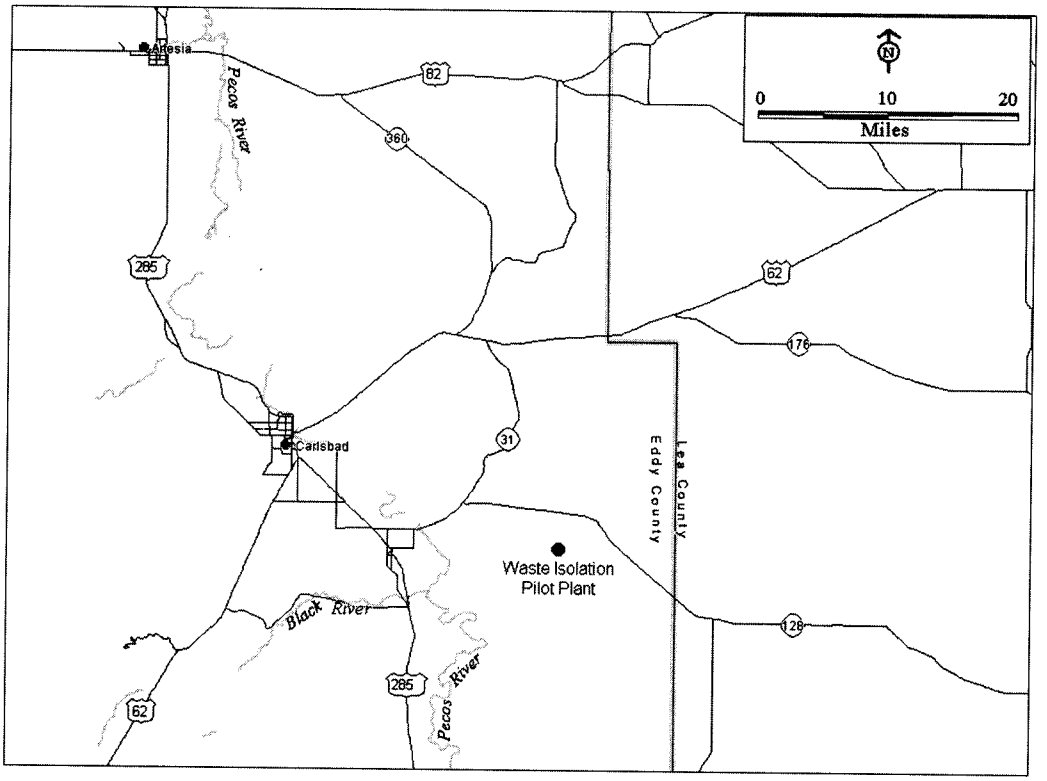
[1]This report is developed in response to a Congressional request in the Fiscal Year (FY) 2000 National Defense Authorization Act (NDAA). As requested by the Act, this report addresses current and anticipated long-term stewardship activities at each site or portion of a site by the end of calendar year 2006 ("Conference Report on S.1059, National Defense Authorization Act for Fiscal Year 2000," *Congressional Record,* August 5, 1999).

Based on current planning, the Waste Isolation Pilot Plant will not require long-term stewardship until after 2006 and, for this reason, the site is not the primary focus of this report. This summary of the site is included to provide to assist in documenting the U.S. Department of Energy's (DOE) role at the site and expected long-term stewardship activities at the site. (See Section 3.2 of Volume I).



Waste Isolation Pilot Plant

1.2 Site Cleanup and Accomplishments

The disposal phase at WIPP is projected to be completed by 2034. By then, it is expected that DOE will have disposed of a maximum of 175,600 cubic meters (6.2 million cubic feet) of TRU waste in WIPP. From 2034 to 2039, the surface facilities at WIPP will be decommissioned, and the underground area will be permanently closed. Following completion of the project, there will be no access to the underground. The surface area will be unrestricted for recreational and agricultural uses, with the exception of 50 hectares (124 acres), which constitute the exclusive-use, passive institutional control area directly above the repository footprint.

2.0 LONG-TERM STEWARDSHIP ACTIVITIES

Long-term stewardship activities for WIPP will consist of both active and passive institutional controls. For at least 100 years, DOE will maintain active institutional controls at the site, which will include constructing a fence and roadway around the surface footprint of the repository; posting of warning signs; conducting routine patrols and surveillance; repairing and/or replacing physical barriers, as needed; and preventing resource exploration at the WIPP site. As required by EPA, passive institutional controls will consist of redundant markers, messages in multiple languages, and records storage in multiple locations -- all designed to warn and inform future generations and civilizations about the location and purpose of WIPP. The passive institutional controls will communicate the location, design, and contents of the disposal system for long periods of time. Additional passive institutional controls include incorporation of WIPP's location on various maps and road atlases,

description of WIPP's location and content in encyclopedias, identification of WIPP as a geographical name in dictionaries, and descriptions of WIPP in educational text references. Post closure monitoring will be conducted in accordance with applicable Federal and State requirements.

3.0 ESTIMATED LONG-TERM STEWARDSHIP COSTS

Estimated costs, identified in the table below, are associated with maintaining the active institutional controls at the site.

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	***Amount***	***Year(s)***	***Amount***	***Year(s)***	***Amount***
FY 2000	$0	**FY 2008**	$0	**FY 2036-2040**	$10,556,200
FY 2001	$0	**FY 2009**	$0	**FY 2041-2045**	$52,781,000
FY 2002	$0	**FY 2010**	$0	**FY 2046-2050**	$52,781,000
FY 2003	$0	**FY 2011-2015**	$0	**FY 2051-2055**	$52,781,000
FY 2004	$0	**FY 2016-2020**	$0	**FY 2056-2060**	$52,781,000
FY 2005	$0	**FY 2021-2025**	$0	**FY 2061-2065**	$52,781,000
FY 2006	$0	**FY 2026-2030**	$0	**FY 2066-2070**	$52,781,000
FY 2007	$0	**FY 2031-2035**	$0		

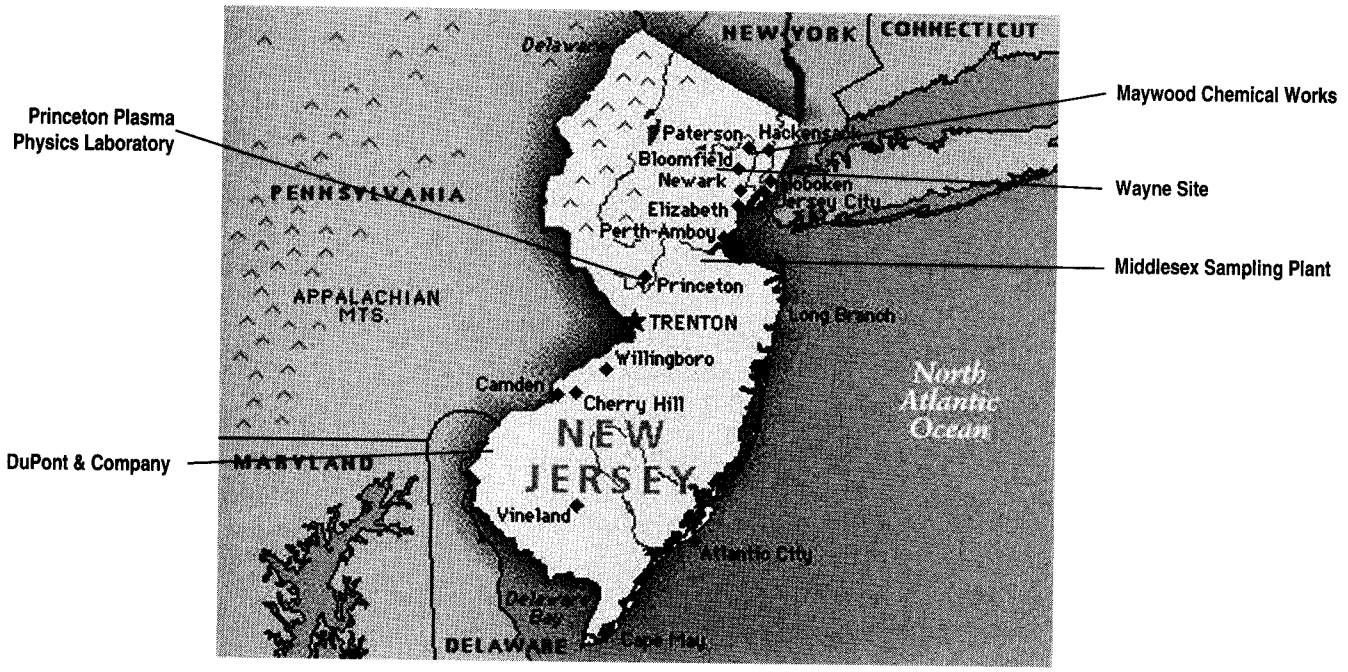
4.0 EXPECTED FUTURE USES AND SITE RESPONSIBILITY

DOE is currently responsible for all activities at WIPP. Following completion of the WIPP Project in 2039, a reduced Federal staff and technical contractor support will maintain the active institutional controls associated with the land withdrawal and records of WIPP. Also starting in 2039, there will be no access to the underground areas and the surface area will be unrestricted for recreational and agricultural uses, with the exception of the 50 hectares (124 acres) which constitute the exclusive-use passive institutional control area.

For more information about the Waste Isolation Pilot Plant, please contact:

Dennis Hurtt, Office of Public Affairs Team Leader
U.S. Department of Energy, Carlsbad Operations Office
P.O. Box 3090
Carlsbad, NM 88221-3090
Phone: 505/234-7327
Fax: 505/887-5419
E-mail: hurttd@wipp.carlsbad.nm.us
or visit the Internet website at http://www.wipp.carlsbad.nm.us or call 1-800-336-WIPP

New Jersey



Long-Term Stewardship Site Highlights

DuPont and Company (page 3)
unknown

Maywood Chemical Works (page 5)
unknown

Middlesex Sampling Plant (page 7)
unknown

Princeton Plasma Physics Laboratory (page 9)
Major Activities - groundwater monitoring and surveillance
Site Size - 36 hectares (88.5 acres)
Start/End Years - 2000/2010
Estimated Average Annual Cost FY 2000-2006 - $280,000

Wayne Site (page 15)
unknown

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Wayne Site 15

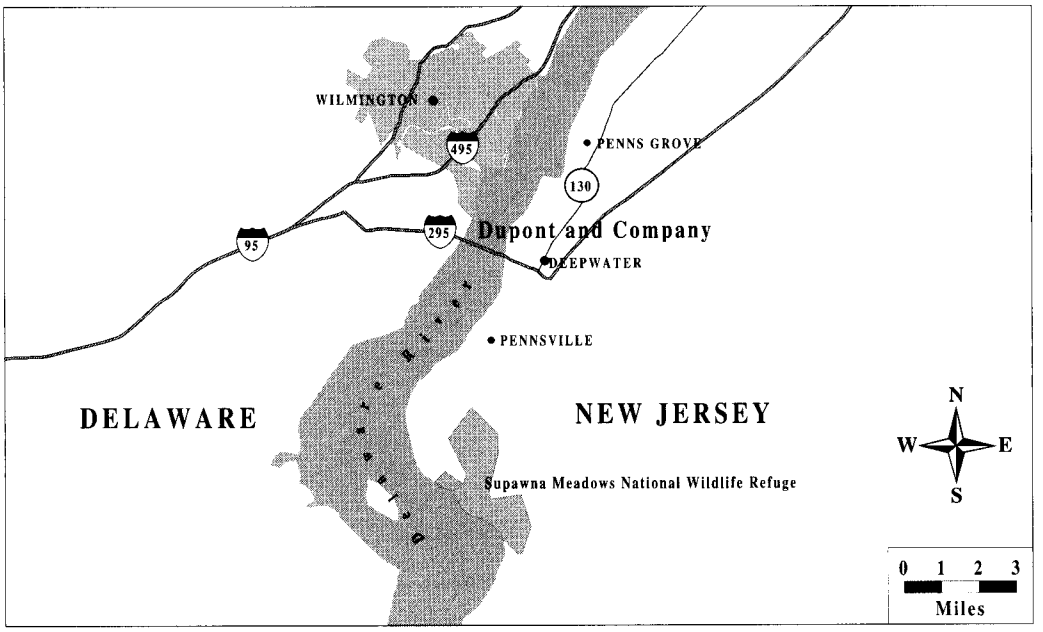
DUPONT & COMPANY [1]

SITE SUMMARY

The DuPont & Company site (also known as the DuPont Chambers Dye Works) is located in the Townships of Pennsville and Penns Grove on the southeastern shore of the Delaware River and is adjacent to the residential community of Deepwater, New Jersey. The site is bordered on the north by a DuPont property (the Carneys Works), on the east by U.S. Route 130, on the south by Salem Canal, and on the west by the Delaware River.

During the 1940s E.I. DuPont de Nemours & Company (DuPont) produced uranium products and conducted research on uranium hexafluoride in three buildings at the site. These activities were conducted first for the U.S. Office of Scientific Research and Development and later under contract to the Manhattan Engineer District and the Atomic Energy Commission (AEC), predecessor agencies of the U.S. Department of Energy (DOE). The activities that DuPont conducted in support of these contracts resulted in the contamination of onsite buildings and soil and generated radiological waste. After these activities ceased, all the contaminated equipment were removed and taken to the AEC portion of the Lake Ontario Ordnance Works in Lewiston, NY. Building decontamination was conducted in 1948 under the direction of the AEC. A radiation survey was then conducted by the AEC, and the buildings were subsequently released to DuPont.

A further survey in 1977 found elevated levels of uranium in Building 845, where uranium peroxide was produced, and in surface and subsurface soils. This led to the DuPont & Company Site's inclusion in the



Dupont & Company

[1] The DuPont & Company site is one of the 21 Formerly Utilized Sites Remedial Action Program (FUSRAP) sites where cleanup responsibility was transferred to the U.S. Army Corps of Engineers (Corps) in accordance with the Energy and Water Development Appropriations Act for FY 1998. At these 21 sites, the Corps is responsible for remediation and DOE is responsible for long-term stewardship activities, if any are deemed necessary. The cleanup decisions for these sites are not yet final and, therefore, the extent of long-term stewardship required for these sites, if any, is not yet known.

Formerly Utilized Sites Remediation Action Program (FUSRAP).

The Corps' remedial action for this site is not yet complete and, therefore, the extent of long-term stewardship required, if any, is not yet known.

For additional information about the DuPont & Company site, please contact:

Public Affairs Office
Philadelphia District
U.S. Army Corps of Engineers
Wanamaker Building
100 Penn Square East
Philadelphia, PA 19107-3390
Phone: 215-656-6516
or visit the Internet website at: http://www.nap.usace.army.mil/

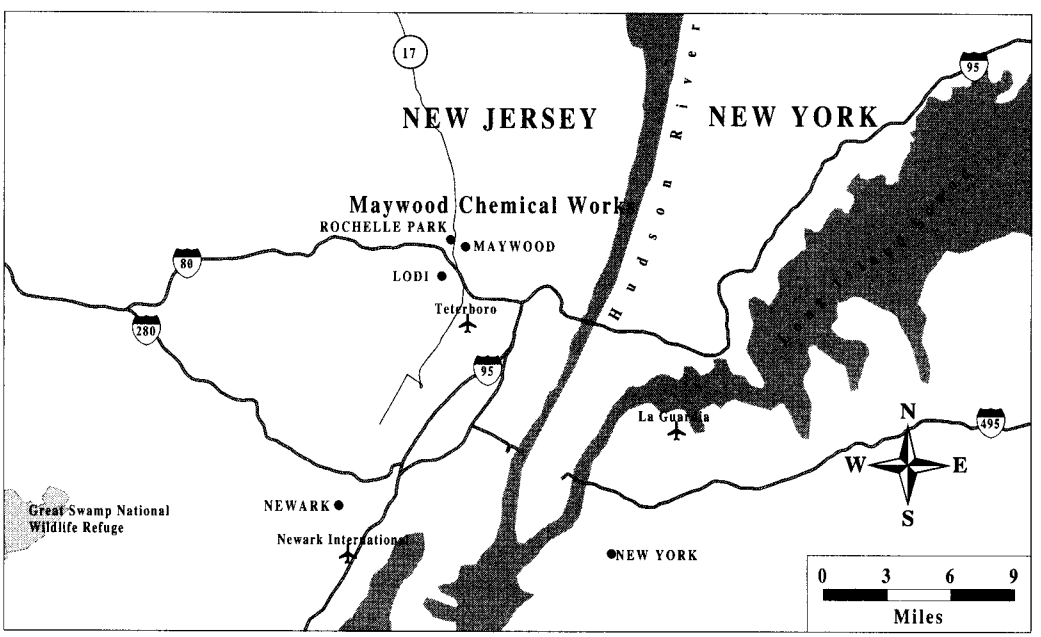
MAYWOOD CHEMICAL WORKS [1]

SITE SUMMARY

The areas comprising the Maywood Chemical Works Site are located in a highly developed area of Bergen County that includes residential, commercial, and municipal property in the Boroughs of Maywood and Lodi and the Township of Rochelle Park in New Jersey. The Maywood Chemical Works Site includes the following areas: (1) the Maywood Interim Storage Site; (2) the Stepan property, an active chemical plant; and (3) about 80 residential, commercial and governmental properties in Maywood, Lodi, and Rochelle Park. The Maywood Interim Storage Site is bordered by State Route 17 on the west, the New York Susquehanna and Western Railroad line on the north, and commercial and industrial properties on the south and east.

From 1916 to 1956, Maywood Chemical Works extracted thorium and rare earth elements from monazite sands for use in commercial products. During the operation of this plant, radioactive waste migrated or was moved offsite and contaminated the surrounding areas. Contamination spread via the former Lodi Brook, which ran south past the site and into the Borough of Lodi. Thorium waste in the brook settled onto properties along its path where commercial buildings and residential houses were later built. Wastes were also used as fill or mulch around the area.

Stepan Company acquired the Maywood Chemical Works in the late 1950s. The company began cleaning up the residual thorium waste by partially stabilizing the residues and tailings. During the 1960s, Stepan Company



Maywood Chemical Works

[1] The Maywood Chemical Works is one of the 21 Formerly Utilized Sites Remedial Action Program (FUSRAP) sites where cleanup responsibility was transferred to the U.S. Army Corps of Engineers (Corps) in accordance with the Energy and Water Development Appropriations Act for FY 1998. At these 21 sites, the Corps is responsible for remediation and DOE is responsible for long-term stewardship activities, if any are deemed necessary. The cleanup decisions for these sites are not yet final and, therefore, the extent of long-term stewardship required for these sites, if any, is not yet known.

transferred contaminated material from one area of the site to burial pits on the Stepan property.

In the 1980s, radioactive materials were discovered in the northeastern corner of the site. Subsequent surveys indicated that the contamination extended beyond site boundaries and, consequently, several residential vicinity properties required remediation. The primary radioactive contaminants are thorium-232 and its decay products, as well as uranium and radium-226. The primary chemical contaminants are heavy metals and rare earth elements. The risk to the public from these contaminants is minimal. Concentrations are generally low and much of the material is inaccessible (subsurface or beneath structures).

The Maywood Site was added to the Environmental Protection Agency's National Priorities List. At the direction of Congress in the 1984 Energy and Water Development Appropriations Act, the site was designated for cleanup under the Formerly Utilized Sites Remedial Action Program (FUSRAP). Additionally, a Memorandum of Understanding was signed between DOE and the Borough of Maywood in the 1980s concerning the removal of the Maywood Interim Storage Pile. The Corps' remedial action for the Maywood Chemical Works Site is not yet complete and, therefore, the extent of long-term stewardship required, if any, is not yet known.

For additional information about the Maywood Chemical Works, please contact:

Chief of Public Affairs
New York District
U.S. Army Corps of Engineers
Jacob K. Javits Federal Building
26 Federal Plaza
New York, NY, 10278-0090
Phone: 212-264-0100
or visit the Internet website at: http://www.nan.usace.army.mil/

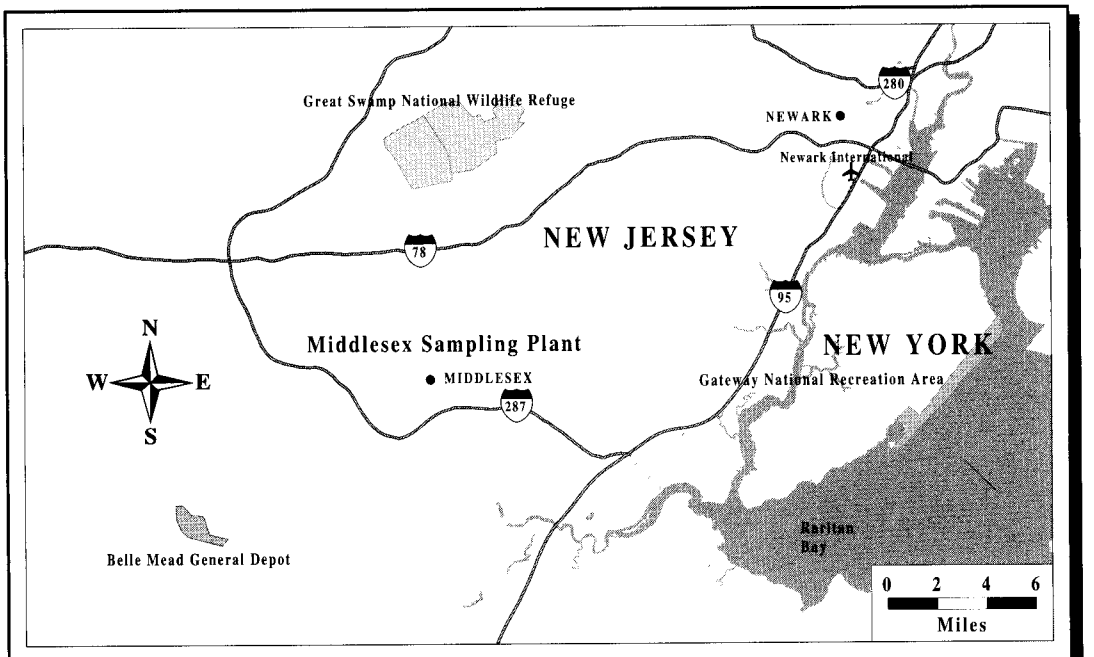
MIDDLESEX SAMPLING PLANT [1]

SITE SUMMARY

The Middlesex Sampling Plant is located in the Borough of Middlesex in New Jersey, approximately 56 kilometers (35 miles) northeast of Trenton and 42 kilometers (26 miles) southwest of Newark. The site is bordered on the east by residential properties on Mountain Avenue, on the south by William Street, and on the north by the Lehigh Valley Railroad line.

In the 1940s, the Manhattan Engineer District (MED), an early predecessor agency to the U.S. Department of Energy (DOE), established the Middlesex Sampling Plant to sample, store, and ship uranium and thorium ores. When MED operations at the site ceased in 1955, the Atomic Energy Commission (AEC), the successor agency to the MED and a predecessor agency to DOE, used this site to store and sample thorium. In the 1960s, operations at the Middlesex Sampling Plant were terminated and all remaining thorium sampling activities were transferred to the Feed Materials Production Center and to the Weldon Spring Plant.

The activities that took place at the site during the 1950s and 1960s contaminated not only onsite soil and facilities but also vicinity properties and a nearby municipal landfill. Primary contaminants at the site include uranium, radium, thorium, lead, and organics.



Middlesex Sampling Plant

[1] The Middlesex Sampling Plant is one of the 21 Formerly Utilized Sites Remedial Action Program (FUSRAP) sites where cleanup responsibility was transferred to the U.S. Army Corps of Engineers (Corps) in accordance with the Energy and Water Development Appropriations Act for FY 1998. At these 21 sites, the Corps is responsible for remediation and DOE is responsible for long-term stewardship activities, if any are deemed necessary. The cleanup decisions for these sites are not yet final and, therefore, the extent of long-term stewardship required for these sites, if any, is not yet known.

When AEC activities were terminated, onsite structures were decontaminated to levels that met the current standards. From the late 1960s until the late 1970s, the site was used by the U.S. Marine Corps. In 1978, the DOE assumed custody of the site and the site was designated for cleanup under the Formerly Utilized Sites Remedial Action Program (FUSRAP). The Army Corps of Engineers' remedial action for the Middlesex Sampling Plant Site is not yet complete and, therefore, the extent of long-term stewardship required, if any, is not yet known.

For additional information about the Middlesex Sampling Plant, please contact:

Chief of Public Affairs
New York District
U.S. Army Corps of Engineers
Jacob K. Javits Federal Building
26 Federal Plaza
New York, NY, 10278-0090
Phone: 212-264-0100
or visit the Internet website at: http://www.nan.usace.army.mil/

PRINCETON PLASMA PHYSICS LABORATORY

1.0 SITE SUMMARY

1.1 Site Description and Mission

The Princeton Plasma Physics Laboratory is a Collaborative National Center for plasma and fusion science. The Laboratory is located on 36 hectares (88.5 acres) of property leased from Princeton University on the James Forrestal Campus, in Plainsboro Township, Middlesex County, New Jersey. The Laboratory operates several devices, including the National Spherical Torus Experiment on Princeton University's campus. The Tokamak Fusion Test Reactor, which achieved world-record energy output, is currently undergoing dismantlement and will be completed by 2003. Other site facilities include maintenance shops, warehouses, transformer yards, storage buildings, administrative offices, educational facilities, and miscellaneous trailers. Princeton University is the operating contractor for the Laboratory. DOE's lease with Princeton University expires in 2026, unless DOE decides to terminate it earlier.

LONG-TERM STEWARDSHIP HIGHLIGHTS

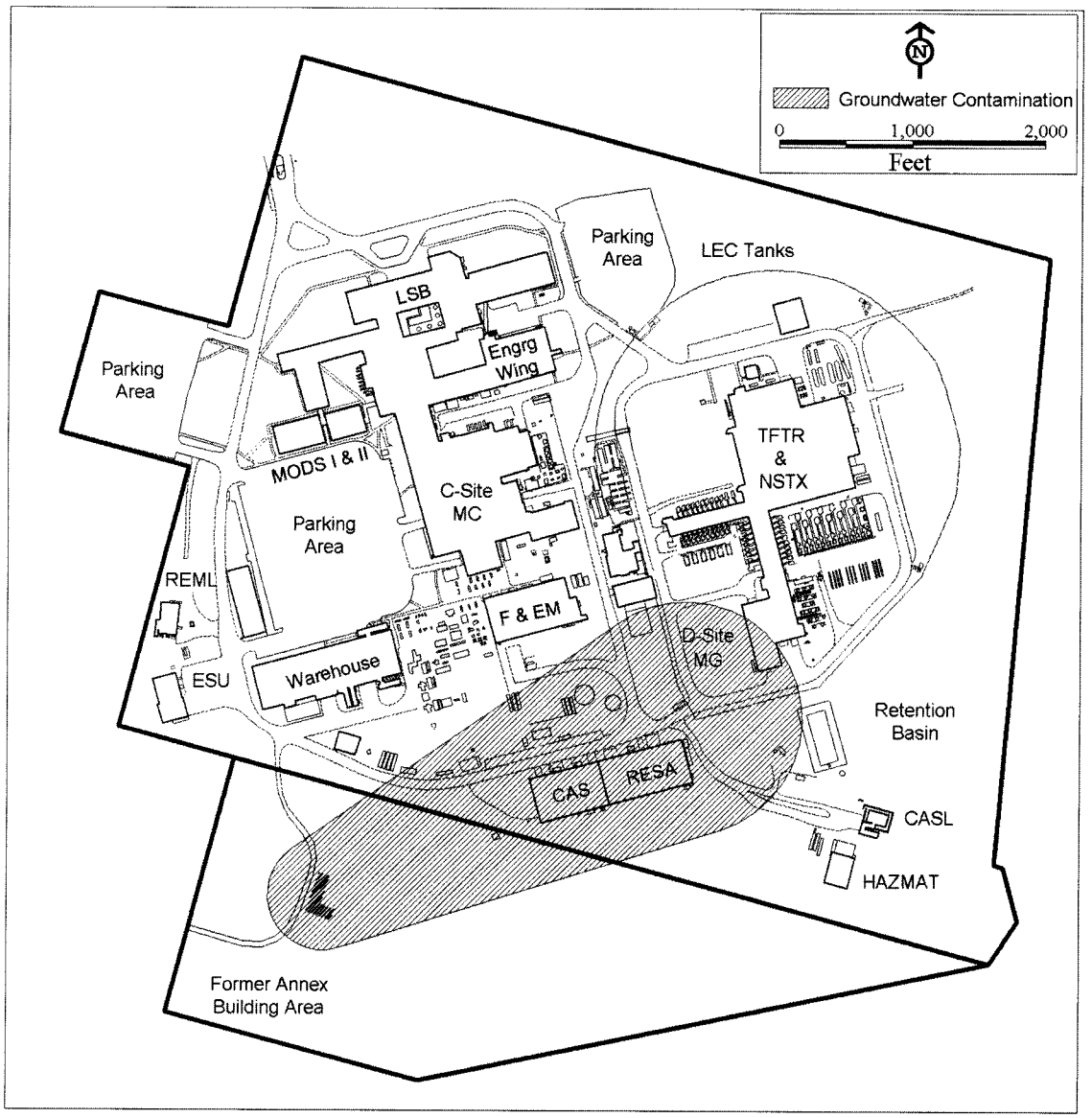
Major Long-Term Stewardship Activities - groundwater monitoring and surveillance
Total Site Area - 36 hectares (88.5 acres)
Estimated Volume of Residual Contaminants - groundwater 189,270 cubic meters (247,556 cubic yards)
Long-Term Stewardship Start-End Years - 2000-2010
Average Annual Long-Term Stewardship Cost FY2000-2006 - $280,000
Landlord - U.S. Department of Energy, Office of Science

The Princeton Plasma Physics Laboratory's primary mission is to conduct research and development of nuclear fusion technology as an attractive energy source. The Laboratory also historically provided research and development for fusion energy programs sponsored by DOE and its predecessor agencies. Research at the Laboratory began in 1959 with construction of the Model C-Stellerator, which was later converted to a pulse-operated device. Past activities and operations contaminated the soil and groundwater at the site with volatile organic compounds (petroleum, hydrocarbons, and solvents). All site remediation activities have been completed for soil, allowing unrestricted use of the site (with respect to soil). Groundwater in the shallow aquifer along the southern portion of the site, which comprises a surface area of about 12 hectares (30 acres), contains relatively low levels of chlorinated volatile organic compounds.

The Laboratory continues to generate waste, including oils, solvents, polychlorinated biphenyls, and low-level radioactive wastes. Waste is neither treated nor disposed of onsite, but it is collected in satellite accumulation areas before it is transferred to offsite locations. Hazardous waste is sent to commercial facilities, and low-level radioactive waste is shipped to other DOE sites for disposal.

1.2 Site Cleanup and Accomplishments

DOE completed soil remediation activities at Site C/D on the university campus in 1999. Soil contamination consisted of chromium (a heavy metal) and oil-related organic compounds. Approximately 153 cubic meters (200 cubic yards) of the metal-contaminated soil were excavated and disposed of at a commercial facility permitted to accept hazardous waste. Approximately 30 cubic meters (40 cubic yards) of organics-contaminated soil were removed and disposed offsite. All contaminated soils were remediated to cleanup standards dictated by the New Jersey Department of Environmental Protection. In 2000, the New Jersey Department of Environmental Protection released the site (with respect to soil) for unrestricted use under a "No Further Action Determination." Because of the success of the soil removal actions, and the full characterization of the soils throughout the site, long-term monitoring of the soil is not required.



Princeton Plasma Physics Laboratory

The single medium of concern that remains at the site is the groundwater contamination within the shallow aquifer, which most likely resulted from surface spills of solvents. This medium will require long-term stewardship activities.

All surface water from the building sumps is discharged into a lined stormwater detention basin, which discharges into a nearby brook. The discharge to the brook is routinely monitored in compliance with a State of New Jersey surface water discharge permit. Because of the natural degradation of the volatile organic compounds within the aquifer, dilution, and volatilization, residual volatile organic compounds are below the regulatory discharge limit to the brook. If volatile organic compounds levels in the discharge rise in the future, mitigation measures may be necessary.

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Site-Wide Long-Term Stewardship Activities

Because of the contamination resulting from past operations, long-term stewardship activities will be required at the Princeton Plasma Physics Laboratory. These activities, for the most part, will involve groundwater monitoring and surveillance to prevent contaminants from migrating offsite. Currently, DOE anticipates monitoring will continue until 2010. Soils are not subject to long-term stewardship activities since they have been remediated to acceptable levels and the site is no longer restricted for use.

No institutional controls are required under the "No Further Action Determination" issued by the New Jersey Department of Environmental Protection. However, because DOE leases the 36 hectares (88.5 acres) of property from Princeton University, DOE is bound by the terms of the lease agreement to return the property to Princeton University free from environmental hazards.

The New Jersey Department of Environmental Protection will implement an institutional control designated as a "classification exception area" for the contaminated groundwater plume at the Laboratory. The "classification exception area" functions as a deed restriction on groundwater at the site, preventing its unauthorized use. The "classification exception area" designation also provides regulatory relief, allowing groundwater contaminants to naturally and passively degrade until the statewide groundwater quality standards are met. Because soil contamination is no longer present at levels above New Jersey Department of Environmental Protection standards and the low levels of groundwater contamination are inaccessible to human contact, exposure to site workers or the public is not a concern. In addition, a baseline ecological evaluation conducted during a site remedial investigation found no adverse environmental impacts from the groundwater contamination. As a result, the site does not require any special physical barriers (e.g., fences) or visual warnings (e.g., signs).

SITE ACCOMPLISHMENTS

- Removed or closed in-place all (11) underground storage tank systems and associated contaminated soil. Added six above-ground, secondarily-confined tanks (1989-1993)
- Installed impermeable line in retention basin for collecting onsite surface water and groundwater from building dewatering sumps (1995)
- Completed two soil removal actions: 153 cubic meters (200 cubic yards) of soil contaminated with heavy metal (chromium); 30 cubic meters (40 cubic yards) of organics-contaminated soil
- Baseline ecological evaluation found no evidence of impacts to vegetation or wildlife attributable to onsite environmental conditions (1998)
- All identified areas of concern (10) for soil contamination characterized, determined clean, and no further action issued by State of New Jersey for soil (2000)

ANTICIPATED SITE ACCOMPLISHMENTS AS OF 2006

- Princeton Plasma Physics Laboratory will continue to monitor the natural attenuation of groundwater contaminants at least until 2010

Record-keeping activities are required under a Memorandum of Understanding between Princeton University and the New Jersey Department of Environmental Protection, which governed the cleanup activities at the Laboratory. The Laboratory is currently required to maintain all characterization, remediation and monitoring records for a minium of 30 years. In addition, the Laboratory also maintains a public information repository in which copies of applicable remedial investigation documents are kept.

STAKEHOLDER INVOLVEMENT

The Laboratory conducts annual briefings with the local municipal Environmental Advisory Committee as part of its ongoing public information efforts.

Technology Development and Deployment

Princeton Plasma Physics Laboratory deployed low-flow groundwater sampling pumps in all groundwater

monitoring wells. This technology consists of small air- driven bladder pumps located at the bottom of each well that gently purges the well water while analyzing various groundwater parameters (e.g., temperature, alkalinity/acidity, redox). Once the parameters have stabilized, a groundwater sample is taken. As a result, the depiction of actual groundwater conditions are more precise, and less waste water is generated during the well purging process. Utilization of this technology will continue for the duration of the long-term stewardship monitoring program.

2.2 Specific Long-Term Stewardship Activities

Groundwater

The single medium of concern that remains at the site is the groundwater contamination within the shallow aquifer, which most likely resulted from past surface spills of chlorinated solvents. The remediation strategy applied to the volatile organic compounds and petroleum (and approved by the New Jersey Department of Environmental Protection) is hydraulic control of migration with existing building dewatering pumps, monitoring, and natural attenuation. This remedy - referred to as "hydraulic groundwater control"- will keep contaminants from migrating offsite while chlorinated volatile organic compounds are allowed to naturally degrade within the aquifer. At this time, no engineered groundwater treatment system is required. The progress of natural attenuation will be monitored by quarterly groundwater sampling until New Jersey water quality standards are met. Target cleanup levels are one part per billion for tetrachloroethene, trichlorethene, 1,1,1-trichloroethane, and dichloroethenes under New Jersey groundwater quality standards.

Approximately 12 hectares (30 acres), with an average saturated thickness of nine meters (30 feet), of the aquifer on the southern boundary of the site is contaminated above New Jersey water standards. This equates to approximately 189,270 cubic meters (247,556 cubic yards) of contaminated groundwater. Monitoring is required to document the selected remedy of hydraulic control and natural contaminant attenuation.

2.3 Regulatory Regime

Long-term stewardship activities of the Princeton Plasma Physics Laboratory are governed by the New Jersey Department of Environmental Protection pursuant to the Administrative Code of the New Jersey Technical Requirements for Site Remediation. This regulatory requirement is executed in accordance with a Memorandum of Understanding (Feb. 3, 1993) between Princeton University and the New Jersey Department of Environmental Protection for the remediating Site C and D of the James Forrestal Campus. The MOU acknowledges that Site C/D is leased by DOE and that DOE contracts with Princeton University to manage and operate the Laboratory. A letter issued by the Department's Bureau of Case Management on March 17, 2000, approved the Remedial Investigation/Remedial Action Selection Report and approved the proposed groundwater remedy of hydraulic containment and natural attenuation.

All long-term stewardship activities exclusively address the groundwater at the Laboratory. A No Further Action Letter and Covenant Not to Sue for the soil at Princeton was signed by the New Jersey Department of Environmental Protection and Princeton University on March 28, 2000. No long-term stewardship activities are required for the soils at the Princeton Plasma Physics Laboratory. Because the long-term remedial activity at the Princeton Plasma Physic Laboratory consists only of the continuation of groundwater monitoring, no additional remedial systems are identified or required at this time. Therefore, a review under the *National Environmental Policy Act of 1969,* as amended, is not applicable and no hazardous or low-level radioactive waste will be generated as a result of the selected long-term stewardship activities.

2.4 Assumptions and Uncertainties

The long-term surveillance and monitoring of the groundwater contamination is assumed to consist of quarterly monitoring for at least 10 years until 2010. No further actions will be required. Princeton Plasma Physics Laboratory will continue to operate as a national laboratory for energy research. Therefore, future use of this facility will remain industrial.

3.0 ESTIMATED LONG-TERM STEWARDSHIP COSTS

The estimated costs for long-term stewardship activities at the Princeton Plasma Physics Laboratory are identified in the table below. The annual site-wide cost estimate for long-term stewardship activities is approximately $280,000 per year for the period of fiscal years (FY) 2000-2010. An annual budget of $273,000 (in FY 1999) dollars supported the quarterly groundwater collection and analysis, general maintenance of monitoring wells, administrative reporting and record-keeping. Beginning in FY 2001, these costs and responsibilities will be transferred from DOE's Office of Environmental Management to DOE's Office of Science.

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	***Amount***	***Year(s)***	***Amount***	***Year(s)***	***Amount***
FY 2000	$273,000	**FY 2008**	$281,000	**FY 2036-2040**	$0
FY 2001	$281,000	**FY 2009**	$281,000	**FY 2041-2045**	$0
FY 2002	$281,000	**FY 2010**	$281,000	**FY 2046-2050**	$0
FY 2003	$281,000	**FY 2011-2015**	$0	**FY 2051-2055**	$0
FY 2004	$281,000	**FY 2016-2020**	$0	**FY 2056-2060**	$0
FY 2005	$281,000	**FY 2021-2025**	$0	**FY 2061-2065**	$0
FY 2006	$281,000	**FY 2026-2030**	$0	**FY 2066-2070**	$0
FY 2007	$281,000	**FY2031-2035**	$0		

4.0 FUTURE USES

The Princeton Plasma Physics Laboratory will continue to operate as a national laboratory conducting research in plasma science and fusion energy. Therefore, future use of this facility will remain industrial — as a commercial/research property consistent with past use. With respect to soil contamination, unrestricted use is allowed. The Laboratory and all surrounding properties receive potable water from the public water utility. The Laboratory uses the nearby Delaware and Raritan Canal for process cooling water. The onsite water supply wells are available only for backup firefighting purposes and are not used for potable purposes. As a result, the existing groundwater contamination has not affected the existing land use as a "commercial/research property." If the Laboratory's lease expires in 2026 without renewal, or is terminated prior to expiration, DOE is bound by the lease agreement to return the property free of environmental hazards.

For additional information about the Princeton Plasma Physics Laboratory, please contact:

Jeffrey Makiel, Environmental Engineer
P.O. Box 102
Princeton, NJ 08542-0102
Phone: 609-243-3721
or visit the Internet website at http://www.pppl.gov

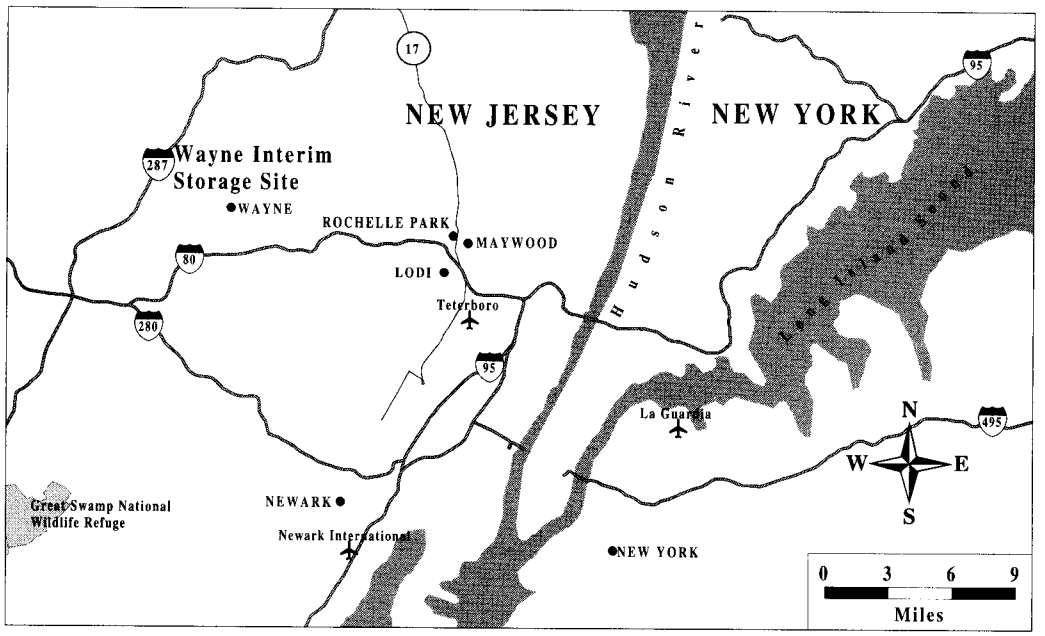
WAYNE SITE [1]

SITE SUMMARY

The Wayne Site is located about 3.2 kilometers (two miles) north of Wayne, New Jersey, in a highly developed area of Passaic County. The site is approximately 58 kilometers (36 miles) northwest of New York City. Between 1948 and 1971, Rare Earths, Inc., and its successor, W.R. Grace and Company, processed monazite sands to recover thorium and other rare earth elements. In 1955, under a contract issued by the Atomic Energy Commission (AEC), a predecessor agency to the U.S. Department of Energy (DOE), the company began to process Government-owned thorium ores for the AEC (AEC-funded thorium processing may have begun as early as 1948). The contract was terminated in 1960. Thereafter, W.R. Grace and Co. processed monazite sands for commercial purposes until 1971. Between 1967 and 1984, the property was leased to and occupied by Electro-Nucleonics, Inc.

Prior to 1960, radioactive residues from the processing of thorium ores were placed in above-ground piles. From 1960 to 1967, the thorium wastes were buried -- sometime between 1960 and 1964, they were buried in large unlined pits. In 1965, the material was exhumed and buried in smaller pits. From 1967 to 1971, thorium phosphate wastes were shipped to the W.R. Grace and Co. plant in Chattanooga, Tennessee.

Liquid wastes were neutralized in an onsite treatment plant and released into the storm water sewer system, which discharges into Sheffield Brook and, eventually, into the Pompton River. In 1971, at the request of W.R. Grace and Co., AEC modified the W.R. Grace license to allow only storage.



Wayne Site

[1] The Wayne Site is one of the 21 Formerly Utilized Sites Remedial Action Program (FUSRAP) sites where cleanup responsibility was transferred to the U.S. Army Corps of Engineers (Corps) in accordance with the Energy and Water Development Appropriations Act for FY 1998. At these 21 sites, the Corps is responsible for remediation and DOE is responsible for long-term stewardship activities, if any are deemed necessary. The cleanup decisions for these sites are not yet final and, therefore, the extent of long-term stewardship required for these sites, if any, is not yet known.

After plant operations ceased in 1971, W.R. Grace and Co. partially decontaminated the site. In addition to covering an onsite disposal area with clean fill, the company razed several buildings and buried the resulting rubble and processing equipment in place. The remaining buildings were decontaminated and left intact.

The primary contaminants of concern are thorium and radium and their daughter products. Tailings migrated offsite via Sheffield Brook and contaminated vicinity properties. Areas surrounding the railroad spur in nearby Pequannock, where thorium-containing ores were unloaded, were also contaminated. Cleanup has been completed and certified at most of the designated vicinity properties. Radioactive residues from the vicinity property cleanup are in interim storage on the site.

The Wayne Site is on the U.S. Environmental Protection Agency (EPA) National Priorities List and is also the subject of a Federal Facilities Agreement between U.S. Department of Energy (DOE) and EPA. In 1983, Congress authorized the cleanup of the Wayne Site under the Formerly Utilized Site Remediation Action Program (FUSRAP). In September of 1984, the Wayne Site was donated to DOE. The Corps' remedial action for the site is not yet complete and, therefore, the extent of long-term stewardship required, if any, is not yet known.

For additional information about the Wayne Site, please contact:

Chief of Public Affairs
New York District
U.S. Army Corps of Engineers
Jacob K. Javits Federal Building
26 Federal Plaza
New York, NY, 10278-0090
Phone: 212-264-0100
or visit the Internet website at: http://www.nan.usace.army.mil/

New York

Long-Term Stewardship Site Highlights

Ashland Oil #1 Site (page 3)
unknown

Ashland Oil #2 Site (page 5)
unknown

Bliss and Laughlin Steel Site (page 7)
unknown

Brookhaven National Laboratory (page 9)
Major Activities - groundwater extraction, treatment, and monitoring; soil/sediment monitoring; access restrictions and other institutional controls; maintenance of capped landfills; surveillance and maintenance of two reactors
Site Size - 2,153 hectares (5,263 acres)
Estimated Average Annual Costs FY 2000-2006 - None. Monitoring costs of remediated locations and facilities, as well as operations, maintenance and monitoring costs for treatment systems, are incorporated in the site Environmental Management budget for FY 2000- 2006.

Colonie Site (page 29)
unknown

Linde Air Products (page 31)
unknown

Niagara Falls Storage Site (page 33)
unknown

Seaway Industrial Park (page 35)
unknown

Separation Process Research Unit (page 37)
Site Size - 8 hectares (20 acres)
Current Landlord - U.S. Department of Energy, Office of Naval Reactors
Expected Future Landlord - U.S. Department of Energy, Office of Naval Reactors

West Valley Demonstration Project (page 41)
Site Size - 90 hectares (230 acres)
Current Landlord - U.S. Department of Energy; New York State Energy Research and Development Authority
Expected Future Landlord - New York State Energy Research and Development Authority

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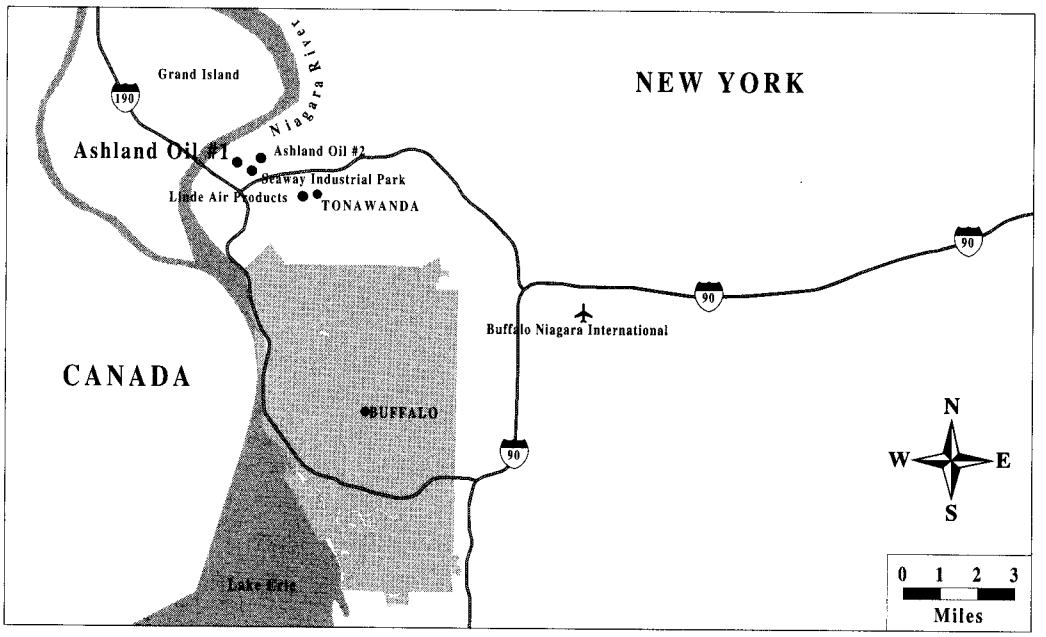
ASHLAND OIL #1 SITE[1]

SITE SUMMARY

The Ashland Oil #1 Site is located in an industrialized area of Tonawanda, New York, and is approximately five kilometers (three miles) northwest of the City of Buffalo. The property is bordered on the north and west by United Refining Company, on the east by Penn Central Transportation Company, on the southwest by Interstate 90, and on the northeast by Seaway Industrial Park. The Ashland Oil #1 Site was used as a storage site for uranium processing residues. While most of the land near the Ashland Oil #1 Site is zoned for industrial use, much of it remains undeveloped.

In the 1940s, the Manhattan Engineer District (MED) (an early predecessor agency to the U.S. Department of Energy) purchased the Ashland Oil #1 property (formerly known as the Haist Property) for use as a disposal site of uranium ore tailings and concentrated refining residues generated at the nearby Linde Air Products Site. The uranium residues were transported to the Ashland Oil #1 Site and were spread over the property.

In the 1960s, the U.S. Atomic Energy Commission (the successor agency to MED and a predecessor agency to the U.S. Department of Energy) determined that the levels of residual radioactivity at the Ashland Oil #1 Site were below then-current criteria. The Ashland Oil Company acquired the property and, in the 1970s, constructed a bermed area and two petroleum storage tanks. During construction of the bermed area and a drainage ditch,



Ashland Oil #1 Site

[1] The Ashland Oil #1 Site is one of the 21 Formerly Utilized Sites Remedial Action Program (FUSRAP) sites where cleanup responsibility was transferred to the U.S. Army Corps of Engineers (Corps) in accordance with the Energy and Water Development Appropriations Act for FY 1998. At these 21 sites, the Corps is responsible for remediation and DOE is responsible for long-term stewardship activities, if any are deemed necessary. The cleanup decisions for these sites are not yet final and, therefore, the extent of long-term stewardship required for these sites, if any, is not yet known.

the Ashland Oil Company deposited most of the excavated soil into the nearby Seaway Landfill and Ashland #2 properties. In the late 1980s, Ashland Oil removed the storage tanks but left the berms in place. That same year, the results of remedial investigation activities indicated that soil contained residual radioactivity above now-current guidelines. The primary contaminants of concern are uranium, radium-226, and thorium-230.

The Ashland Oil Company remains the owner of most of the Ashland Oil #1 Site. The company retained the portion of the property where radioactive material was present but sold the balance of the production and storage tank areas to United Refining. United Refining plans to remove the refining equipment and use the property as a tank farm and transfer station.

The Corps' remedial action for the Ashland Oil #1 Site is not yet complete and, therefore, the extent of long-term stewardship required, if any, is not yet known. Ashland Oil #1, Ashland Oil #2, the Seaway Industrial Park, and the Linde Air Products Site are included in the Tonawanda Site integrated environmental documentation process to comply with requirements of the *Comprehensive Environmental Response, Compensation, and Liability Act* and the *National Environmental Policy Act*.

For additional information about the Ashland Oil #1 Site, please contact:

FUSRAP Public Information Center
Buffalo District
U.S. Army Corps of Engineers
1776 Niagara Street
Buffalo, NY 14207-3199
Phone: 800-833-6390
or visit the Internet website at: http://www.lrb.usace.army.mil

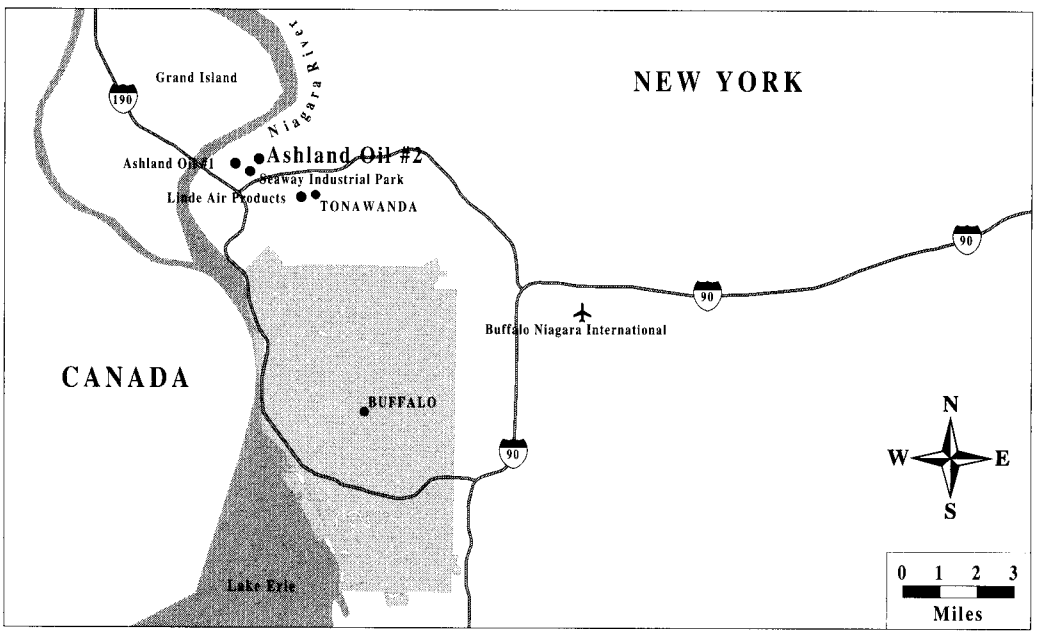
ASHLAND OIL #2 SITE[1]

SITE SUMMARY

The Ashland Oil #2 Site is located in the Town of Tonawanda, New York, approximately five kilometers (three miles) northwest of Buffalo. The site is bordered by undeveloped privately- and publicly-owned property. The Ashland Oil #2 Site was used as a landfill for soil contaminated with uranium residues.

From the 1950s to the 1980s, the Ashland Oil Co. used a portion of the Ashland Oil #2 Site as a landfill for the disposal of general plant refuse and industrial and chemical wastes and materials. During the 1970s and early 1980s, the Ashland Oil Co. transported an unknown quantity of soil mixed with radioactive residues from the Ashland Oil #1 Site to the Ashland Oil #2 landfill. The soil at the Ashland Oil #1 Site had been contaminated by radioactive residues which originated from uranium processing activities at the nearby Linde Air Products Site. In the early 1980s, the Ashland Oil Co. closed the Ashland Oil #2 Site landfill and covered it with clay.

During the late 1970's and the 1980's, the U.S. Department of Energy (DOE) conducted four characterization studies at the Ashland Oil #2 Site to evaluate the radioactive contaminants and hydrogeological characteristics of the site. These studies determined that soil at the site contained residual radioactivity at levels exceeding Federal guidelines. The soil is contaminated with thorium and radium; the underlying groundwater has also been contaminated by thorium-238, radium-226, and uranium.



Ashland Oil #2 Site

[1] The Ashland Oil #2 Site is one of the 21 Formerly Utilized Sites Remedial Action Program (FUSRAP) sites where cleanup responsibility was transferred to the U.S. Army Corps of Engineers (Corps) in accordance with the Energy and Water Development Appropriations Act for FY 1998. At these 21 sites, the Corps is responsible for remediation and DOE is responsible for long-term stewardship activities, if any are deemed necessary. The cleanup decisions for these sites are not yet final and, therefore, the extent of long-term stewardship required for these sites, if any, is not yet known.

The Corps' remedial action for the Ashland Oil #2 Site is not yet complete and, therefore, the extent of long-term stewardship required, if any, is not yet known. Ashland Oil #1, Ashland Oil #2, the Seaway Industrial Park, and the Linde Air Products Sites are included in the Tonawanda Site integrated environmental documentation process to comply with requirements of the *Comprehensive Environmental Response, Compensation, and Liability Act* and the *National Environmental Policy Act*.

For additional information about the Ashland Oil #2 Site, please contact:

FUSRAP Public Information Center
Buffalo District
U.S. Army Corps of Engineers
1776 Niagara Street
Buffalo, NY 14207-3199
Phone: 800-833-6390
or visit the Internet website at: http://www.lrb.usace.army.mil

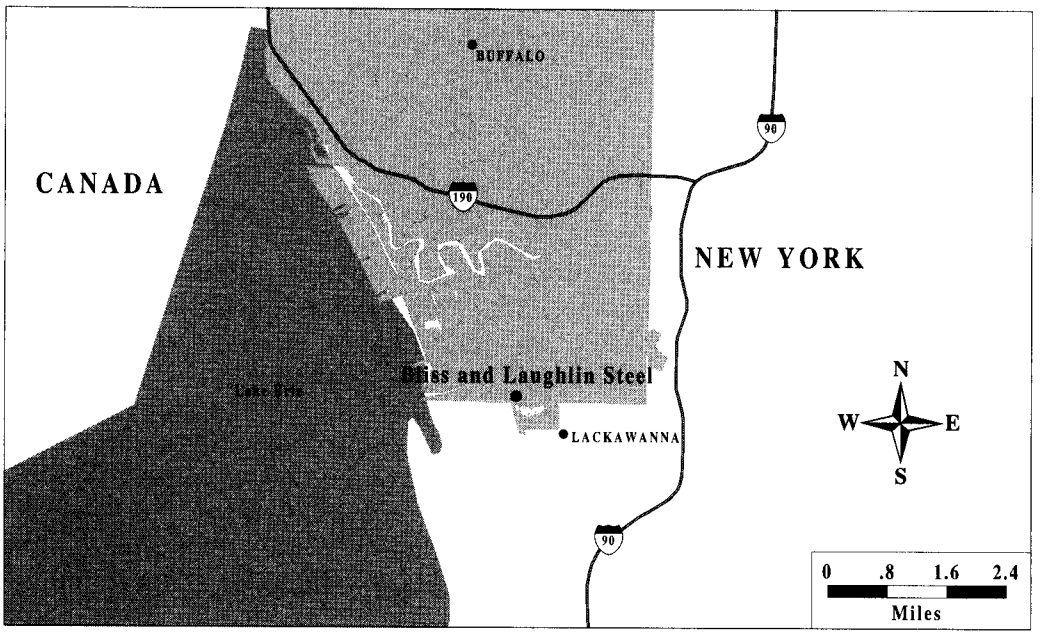
BLISS AND LAUGHLIN STEEL SITE[1]

SITE SUMMARY

The Bliss and Laughlin Steel Site is located in Lackawanna, New York, just south of Buffalo. The Site is bordered on the south and west by a railroad right-of-way and on the east by Hopkins Street. A large asphalt parking lot is located in the northeastern portion of the property.

The Bliss & Laughlin Steel Company historically was a large processor of cold drawn steel. In the early 1950s, Bliss and Laughlin performed machining and straightening operations on uranium rods in support of Atomic Energy Commission (a predecessor agency to the U.S. Department of Energy) activities. The Atomic Energy Commission (AEC) records suggest that the work was performed for the National Lead Company of Ohio, an AEC prime contractor, and various AEC organizations. Records also indicate that drums of turnings generated by Bliss and Laughlin activities were removed from the Site. Bliss and Laughlin sold the facility to Ramco Steel, Inc. Later, Niagara Cold Drawn Corporation owned and occupied the sole building on the Site.

A radiological survey found low levels of contamination in the floors and in a few overhead areas. The contaminant of concern for the facility at the Bliss and Laughlin Steel Site is uranium. The contamination is believed to be fully contained within the building.



Bliss and Laughlin Steel Site

[1] The Bliss and Laughlin Steel Site is one of the 21 Formerly Utilized Sites Remedial Action Program (FUSRAP) sites where cleanup responsibility was transferred to the U.S. Army Corps of Engineers (Corps) in accordance with the Energy and Water Development Appropriations Act for FY 1998. At these 21 sites, the Corps is responsible for remediation and DOE is responsible for long-term stewardship activities, if any are deemed necessary. The cleanup decisions for these sites are not yet final and, therefore, the extent of long-term stewardship required for these sites, if any, is not yet known.

The Corps' remedial action for the Bliss and Laughlin Steel Site is not yet complete and, therefore, the extent of long-term stewardship required, if any, is not yet known.

For additional information about the Bliss and Laughlin Steel Site, please contact:

FUSRAP Public Information Center
Buffalo District
U.S. Army Corps of Engineers
1776 Niagara Street
Buffalo, NY 14207-3199
Phone: 800-833-6390
or visit the Internet website at: http://www.lrb.usace.army.mil

BROOKHAVEN NATIONAL LABORATORY

1.0 SITE SUMMARY

1.1 Site Description and Mission

Brookhaven National Laboratory has been involved in research and development activities in support of the Department of Energy (DOE) and its predecessor agencies since it was established in 1947. Formerly Camp Upton, a U.S. Army installation site, Brookhaven is a 2,153-hectare (5,263-acre) site on Long Island in Upton, Suffolk County, New York, approximately 97 kilometers (60 miles) east of New York City. Approximately 8,000 people live within one half kilometer (0.3 mile) of the Brookhaven National Laboratory site boundary, and approximately 500,000 people live within 20 kilometers (miles) of the site boundary.

Brookhaven National Laboratory's current mission is to conduct fundamental research, including conception, design, construction, and operation of large, complex research facilities. These facilities carry out both basic and applied research in high-energy, nuclear and solid-state physics; fundamental material and structural properties and the interactions of matter; nuclear medicine, biomedical and environmental sciences; and energy technologies. The laboratory is operated by Brookhaven Science Associates, a partnership of Battelle Memorial Institute and the State University of New York at Stony Brook. The DOE Office of Science is the landlord for Brookhaven National Laboratory's ongoing research mission.

LONG-TERM STEWARDSHIP HIGHLIGHTS

Major Long-Term Stewardship Activities - groundwater extraction, treatment, and monitoring; soil/sediment monitoring; access restrictions and other institutional controls; maintenance of capped landfills; surveillance and maintenance of two reactors
Total Site Area - 2,153 hectares (5,263 acres)
**Estimated Volume of Residual Contaminants* - soil 1,911 cubic meters (2,500 cubic yards); groundwater unknown; facilities unknown; surface water/sediment unknown; engineered units unknown
Portions in Long-Term Stewardship as of 2006 - 2
Average Annual Long-Term Stewardship Cost FY 2000-2006 - None - Monitoring costs of remediated locations and facilities, as well as operations, maintenance and monitoring costs for treatment systems, are incorporated in the site Environmental Management budget for FY 2000-2006
Landlord - U.S. Department of Energy, Office of Science
*The estimated volume indicates only the known amounts of residual contaminants. For certain portions discussed for this site, exact volume is not known at this point. For specific discussions, please see Section 3.0.

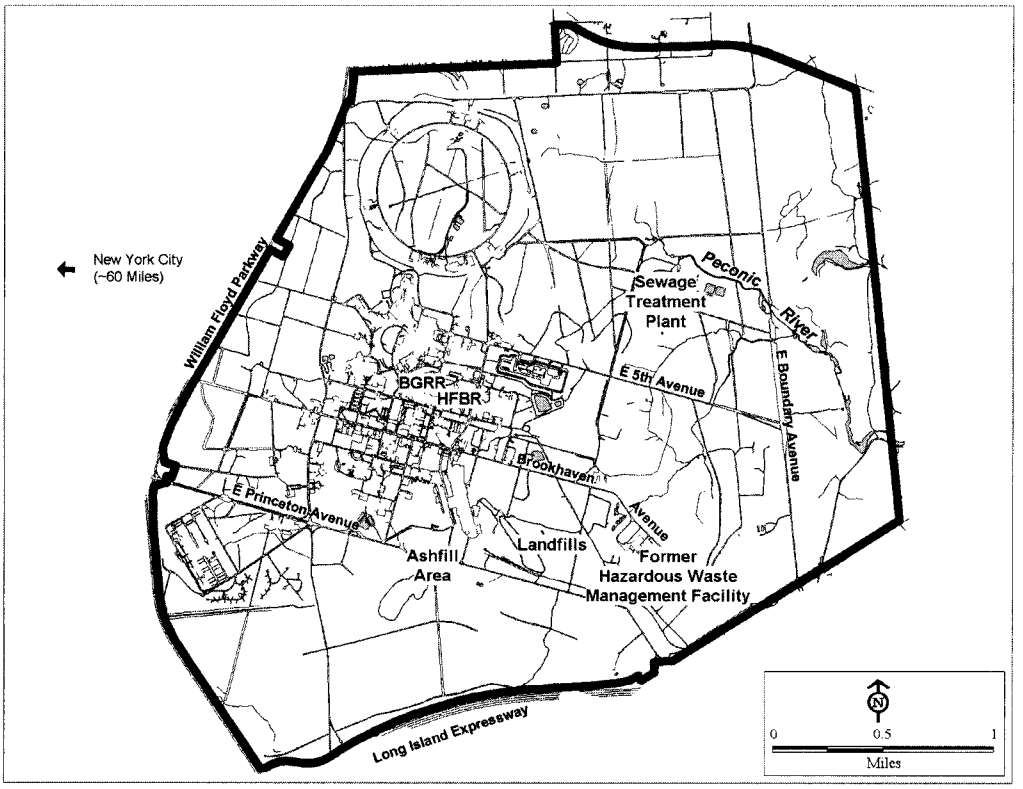
1.2 Site Cleanup and Accomplishments

Brookhaven was added to New York State's List of Inactive Waste Sites in 1980 and the Federal National Priorities List in November 1989. A tri-party Federal Facilities Compliance Agreement (also known as the Interagency Agreement) subsequently was negotiated between DOE, the U.S. Environmental Protection Agency (EPA) Region II, and the New York Department of Environmental Conservation. This Agreement, which became effective in 1992, integrates requirements under the *Resource Conservation and Recovery Act* (RCRA), the *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA), DOE cleanup authorities under the *Atomic Energy Act*, and applicable New York State requirements.

The Federal Facilities Compliance Agreement provides the overall framework for conducting the environmental restoration program, including procedures for dispute resolution, assessment of stipulated penalties by EPA, document review, reporting and notification, schedule extensions, compliance with applicable or relevant and appropriate requirements, and reimbursement of New York State oversight costs.

The facility is divided into 29 Areas of Concern that have been grouped into "Operable Units" (OU) based on

similarity of contaminants and contaminated media, hydrogeology, and geographic proximity. Individual remedial actions within each operable unit have been prioritized based on risk reduction in the areas of public safety and health, site personnel safety and health, and environmental protection. Nearer-term removal actions reduce risks from contaminant releases that require immediate attention and action or involve clear-cut solutions for well-defined problems. Finally, Brookhaven's pollution prevention and waste minimization strategy has limited the generation of waste materials that need to be disposed offsite. DOE is in the process of conducting remedial investigations and feasibility studies for the operable units under the CERCLA remedial action process. Three Records of Decision have been issued as of June 2000.



Brookhaven National Laboratory

The DOE Office of Environmental Management will fund the site environmental restoration activities through fiscal year 2006 (when all groundwater treatment systems are operational, all soil remediations are complete, and the Brookhaven Graphite Research Reactor is decommissioned). The Office of Environmental Management's Waste Management Program at Brookhaven transitioned to the Office of Science in 2000. The Office of Science, the site landlord, has an ongoing research mission at Brookhaven, and, according to current planning assumptions, will be responsible for long-term stewardship activities and all future land use issues. DOE anticipates that Brookhaven National Laboratory will remain under the control and ownership of the Federal government, and no land is planned to be released or transferred to the public.

Groundwater remediation and protection are the primary objectives of environmental restoration activities at the site. Groundwater contaminated with volatile organic compounds above drinking water standards occurs onsite and offsite. Public water hookups have been provided to an area south and southeast of Brookhaven to ensure that public health is protected while groundwater remediation is underway. Tritium and strontium above drinking water standards are found onsite and are planned to be addressed by a combination of active remediation and

natural attenuation.

Radiologically contaminated soils from several areas of the site will be excavated and disposed offsite. DOE established risk-based cleanup levels based on potential exposure, including such factors as potential future land use, radionuclide migration, and radioactive decay. For most of the soils, the concentration of cesium-137 determines the volume of soil to be remediated. DOE has established remediation goals that will ensure potential exposure does not exceed a dose of 15 millirem per year above background. For cesium-137, a remediation goal of 67 pCi/g has been established for soils in the area found most suitable for future industrial use (at the old Hazardous Waste Management Area) and 23 pCi/g which reflects a residential use for other areas of the site (Other Radioactive Soils and Rest of Site portions).

SITE ACCOMPLISHMENTS

- Removed 10 underground storage tanks from the facility
- Capped four landfills
- Removed contaminated water from deep drain sump, fans, pile fan sump and associated contaminated soil at Brookhaven Graphite Research Reactor
- Began operation of five groundwater systems
- Excavated glass/chemical/animal pits and cesspools; waste is being disposed offsite

BY 2006 BROOKHAVEN NATIONAL LABORATORY WILL HAVE:

- Installed and begun operation of all groundwater treatment systems
- Completed all contaminated soil remediation
- Decommissioned Brookhaven Graphite Research Reactor

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

DOE has an ongoing research mission at this site and will be responsible for all long-term stewardship activities, funding, and future land use at Brookhaven National Laboratory. Long-term stewardship activities will include operations and maintenance of the groundwater treatment systems and continued groundwater monitoring. Quarterly to annual groundwater monitoring record-keeping and reporting will be required, most likely for the next 30 to 40 years. For planning purposes, DOE estimated the end-date for groundwater monitoring and treatment to be 2034.

SITE LONG-TERM STEWARDSHIP GOALS

- Operation of groundwater extraction and treatment systems to achieve end states (State drinking water standards)
- Maintenance of institutional controls to manage residual hazards (engineered units, facilities, contaminated soil, groundwater, and surface sediments)
- Surveillance and maintenance of two decommissioned reactors

DOE will maintain access controls and perform surveillance and maintenance activities, as necessary. Some areas of the site, where there are landfill caps, will be restricted so as not to compromise the caps. For some areas of the site, residual contamination below cleanup levels will be monitored to ensure continued protection of human health and the environment. Administrative Records are maintained at Brookhaven National Laboratory and the EPA Region 2 Office. Information repositories are and will be integrated into the site monitoring and surveillance programs conducted by the landlord program after 2006. Monitoring data will be provided as part of the Site Environmental Reports and other reports, as required. Records will also be kept as required by the Federal Facilities Compliance Agreement.

DOE anticipates that the site's future land use will remain "industrial with restricted access" in accordance with DOE's ongoing research mission at the site.

2.2 Assumptions and Uncertainties

DOE has not finalized long-term stewardship activities for several site portions pending final CERCLA Records of Decision or a determination of facility end states. For example, DOE is still developing long-term stewardship activities and requirements for the Peconic River, the Brookhaven Graphite Research Reactor, and the High Flux Beam Reactor areas of the site. Estimated costs for long-term stewardship requirements of the Brookhaven Graphite Research Reactor and Peconic River sediments are based on assumed end states following remediation.

2.3 Estimated Site-Wide Long-Term Stewardship Costs

Estimated costs for long-term stewardship activities for Brookhaven National Laboratory are identified in the table below. DOE estimates long-term surveillance and monitoring costs to average approximately $2 million per year. Since planning is in its earliest stages, however, the estimated costs provided in the tables do not include long-term stewardship costs for the High Flux Beam Reactor, which was transferred from the DOE Office of Science to the DOE Office of Environmental Management in April 2000. Estimated costs for the Brookhaven Graphite Research Reactor are included for beyond FY 2006, and are based on DOE's Office of Environmental Management's current planning for decommissioning this facility. Costs for long-term stewardship activities for the former Hazardous Waste Management Facility are included in the estimates for the Landfills portion of the site. Costs for the transfer of long-term stewardship responsibilities for the Landfills portion in 2003, are included in the overall DOE Environmental Management budget but have not been specified as long-term stewardship costs for purposes of this report.

STAKEHOLDER INVOLVEMENT

Local communities and the public are afforded opportunities to provide input to long-term stewardship issues through the CERCLA decision process and associated Records of Decision. Public comment periods and meetings are held on cleanup projects, and responses to the public's comments are provided in the Responsiveness Summary sections of the Records of Decision. Input is also sought from the Brookhaven Executive Roundtable, an organization of local elected officials and regulatory agencies, and the Brookhaven National Laboratory Community Advisory Council.

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	***Amount***	***Year(s)***	***Amount***	***Year(s)***	***Amount***
FY 2000	$0	**FY 2008**	$4,435,065	**FY 2036-2040**	TBD
FY 2001	$0	**FY 2009**	$4,026,333	**FY 2041-2045**	TBD
FY 2002	$0	**FY 2010**	$3,344,847	**FY 2046-2050**	TBD
FY 2003	$0	**FY 2011-2015**	$12,480,033	**FY 2051-2055**	TBD
FY 2004	$0	**FY 2016-2020**	$9,810,085	**FY 2056-2060**	TBD
FY 2005	$0	**FY 2021-2025**	$7,639,066	**FY 2061-2065**	TBD
FY 2006	$0	**FY 2026-2030**	$6,591,431	**FY 2066-2070**	TBD
FY 2007	$4,793,967	**FY 2031-2035**	$3,554,048		

3.0 PORTION OVERVIEW

Brookhaven National Laboratory is managed by operable units. For purposes of this report, the site has been

subdivided into seven portions to allow for a more precise discussion of the geographic locations of long-term stewardship activities at the site at the end of 2007. For the purposes of this report, a "portion" is defined as a geographically contiguous and distinct area (which may involve residually contaminated facilities, engineered units, soil, groundwater, and/or surface water/sediment) for which cleanup, disposal, or stabilization will have been completed and long-term stewardship activities will be required as of 2007. The Brookhaven National Laboratory site consists of seven portions: (1) BGRR/HFBR decontamination and decommissioning, (2) Groundwater (OU-III, primarily, and OU-VI), (3) Former HWMF (OU-I), (4) Other Radioactive Soils (OU-I), (5) Landfills (OU-I), (6) Rest of Site (OU-I), and (7) Peconic River (OU-V).

Some of the geographic areas of the Brookhaven National Laboratory site are not represented as portions. These include areas of the site that have an ongoing mission and for which long-term stewardship activities will not be required, as well as areas where remediation activities will not be complete or where stabilization will not occur within the FY 2006 time frame specified by the *National Defense Authorization Act for Fiscal Year 2000* (FY 2000 NDAA) language. Brookhaven National Laboratory states that, with the exception of the High Flux Beam Reactor, which was accepted in the DOE Office of Environmental Management Program in April 2000, all currently baselined site remediation activities and decontamination and decommissioning activities are to be completed by the end of 2006; therefore there are no areas of the site for which remediation will be ongoing as of the end of 2006. Only two portions of the Brookhaven National Laboratory site, the BGRR/HFBR decontamination and decommissioning portion and Landfills portion, will require long-term stewardship activities prior to 2006. The other portions of the site, including Groundwater, Former Hazardous Waste Management Facility, Other Radioactive Soils, Peconic River, and Rest of Site will require some long-term stewardship activities starting in 2007. DOE anticipates that decontamination and decommissioning and site remediation activities for the site portions other than the HFBR decontamination and decommissioning are anticipated to be completed by the end of 2006.

The remaining sections discuss "portions" of the Brookhaven National Laboratory site that will require long-term stewardship activities by 2007. Each portion is identified in the text and table below, with a more detailed discussion of cleanup and long-term stewardship activities in Sections 3.1 through 3.7.

- The 0.8 hectare (1.9-acre) **BGRR/HFBR Decontamination and Decommissioning (D&D)** portion includes the Brookhaven Graphite Research Reactor and the High Flux Beam Reactor, which are being decontaminated and decommissioned. The BGRR and the HFBR are identified as a separate site portion because they are similar facilities, e.g., reactors with undetermined end states. Groundwater contamination from these facilities is discussed separately in the Groundwater portion below.

- The 2,630-hectare (6,500-acre) **Groundwater** portion of the site consists of contaminated groundwater underlying Brookhaven National Laboratory site areas and offsite areas. (Contaminated groundwater included in this site portion may underlie other site portions). All of the groundwater has been aggregated into a single site portion because they have similar remedial objectives and long-term stewardship requirements.

- The 7.3-hectare (18-acre) **Landfills** portion of the site consists of the Current Landfill, the Former Landfill Area (Former Landfill, Slit Trench and Interim Landfill) and the Ash Pit. These landfill areas are grouped together into a single portion because they are similar in construction (i.e. contain buried waste) and have similar long-term monitoring and institutional control requirements.

- The 4.8-hectare (12-acre) **Former Hazardous Waste Management Facility** (HWMF) portion of the site has been singled out as a separate portion because it has unique long-term stewardship requirements and cleanup levels associated with radiologically contaminated soils that are different from the other soil portions at Brookhaven National Laboratory.

- This 0.8-hectare (two-acre) **Other Radioactive Soils** portion of the site consists of scattered areas of soil contaminated with radionuclides, primarily cesium-137 and strontium-90. Most of this soil is shallow, i.e. the top 0.3-0.6 meter (one-two feet), though contamination is as deep as 7.6 meters (25 feet) in several areas. One area is also contaminated with lead. These areas have been singled out as a separate portion because they have different long-term stewardship requirements and cleanup levels than other portions.

- The 0.8-hectare (two-acre) **Rest of Site** portion of the Brookhaven National Laboratory site includes those Areas of Concern identified through the Remedial Investigation/ Feasibility Study process for the site. These areas are included in the site Environmental Restoration program, have minimal long-term stewardship requirements, and are not included in the other site portions.

- The four-hectare (ten-acre) **Peconic River** site portion include areas of the Peconic River and sources of contamination, including the Sewage Treatment Plant, the Satellite Disposal Area, and a portion of the site sewer system. The Peconic River portion is included as a separate site portion because it is a geographically distinct area under the Operable Unit V CERCLA program.

Long-Term Stewardship Information		
Portion Name and Location	***Long-Term Stewardship Start Year***	***Long-Term Stewardship End Year***
BGRR/HFBR Decontamination and Decommissioning*	2006**	2050***
Groundwater (OU-III, primarily, and OU-VI)	2007	2034
Former HWMF (OU-I)	2007	2034
Other Radioactive Soils (OU-I)	2007	2034
Landfills (OU-I)	2003	2034****
Rest of Site (OU-I)	2007	2034
Peconic River (OU-V)	2007	2009

* Assumes start of long-term stewardship for BGRR only; schedule for HFBR is under development.
** Monitoring costs of remediated locations and facilities, as well as operations, maintenance and monitoring costs for treatment systems, are incorporated in the site Environmental Management budget for FY 2000-2006.
*** Assumption from BGRR Removal Action Alternatives Study; plans not developed past 2050.
**** Plans not developed past 2034.

3.1 Brookhaven Graphite Research Reactor and High Flux Beam Reactor Decontamination and Decommissioning

The 0.77 hectare (1.9 acre) Brookhaven Graphite Research Reactor and the High Flux Beam Reactor are similar reactor facilities with undetermined end states. The end state for the Brookhaven Graphite Research Reactor is being decided in collaboration with regulators and stakeholders. An assumed end state for planning purposes includes major removal actions for all contaminated structures, appurtenances, and contaminated soil, with the reactor core (702 Building) sealed and left in place and the containment/operations building (701 Building) left intact for other laboratory re-use options. A Removal Action Alternatives Study was issued for public review and comment in January 2000. This study recommends a further evaluation of a short list of alternatives in an Engineering Evaluation/Cost Analysis document. At the conclusion of Removal Actions under CERCLA, a Record of Decision will be published in 2004 or early 2005.

Portion-wide long-term stewardship activities are expected to begin in 2006 and will continue as long as the reactor pile remains, based on information to date. Institutional controls will include access restrictions and a surveillance and maintenance program. Engineered controls for the Brookhaven Graphite Research Reactor include sealing the reactor's biological shield wall and isolating the below-grade ducts, maintaining the 701 Building as the primary barrier, and conducting long-term surveillance and maintenance of the facility. Groundwater wells surrounding the Brookhaven Graphite Research Reactor facility will be monitored to ensure that there is no contamination migration to the underlying aquifer. Surveillance and maintenance activities include radiological monitoring of the reactor facility (reactor pile) and routine maintenance, such as periodic roof repairs and painting of Building 701.

BROOKHAVEN GRAPHITE RESEARCH REACTOR AND HIGH FLUX BEAM REACTOR DECONTAMINATION AND DECOMMISSIONING HIGHLIGHTS

Major Long-Term Stewardship Activities - end state and long-term stewardship activities have not been finalized for this site portion
Portion Size - 0.77 hectares (1.9 acres)
Estimated Volume of Residual Contaminants - facilities and soil unknown
Long-Term Stewardship Start-End Years - 2006-2050
Average Annual Long-Term Stewardship Costs FY 2000-2006 - None - Monitoring costs of remediated locations and facilities, as well as operations, maintenance and monitoring costs for treatment systems, are incorporated in the site Environmental Management budget for FY 2000-2006

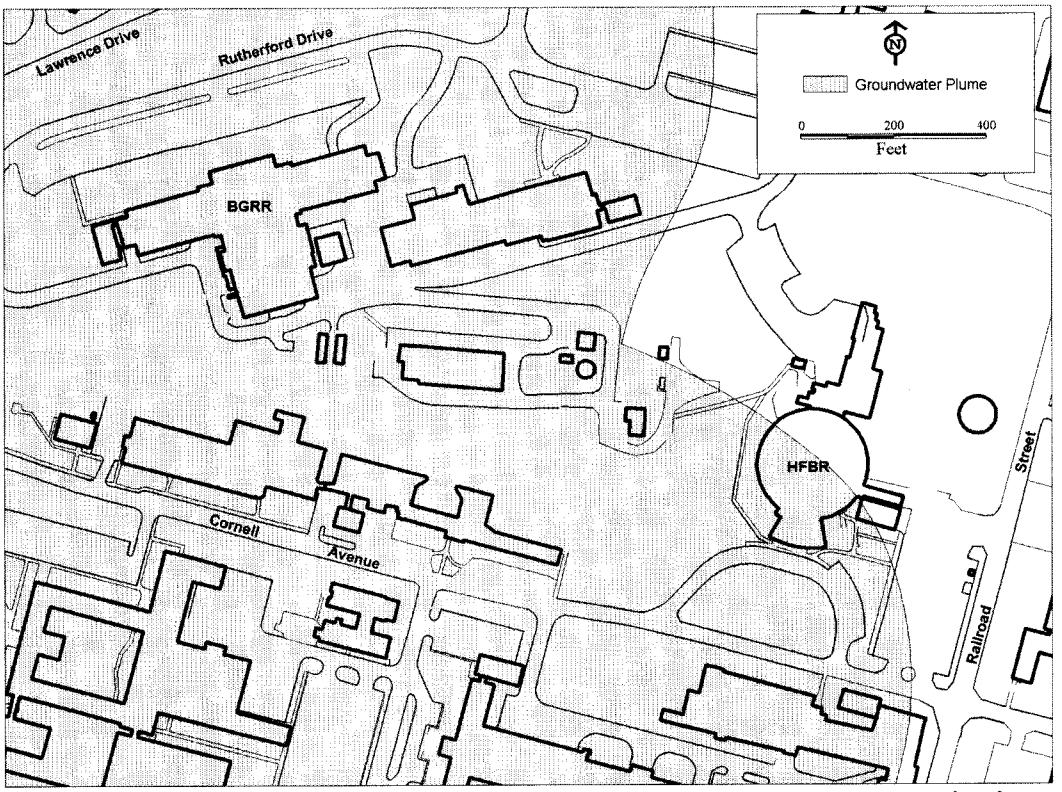
The High Flux Beam Reactor was permanently shut down in 1999. In April 2000, responsibility for the High Flux Beam Reactor was transferred from the DOE Office of Science to the DOE Office of Environmental Management. The end state for the High Flux Beam Reactor has not been determined at this time. Anticipated engineered controls for the High Flux Beam Reactor include maintaining the integrity of the confinement building during post decommissioning and long-term surveillance and maintenance, as needed. The groundwater contamination from these facilities is covered under the Groundwater portion (Section 3.2) that addresses all groundwater at Brookhaven National Laboratory (which has similar remedial objectives and long-term stewardship).

3.1.1 Facilities

The reactor structures and components present a unique facility media. Major reactor operational and structural components consist of concrete, steel, lead shielding, piping systems, electrical distribution systems, heating ventilation and air conditioning systems, and reactor control systems. Many of these components are contaminated radiologically and/or contain hazardous materials, including asbestos, mercury, polychlorinated biphenyls. The two reactor facilities encompass 0.8 hectare (1.9 acres.)

The residual contamination in the facilities consists of mixed fission products (cesium-137 and strontium-90); failed fuel residue in the BGRR (plutonium, uranium, and americium); induced radioactivity from reactor operations (carbon-14, iron-55, cobalt-60); and hazardous material in facility and reactor components containing lead, asbestos, and polychlorinated biphenyls. Since DOE has not fully characterized either the BGRR or the HFBR, the volume of contamination is unknown at this time. Characterization of the BGRR is underway.

Decontamination and decommissioning and long-term stewardship activities on the former reactors in this site portion are being conducted pursuant to Brookhaven's Standards Based Management System, all applicable Federal and State requirements, and applicable DOE Orders. Remediation of contaminated soils and groundwater at Brookhaven National Laboratory is being conducted in accordance with the Federal Facilities Compliance Agreement signed in 1992 by DOE, the U.S. Environmental Protection Agency, and the New York State Department of Environmental Conservation. The BGRR also is an Area of Concern identified in the Federal Facilities Compliance Agreement.



Brookhaven Graphite Research Reactor and High Flux Beam Reactor Decontamination and Decommissioning

Facilities Long-Term Stewardship Activities

Long-term stewardship activities for the decontaminated and decommissioned reactors will include access controls and surveillance and maintenance for the Brookhaven Graphite Research Reactor and Building 701. Long-term stewardship plans for the High Flux Beam Reactor site have not yet been developed.

3.1.2 Soil

DOE is completing soil cleanup within one of the removal actions in accordance with CERCLA. DOE already has removed some of this soil. During the Brookhaven Graphite Research Reactor's operational and post-shutdown period, contaminated water leaked into the soil column under major reactor structures (fuel canal, below-grade ducts, surface soil, pile fan sump), resulting in soil contamination that must be remediated. The reactor's operational history indicates that the fuel canal leaked during operation and intrusion water was discovered inside the underground ducts. Fuel casks were decontaminated outside the fuel storage canal, resulting in surface soil contamination (which has subsequently been paved over). DOE has not characterized the remaining contaminated soil and, as a result, has not determined the depth and volume of contamination. The residual contamination in the soil consists of fission products (cesium-137 and strontium-90), uranium, plutonium, and americium.

Soils Long-Term Stewardship Activities

The extent of contamination and planned cleanup levels have not yet been determined.

3.1.3 Estimated Long-Term Stewardship Costs for BGRR and HFBR D&D

DOE has only included estimated long-term stewardship costs for the BGRR, and these costs are based on DOE's Environmental Management's current planning for decommissioning this facility. The costs included surveillance and monitoring activities, such as radiological monitoring of the reactor facility, and routine maintenance, such as periodic roof repairs. DOE will monitor the BGRR facility to ensure that there is no contamination migrating to the underlying aquifer.

*Long-Term Stewardship Costs (Constant Year 2000 Dollars)**							
FY 2000 - FY 2010	***FY 2011 - FY 2020***	***FY 2021 - FY 2030***	***FY 2031 - FY 2040***	***FY 2041 - FY 2050***	***FY 2051 - FY 2060***	***FY 2061 - FY 2070***	***Estimated Total***
$2,000,000	$5,000,000	$5,000,000	$5,000,000	$5,000,000	TBD	TBD	$22,000,000

* Only costs for BGRR are included.

3.2 Groundwater

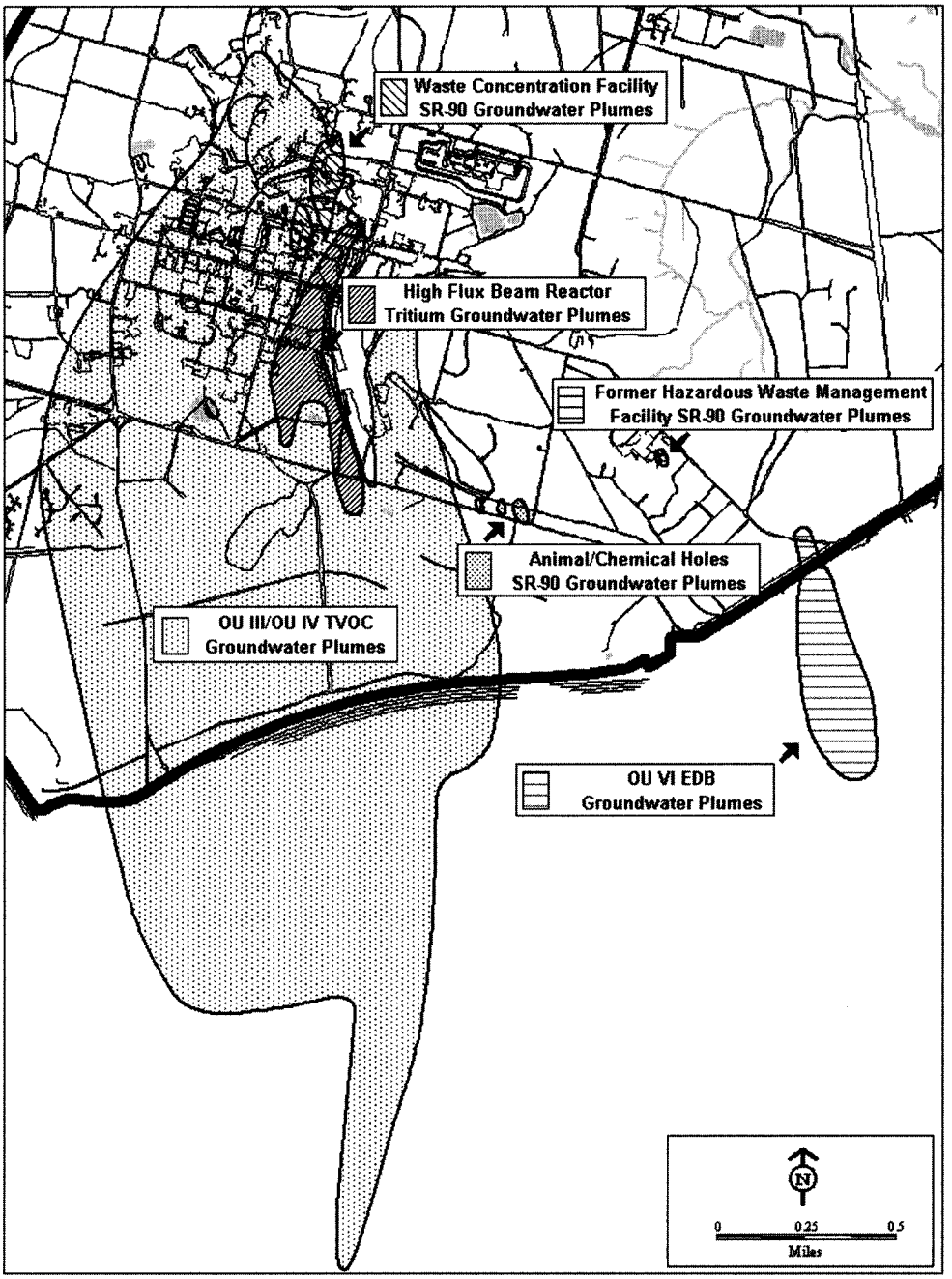
This 2,630 hectare (6,500-acre) portion addresses all groundwater plumes at Brookhaven National Laboratory, including both onsite and offsite groundwater contamination, which have similar remedial objectives and similar long-term stewardship requirements. The groundwater plumes include both onsite and offsite plumes. In general, the direction of groundwater flow is south. Since Brookhaven National Laboratory is just south of Long Island's groundwater divide, the plumes tend to descend in depth as they move south. Several volatile organic compound groundwater plumes have moved offsite but a 1996 private well sampling program conducted by the Suffolk County Department of Health confirmed DOE information that the plumes were generally deeper than private wells in the area. However, DOE provided public water to offsite areas as a precautionary measure. The Brookhaven National Laboratory site also has several onsite strontium-90 and tritium groundwater plumes at concentrations greater than drinking water standards. Levels of tritium less than the drinking water standard have been found off the Brookhaven National Laboratory site in some areas.

GROUNDWATER HIGHLIGHTS

Major Long-Term Stewardship Activities - operation of groundwater extraction and treatment systems; groundwater monitoring,
Portion Size - 2,630 hectares (6,500 acres) including onsite and offsite areas of contaminated groundwater
Estimated Volume of Residual Contaminants - groundwater unknown
Long-Term Stewardship Start-End Years - 2007-2034
Average Annual Long-Term Stewardship Costs FY 2000-2006 - None - Monitoring costs of remediated locations and facilities, as well as operations, maintenance and monitoring costs for treatment systems, are incorporated in the site Environmental Management budget for FY 2000-2006

Portion-wide long-term stewardship activities are scheduled to begin in 2007 and estimated to end in 2034. Additional scope may be added to the management and remediation of this portion upon completion of negotiations between EPA and the New York State Department of Environmental Conservation on two Records of Decision which impact this portion. Design activities are underway since the finalization of the Operable Unit III Record of Decision in June 2000, and several of the required groundwater treatment systems have already been constructed. Operable Unit III contains most of the site's contaminated groundwater. DOE will restrict the installation of potable wells in contaminated areas onsite to ensure that Brookhaven National Laboratory workers do not consume contaminated groundwater. Brookhaven National Laboratory's potable water is monitored in accordance with New York State Health Department requirements. Brookhaven National Laboratory will also restrict the installation of process supply wells and groundwater discharges in areas that will adversely impact management of the various plumes.

For the offsite volatile organic compound plumes, DOE provided public water to areas offsite potentially impacted by the plumes. Public water supplies are managed in accordance with Federal Safe Drinking Water Act standards implemented by the Suffolk County Department of Health Services. New construction in these areas would have to connect to public water mains in accordance with Suffolk County building codes. For those residents who have not connected to the public water system, DOE will provide free private well sampling through the Suffolk County Department of Health Services and will continue to recommend that residents get their wells sampled. Institutional control activities are and will continue to be required as part of the groundwater



Groundwater Portion

remedies in the Records of Decision for Operable Unit III, Operable Unit V, and Operable Unit VI. The continued effectiveness of these institutional controls will also be evaluated as part of the 5-year reviews required by CERCLA.

The site groundwater protection program has been established in accordance with the requirements of DOE Order 5400.1, *General Environmental Protection Program.* Remediation of groundwater at the Brookhaven National Laboratory site and offsite areas and groundwater long-term stewardship activities (ongoing groundwater extraction, treatment, and monitoring) is being conducted by the Laboratory Environmental Restoration Program in accordance with milestones established in the Federal Facilities Compliance Agreement and under Federal regulations in 40 CFR Parts 300, 302, 355, and 370. Safe Drinking Water Act implementation is administered in Suffolk County by the Suffolk County Department of Health Services. Operation of groundwater extraction and treatment systems at the site is being conducted in accordance with the provisions of the 1992 Federal Facilities Compliance Agreement.

Groundwater Long-Term Stewardship Activities

Groundwater extraction, treatment, and monitoring will continue until the drinking water standards are achieved in the aquifer, which is estimated to be in 30 years. By the end of 2006, all groundwater treatment systems will be operational and environmental monitoring will be underway. Long term stewardship activities will include operation and maintenance of the groundwater extraction and treatment systems. DOE anticipates that groundwater monitoring and treatment will be required for the next 25 to 30 years following startup of the remaining planned treatment systems. Groundwater extraction, treatment, and monitoring are planned to be conducted until the groundwater meets state drinking water standards. The estimated end date for groundwater monitoring, extraction, and treatment is FY 2034. No stewardship activities will be required after drinking water standards are established for the groundwater. The primary risk pathway is the potential consumption of groundwater containing contaminant concentrations above drinking water standards. The primary contaminants are volatile organic compounds, strontium-90, and tritium. The target cleanup standards are the drinking water standards (i.e., 5 ug/L for volatile organic compounds, 8 pCi/L for strontium-90, and 20,000 pCi/L for tritium).

3.2.1 Estimated Long-Term Stewardship Costs for Groundwater

Long-Term Stewardship Costs (Constant Year 2000 Dollars)							
FY 2000 - FY 2010	***FY 2011 - FY 2020***	***FY 2021 - FY 2030***	***FY 2031 - FY 2040***	***FY 2041 - FY 2050***	***FY 2051 - FY 2060***	***FY 2061 - FY 2070***	***Estimated Total***
$13,537,802	$16,521,518	$8,461,897	$746,608	$0	$0	$0	$39,267,825

3.3 Former Hazardous Waste Management Facility

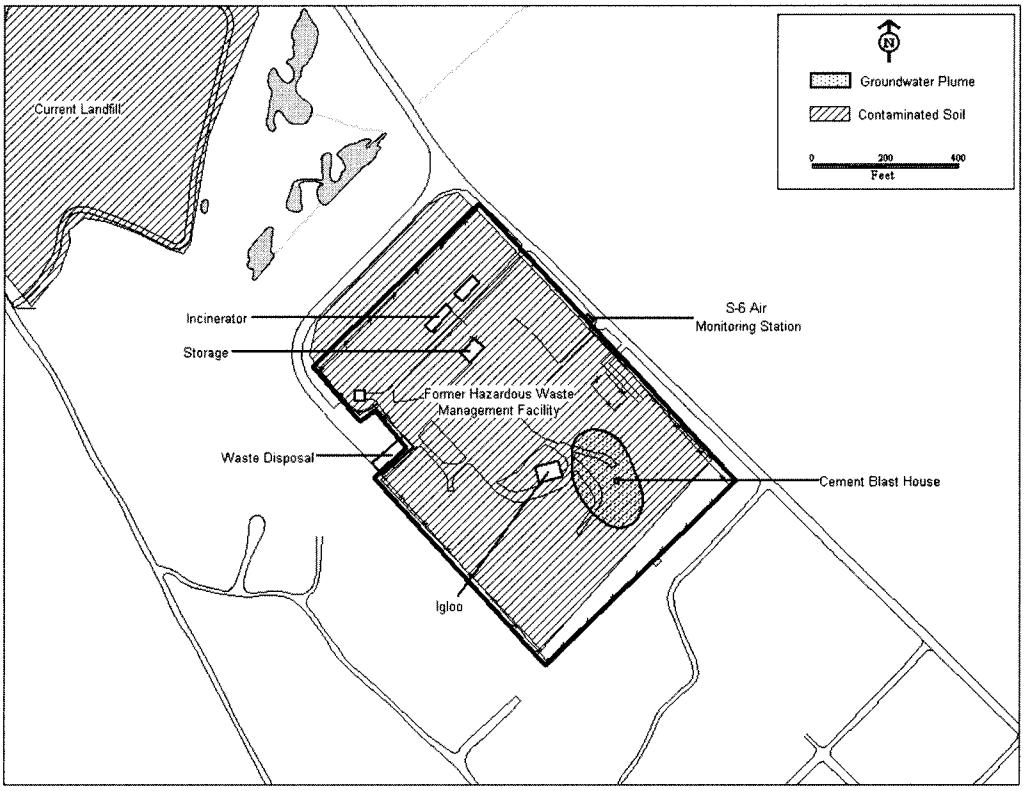
The Former Hazardous Waste Management Facility is a 4.8-hectare (12-acre) facility that is defined as a separate portion because it has unique long-term stewardship requirements and cleanup levels. The property is owned by DOE and is planned to remain part of Brookhaven National Laboratory. Future uses will be evaluated and restricted so that future users will not be exposed to unacceptable levels of contaminants. Appropriate deed restrictions would be put in place of

FORMER HAZARDOUS WASTE MANAGEMENT FACILITY HIGHLIGHTS

Major Long-Term Stewardship Activities - access restrictions and other institutional controls
Portion Size - 4.8 hectares (12 acres)
Estimated Volume of Residual Contaminants - soil unknown
Long-Term Stewardship Start-End Years - 2007-2034
Average Annual Long-Term Stewardship Costs FY 2000-2006 - included in the Landfills Portion costs

the property were to be transferred from DOE. There are no engineered controls at this site, and the costs for long-term stewardship activities are included in the Landfills portion. Design activities are underway based on the final remedy for this portion, as agreed upon by EPA and the New York State Department of Environmental Conservation in the Operable Unit I Record of Decision, which was finalized in Fall 1999. The selection remedy involves large-scale excavation and disposal of contaminated soil.

Closure and remediation of the former hazardous waste management facility and any post closure long-term stewardship activities are being conducted in accordance with the Federal Facilities Compliance Agreement.



Former Hazardous Waste Management Facility

3.3.1 Soil

The Former Hazardous Waste Management Facility is currently a fenced 12-acre area with controlled access. Operations in the facility ended in 1997. All remaining wastes and buildings will be removed prior to soil remediation. The selected remedy is large-scale soil excavation and offsite disposal. This portion of the site will be remediated to industrial cleanup goals. Following 50 years of institutional controls, the land could be available for industrial use.

Soils Long-Term Stewardship Activities

Post-remediation residual contamination will consist of levels of cesium-137, strontium-90 and lead below cleanup levels. Residual contamination below cleanup levels for unrestricted use will be monitored, and future uses of the site will be reviewed so that any activities performed would not cause unacceptable exposure to residual contamination.

3.3.2 Estimated Long-Term Stewardship Costs for the Former Hazardous Waste Management Facility

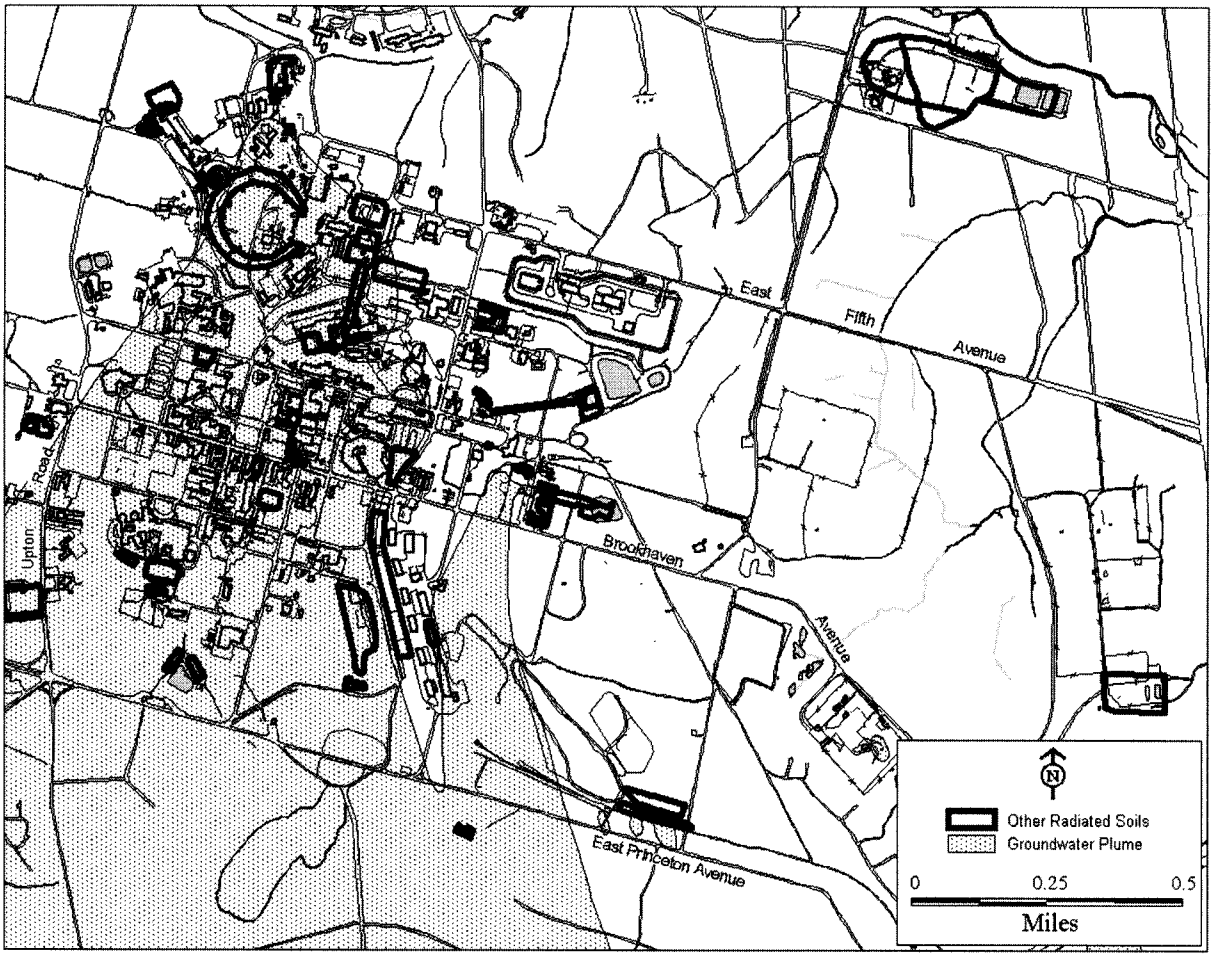
Costs for limited long-term stewardship activities at the Former Hazardous Waste Management Facility are included with the Landfills portion.

3.4 Other Radioactive Soils

The Other Radioactive Soils account for 0.8 hectare (two acres) of the site and are defined as a separate portion because they have unique long-term stewardship requirements and cleanup levels. These soils are contaminated with radionuclides, primarily cesium-137 and strontium-90. Most of this soil is shallow, i.e., the top 0.3-0.6 meter (one-two feet), though contamination may be as deep as 7.6 meters (25 feet) in several areas. One area is also contaminated with lead.

OTHER RADIOACTIVE SOILS HIGHLIGHTS

Major Long-Term Stewardship Activities - maintenance of future use and deed restrictions
Portion Size - 0.8 hectare (2 acres)
Estimated Volume of Residual Contaminants - soil 1,911 cubic meters (2,500 cubic yards)
Long-Term Stewardship Start-End Years - 2007-2034
Average Annual Long-Term Stewardship Costs FY 2000-2006 - included in the Landfill Portion costs



Other Radioactive Soils Portion

A Record of Decision has been finalized for these areas. Remediation of the landscaping soils began in Spring 2000 and will be completed this year. Design activities are currently underway for the remainder of the areas in this portion. Post remediation contamination will consist of levels of cesium-137, strontium-90 and lead below cleanup levels but above background levels. The estimated volume of post-cleanup contamination is estimated to be up to 1,911 cubic meters (2,500 cubic yards.)
The property is owned by DOE and will remain part of Brookhaven National Laboratory. Future uses will be evaluated and restricted so that the levels of contaminants will not exceed above regulatory limits. Appropriate deed restrictions will be put in place if the property is transferred from DOE. There are no engineered controls at this site and the costs for long-term stewardship activities are included in the Landfills portion of the site.

Soils Long-Term Stewardship Activities

A Record of Decision has been finalized for the Other Radioactive Soil portion areas. Remediation of the landscaping soils began in spring 2000. Design activities are underway for the remainder of the areas in this portion. Long-term stewardship activities would include primarily institutional controls, with periodic radiation surveys.

3.4.1 Estimated Long-Term Stewardship Costs for the Other Radioactive Soils

Costs for this portion are included in the Landfills portion costs.

3.5 Landfills

The Landfills portion is seven hectares (18 acres) and consists of five landfills – the Current Landfill, the Former Landfill Area (including the Former Landfill, Slit Trench, and Interim Landfill), and the Ash Pit. These areas are grouped together into a single site portion because they are similar in construction, contain buried waste, and have similar requirements for long-term monitoring and institutional control. A Record of Decision has been signed that specifies the required remediation and long-term stewardship actions for these sites.

LANDFILLS HIGHLIGHTS

Major Long-Term Stewardship Activities - long-term surveillance and maintenance of engineered units, access restrictions and other institutional controls
Portion Size - 7 hectares (18 acres)
Estimated Volume of Residual Contaminants - engineered units unknown
Long-Term Stewardship Start-End Years - 2003-2034
Average Annual Long-Term Stewardship Costs FY 2000-2006 - None. Monitoring costs of remediated locations and facilities, as well as operations, maintenance and monitoring costs for treatment systems, are incorporated in the site Environmental Management budget for FY 2000-2006.

These sites are owned by DOE and will remain part of Brookhaven National Laboratory. Portion-wide long-term stewardship activities are included in the DOE Environmental Management budget through FY 2006 and are not included here. Long-term stewardship costs have been estimated through FY 2034. Some level of effort is expected after this, but it has not been estimated.

3.5.1 Engineered Units

This medium comprises all of the buried waste at Brookhaven National Laboratory (i.e., the five landfills). Remediation and monitoring activities for these engineered units are discussed below.

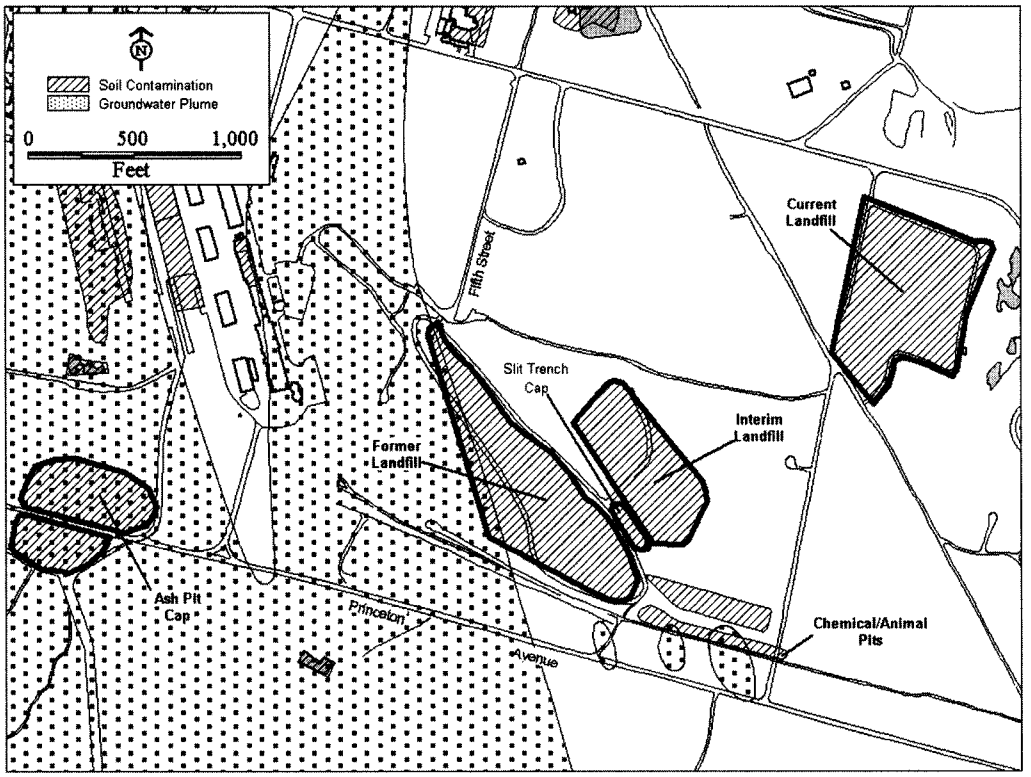
The Current and Former Landfills (each about three hectares [eight acres]) contain primarily municipal/sanitary type wastes, as well as residual chemical and low-level radioactive wastes (i.e., mouse litter, sewage treatment plant sludge). The Current Landfill and subportions of the Former Landfill Area (i.e., Former Landfill, Slit

Trench, and Interim Landfill) were closed with a multi-layer geomembrane and soil cap, in accordance with the New York State Department of Environmental Conservation's Solid Waste Management Facility requirements (6NYCRR Part 360, also known as the "Long Island Landfill Law"). Other components of the engineered units were constructed in accordance with the 6NYCRR Part 360. Buried wastes from the Chemical/Animal Pits and Glass Holes were excavated and are being disposed offsite. A long-term environmental monitoring system, including groundwater and landfill gas, is in place and is being conducted in accordance with the post-closure operating and maintenance requirements specified in 6NYCRR Part 360.

The Ash Pit, encompassing about three acres, contains incinerator ash that was placed in the pit between 1943 and 1963. The Ash Pit will be covered with a 15-centimeter (six-inch) soil cap, in accordance with EPA guidance for lead-contaminated soil. The purpose of the cap is to restrict potential exposure to heavy metals (e.g., lead) in the exposed ash.

Engineered Units Long-Term Stewardship Activities

Inactive landfills at the site have been capped in accordance with New York State Department of Environmental Conservation requirements. Long-term maintenance of the landfill caps and environmental monitoring (e.g. soil gas and groundwater) will be conducted throughout the landfill post closure period. Future activities at the former landfill sites will be restricted so that the caps are not compromised. Quarterly to annual groundwater monitoring, record-keeping and reporting will be required for the former landfill sites. DOE anticipates that these activities will be required for the next 30 to 40 years at a minimum. The current estimated end date for long-term stewardship activities for the Former landfill sites is 2034, though some level of effort is expected after that. The ashfill will be covered with a soil cap. The soil cap will be maintained and future activities at the site will be restricted.



Landfills

3.5.2 Estimated Long-Term Stewardship Costs for the Landfills

Costs are based on methane monitoring, groundwater sampling and monthly inspections for the Current and Former landfill, and annual visual inspections of the Ash Pit. Costs for implementing the required monitoring and maintenance activities for the capped landfills are well understood because DOE has performed these activities for several years. Monitoring costs of remediated locations and facilities, as well as operations, maintenance and monitoring costs for treatment systems, are incorporated in the site Environmental Management budget for FY 2000-2006. Costs for long-term stewardship activities for the former Hazardous Waste Management Facility are included in the estimates for the Landfills portion of the site. Costs for the transfer of long-term stewardship responsibilities for the Landfills portion in 2003, are included in the overall DOE Environmental Management budget but have not been specified as long-term stewardship costs for purposes of this report.

Long-Term Stewardship Costs (Constant Year 2000 Dollars)							
FY 2000 - FY 2010	***FY 2011 - FY 2020***	***FY 2021 - FY 2030***	***FY 2031 - FY 2040***	***FY 2041 - FY 2050***	***FY 2051 - FY 2060***	***FY 2061 - FY 2070***	***Estimated Total***
$615,080	$768,600	$768,600	$307,440	TBD	TBD	TBD	$2,459,720

3.6 Rest of Site

The final Records of Decision have been signed with EPA and the New York State Department of Environmental Conservation for these areas. The Rest of Site portion is 0.8 hectare (two acres) and includes those Areas of Concern that are in the Laboratory Environmental Restoration program, have long-term stewardship requirements, and are not included in the other portions. Any groundwater contamination underlying these Areas of Concern is not included in the Rest of Site portion, but is included in the groundwater site portion. Areas of Concern that include radioactive soil contamination are addressed in other site portions, and are not included in the Rest of Site portion.

REST OF SITE HIGHLIGHTS

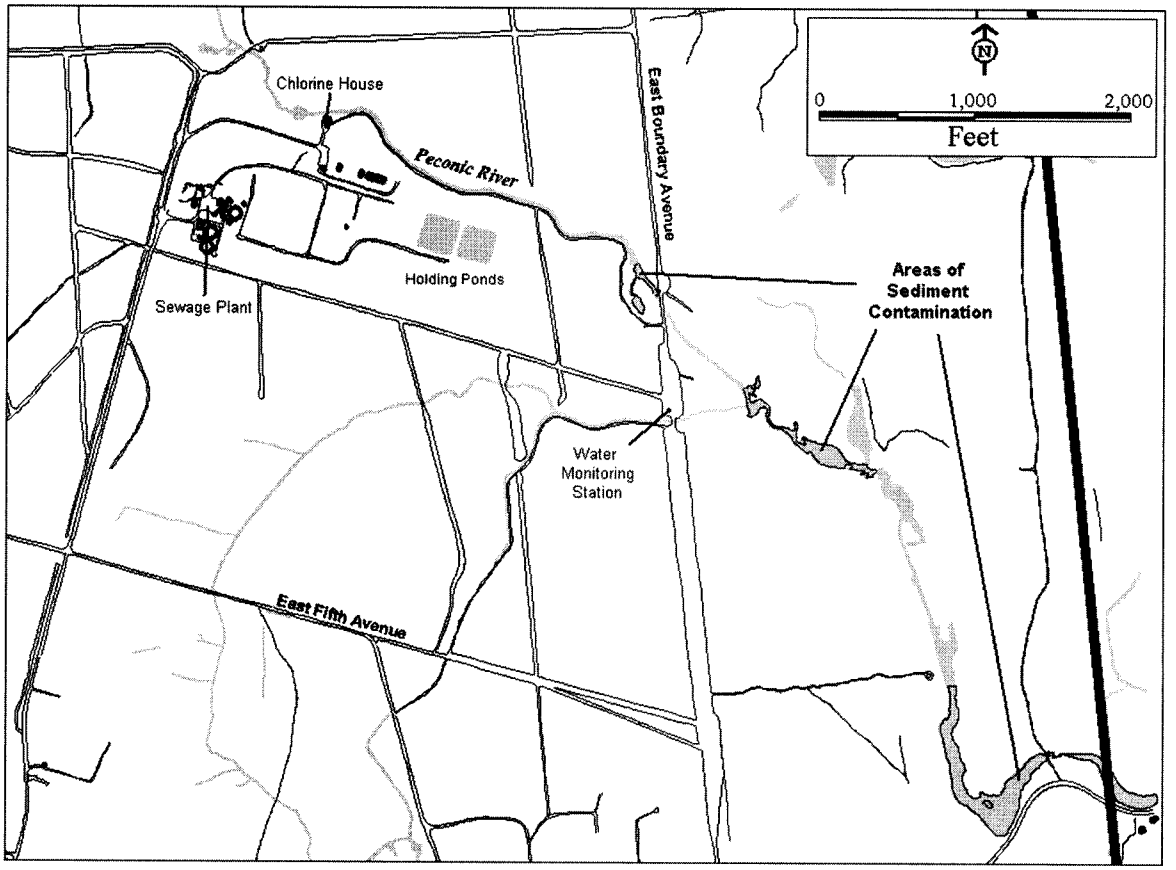
Major Long-Term Stewardship Activities - not yet specified - future use and deed restrictions, however Record of Decision is not yet finalized
Portion Size - 0.8 hectare (2 acres)
Estimated Volume of Residual Contaminants - groundwater unknown
Long-Term Stewardship Start-End Years - 2007-2034
Average Annual Long-Term Stewardship Costs FY 2000-2006 - included in the Groundwater portion costs

3.6.1 Soil

This portion consists of 0.8 hectare (two acres) of mostly surface soil contaminated with a variety of industrial facility contaminants. Radioactively contaminated soil is addressed in other site portions. The areas have been characterized via the Remedial Investigation/Feasibility Study process, and Records of Decision have been issued. The residual contamination is below levels that pose a concern for public health, and the volume of residual contamination is unknown.

Soil Long-Term Stewardship Activities

The property is owned by DOE and will remain part of Brookhaven National Laboratory. Future uses will be evaluated and restricted, as appropriate, so that future users will not be exposed to levels of contaminants above regulatory levels. Appropriate deed restrictions will be put in place if the property is transferred from DOE. In general, these Areas of Concern have been remediated to levels that can be free released, and costs for long-term



Peconic River

stewardship activities are minimal. Costs and requirements for groundwater monitoring associated with Areas of Concern included in this portion of the site are discussed above under the Groundwater portion of the site.

3.6.2 Estimated Long-Term Stewardship Costs for Rest of Site

Costs for this portion are included in the Groundwater portion costs in Section 3.2.

3.7 Peconic River

The Peconic River portion is a four-hectare (ten-acre) geographically distinct area under the Operable Unit V CERCLA program. The final cleanup remedy for contamination in the Peconic River and required long-term stewardship activities have not yet been determined. However, DOE currently assumes that portion-wide long-term stewardship activities will begin in 2007 and end in 2009.

PECONIC RIVER HIGHLIGHTS

Major Long-Term Stewardship Activities - monitoring of residually contaminated sediment
Portion Size - 4 hectares (10 acres)
Estimated Volume of Residual Contaminants - surface water/sediment - unknown
Long-Term Stewardship Start-End Years - 2007-2009
Average Annual Long-Term Stewardship Costs FY 2000-2006 - n/a (cost begin FY 2007)

3.7.1 Surface Water/Sediment

Sediment in the Peconic River, located from the discharge point of Brookhaven National Laboratory's sewage treatment plant to just beyond the site's eastern boundary, have been impacted due to historical discharges. The contaminated fine grained sediments have accumulated mainly within the top six inches of the depositional areas of the river. The final remedy for the Peconic River has not yet been made and will be contained in the Operable Unit V Record of Decision.

The locations and amounts of sediment to be removed from these areas will depend on the final remedy selected. If sediment removal is part of the final remedial action plan, then post-remediation monitoring of any reconstructed wetlands will be required, in addition to long-term monitoring of any residual contaminated sediments. Residual sediment contamination will include heavy metals, polychlorinated biphenyls, and radionuclides (primarily cesium-137). The volume of residual contamination is still undetermined and will depend on the extent of excavation.

Surface Water/Sediment Long-Term Stewardship Activities

The long-term stewardship responsibilities will be based on the final remedy (to be selected) for the Operable Unit V Record of Decision under CERCLA. No institutional and/or engineering controls have been identified for this site portion at this time.

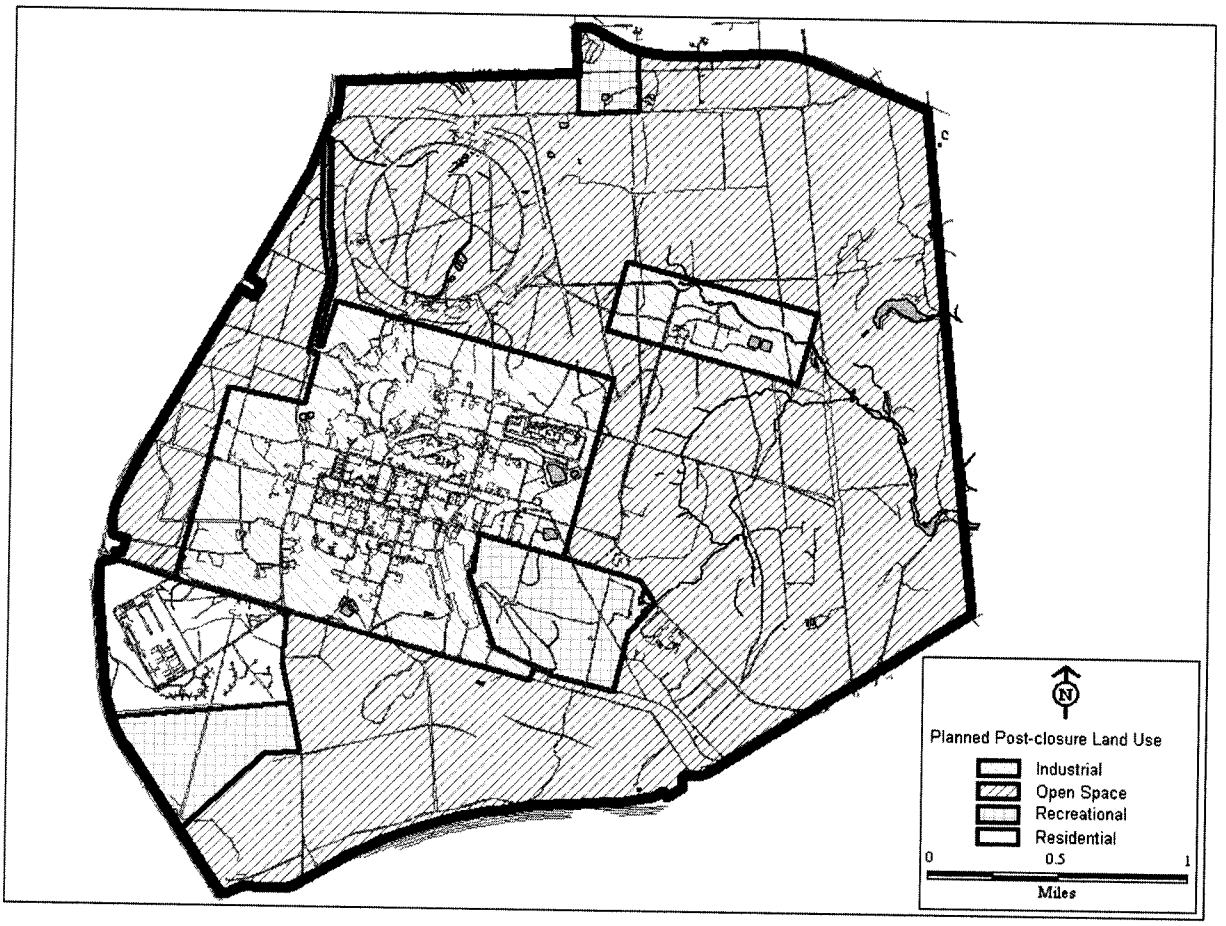
3.7.2 Estimated Long-Term Stewardship Costs for Peconic River

Long-term stewardship costs are based on DOE's assumption that post-remediation monitoring of wetlands will be needed for five years. DOE included the costs prior to the end of FY 2006 in the remediation costs in the planned Environmental Management budget. This estimate is based on Environmental Management's current planning information. If new information is received, DOE will perform additional remediation, as necessary.

Long-Term Stewardship Costs (Constant Year 2000 Dollars)							
FY 2000 - FY 2010	*FY 2011 - FY 2020*	*FY 2021 - FY 2030*	*FY 2031 - FY 2040*	*FY 2041 - FY 2050*	*FY 2051 - FY 2060*	*FY 2061 - FY 2070*	*Estimated Total*
$467,988	$0	$0	$0	$0	$0	$0	$467,988

4.0 FUTURE USES

The Future Use Site Working Group has identified future land use at the Brookhaven National Laboratory as Industrial, Residential, and Open Space/Wildlife Management. Assuming the current mission will continue for the life cycle of this estimate, future use of laboratory facilities will remain industrial, with restricted access. Residential areas currently consist of onsite housing for laboratory workers. DOE assures the future use for all other areas, outside the laboratory's structural configuration, will to be open space/wildlife management.



Land Use

For additional information about the Brookhaven National Laboratory, please contact:

John Carter
P.O. Box 500, Building 464
Upton, NY 11973-5000
Phone: 631-344-5195
or visit the Internet website at http://www.bnl.gov

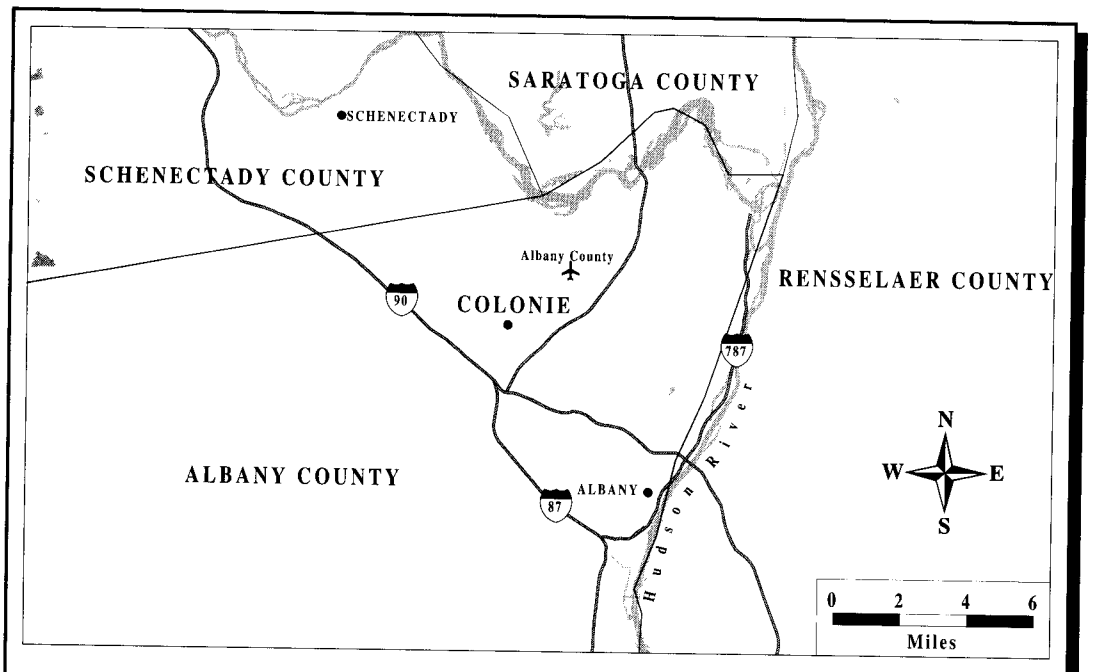
COLONIE SITE[1]

SITE SUMMARY

The Colonie Site is located in the Town of Colonie in Albany County, New York, approximately 6.5 kilometers (four miles) northwest of downtown Albany. The site consists of five buildings of varying sizes, paved surfaces, and grasslands. Land use in the vicinity of the site is primarily residential and commercial.

From the late 1930s to 1980s, National Lead Industries owned and operated the Colonie Site. The site was first used as a foundry, and it was later used to manufacture thorium and depleted uranium products under license by the Atomic Energy Commission (a predecessor agency of the U.S. Department of Energy). The operations at the Colonie Site, along with the onsite burial of manufacturing wastes, contaminated buildings, onsite soils, vicinity properties, and groundwater. The National Lead Industries building is contaminated with radioactive and chemical constituents at levels that exceed regulatory guidelines.

In 1983, Congress authorized the cleanup of the Colonie Site and nearby private properties under the Formerly Utilized Sites Remedial Action Program (FUSRAP). Congress also authorized the transfer of site ownership to the Department of Energy. Work began almost immediately to put the facility in a safe shutdown mode. Subsequent radiological surveys identified over 50 vicinity properties (adjacent residential and commercial properties) that had levels of residual radioactivity above regulatory guidelines. The primary contaminants of concern at the site are uranium, thorium, lead, copper, and tetrachlorethene (PCE). The groundwater at the site



Colonie Site

[1] The Colonie Site is one of the 21 Formerly Utilized Sites Remedial Action Program (FUSRAP) sites where cleanup responsibility was transferred to the U.S. Army Corps of Engineers (Corps) in accordance with the Energy and Water Development Appropriations Act for FY 1998. At these 21 sites, the Corps is responsible for remediation and DOE is responsible for long-term stewardship activities, if any are deemed necessary. The cleanup decisions for these sites are not yet final and, therefore, the extent of long-term stewardship required for these sites, if any, is not yet known.

is also contaminated with heavy metals and volatile organic compounds (VOCs).

Materials containing low levels of radioactivity were removed from all but three of the vicinity properties and stored inside the site's main building for future disposition. The other three properties are adjacent to the site and will be cleaned up when the site's grounds are remediated. Because the three vicinity properties that have yet to be cleaned up are uninhabited, the contamination poses little or no risk to the public.

Since environmental surveillance at the site began, analytical results have consistently shown that Colonie is not contributing significantly to radioactivity in the environment. The Corps' remedial action for this site is not yet complete and, therefore, the extent of long-term stewardship required, if any, is not yet known.

For more information about the Colonie Site, please contact:

Chief of Public Affairs
New York District
U.S. Army Corps of Engineers
Jacob K. Javits Federal Building
26 Federal Plaza
New York, NY, 10278-0090
Phone: 212-264-0100
or visit the Internet website at: http://www.nan.usace.army.mil/

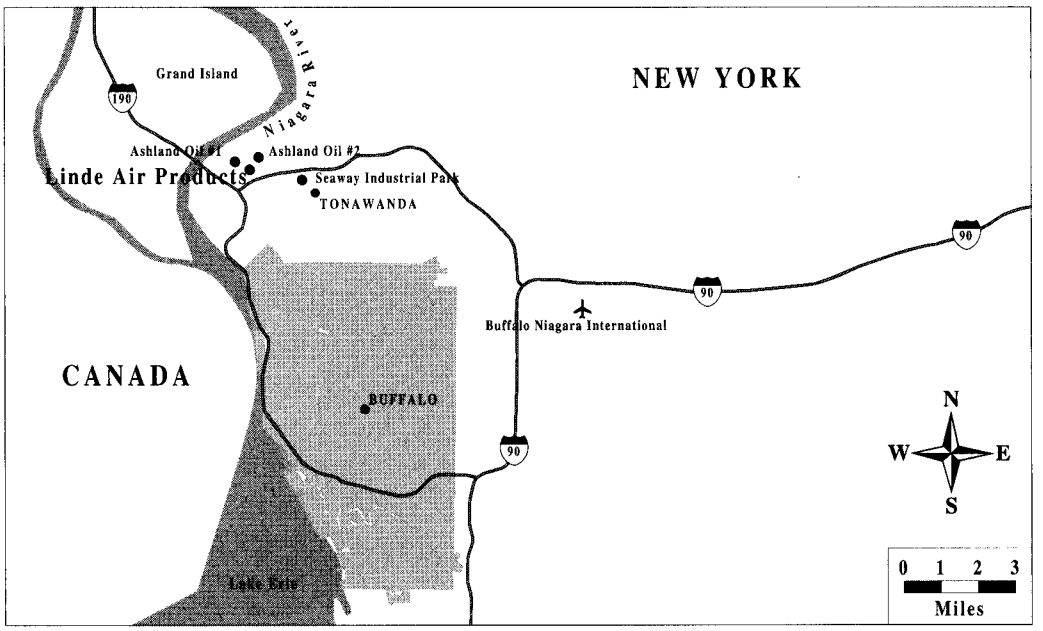
LINDE AIR PRODUCTS SITE [1]

SITE SUMMARY

The Linde Air Products Site is currently owned and operated by Praxair, Inc., as an engineering and development facility. The Linde Air Products Site is located in the Town of Tonawanda, New York, approximately five kilometers (three miles) northwest of Buffalo. The site is bordered on the north and south by industries and small businesses, on the east by Conrail railroad tracks and an open area, and on the west by a park. Numerous residential properties are located near the site.

During the 1940s, the Linde Air Products Site was used for uranium processing for the Manhattan Engineer District and the Atomic Energy Commission (AEC), predecessor agencies of the U.S. Department of Energy (DOE). Waste generated by uranium processing at the site was stored at the Ashland Oil #1 Site. Some waste residues were later moved to the adjacent Ashland Oil #2 Site and the Seaway Landfill.

The Linde Air Products Site was designated by DOE for cleanup under the Formerly Utilized Sites Remedial Action Program (FUSRAP). DOE conducted several radiological surveys that identified several radioactive constituents including uranium, radium-226, and thorium-230.



Linde Air Products

[1] The Linde Air Products Site is one of the 21 Formerly Utilized Sites Remedial Action Program (FUSRAP) sites where cleanup responsibility was transferred to the U.S. Army Corps of Engineers (Corps) in accordance with the Energy and Water Development Appropriations Act for FY 1998. At these 21 sites, the Corps is responsible for remediation and DOE is responsible for long-term stewardship activities, if any are deemed necessary. The cleanup decisions for these sites are not yet final and, therefore, the extent of long-term stewardship required for these sites, if any, is not yet known.

The Corps' remedial action for this site is not yet complete and, therefore, the extent of long-term stewardship required, if any, is not yet known.

For additional information about the Linde Air Products Site, please contact:
FUSRAP Public Information Center
Buffalo District
U.S. Army Corps of Engineers
1776 Niagara Street
Buffalo, NY 14207-3199
Phone: 800-833-6390
or visit the Internet website at: http://www.lrb.usace.army.mil

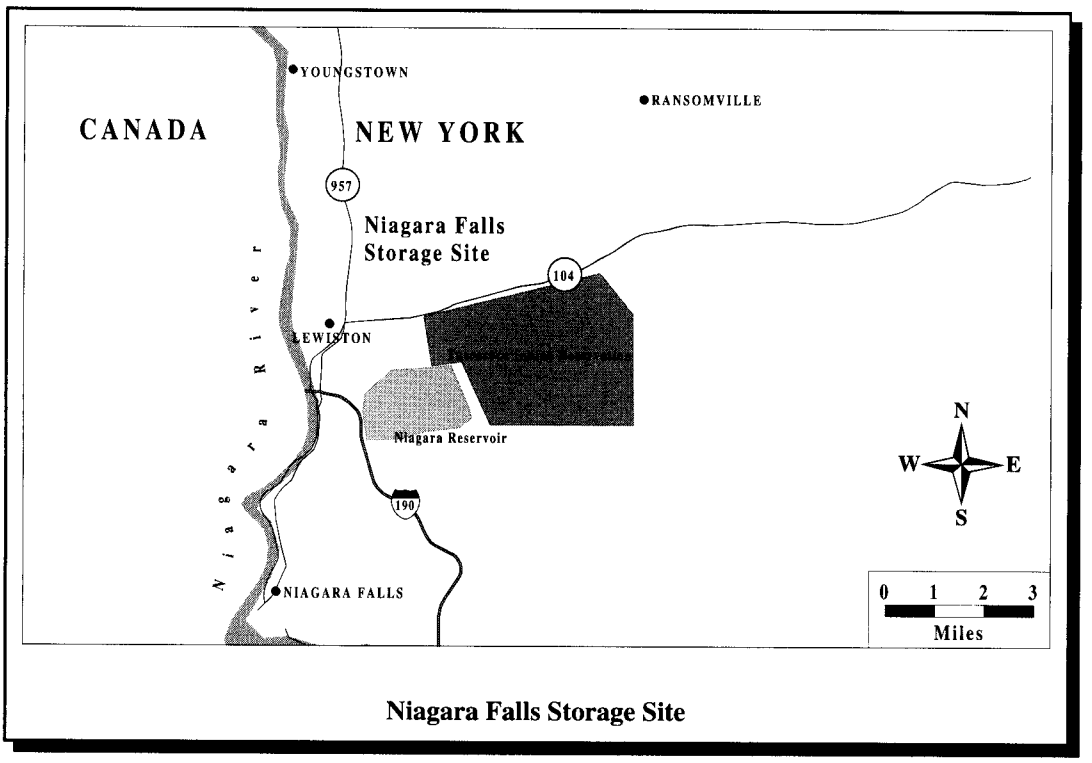
NIAGARA FALLS STORAGE SITE[1]

SITE SUMMARY

The Niagara Falls Storage Site is located in Lewiston, New York, about 16 kilometers (10 miles) north of the City of Niagara Falls. The Niagara Falls Storage Site includes a three-story building with adjacent silos, an office building, a small storage shed, a storage building, and a large engineered disposal cell. The site is bordered on the north by a chemical waste disposal facility, on the east and south by a solid waste disposal facility, and on the west by a Niagara Mohawk Power Corporation right-of-way.

The Niagara Falls Storage Site was originally part of the U.S. Army's former Lake Ontario Ordnance Works and was first used by the Manhattan Engineer District, an early predecessor agency of the U.S. Department of Energy (DOE), in 1944 for storing uranium ore processing residues. In 1948, the Atomic Energy Commission (AEC), the successor agency to MED and a predecessor agency of DOE, acquired 611 hectares (1,511 acres) of the Lake Ontario Ordnance Works, including these original storage areas. In the late 1940s and 1950s, additional residues and other radioactive waste were transported to the site from eastern and midwestern states. In 1955, major portions of the AEC site were declared as excess. By 1975, almost all of the residues and waste were consolidated on the current 77-hectare (191-acre) tract and the remainder of the initial acquisition (611 hectares) had been disposed of by the General Services Administration (GSA).

In October 1970 and June 1971, AEC conducted radiological surveys of the 523 hectares (1,320 acres) it formerly



Niagara Falls Storage Site

[1] The Niagara Falls Storage Site is one of the 21 Formerly Utilized Sites Remedial Action Program (FUSRAP) sites where cleanup responsibility was transferred to the U.S. Army Corps of Engineers (Corps) in accordance with the Energy and Water Development Appropriations Act for FY 1998. At these 21 sites, the Corps is responsible for remediation and DOE is responsible for long-term stewardship activities, if any are deemed necessary. The cleanup decisions for these sites are not yet final and, therefore, the extent of long-term stewardship required for these sites, if any, is not yet known.

held and found that some areas contained residual radioactive contamination above current guidelines. The primary contaminants of concern were radium-226 and its decay products and thorium-230. Decontamination carried out in 1972 involved the removal of over 11,000 cubic meters (over 14,000 cubic yards) of radioactive soil and debris and relocating it to the current site. In the early 1980s, DOE conducted more comprehensive characterization efforts at the storage site and vicinity properties . Radioactive contamination was detected in onsite buildings, soils, sediments, vegetation, and groundwater; radon emanation from stored and buried residues was also identified. Radioactive contamination above guidelines was also identified at several vicinity properties and locations along drainage ditches. Remedial actions on these public and private vicinity properties and drainage ditches were initiated in 1983. Cleanup was completed at all but three of the vicinity properties by late 1985. Radium226 concentrations in groundwater did not exceed guidelines for uncontrolled-access sites at either onsite or offsite sampling locations.

In the 1980s, DOE consolidated the radioactive materials in a large engineered disposal cell. The area containing the wastes and residues was covered with an interim clay cap and re-seeded. The cap was designed to retard radon emissions and rainwater infiltration.

The Corps' remedial action for this site is not yet complete and, therefore, the extent of long-term stewardship required, if any, is not yet known.

For additional information about the Niagara Falls Storage Site, please contact:

FUSRAP Public Information Center
Buffalo District
U.S. Army Corps of Engineers
1776 Niagara Street
Buffalo, NY 14207-3199
Phone: 800-833-6390
or visit the Internet website at: http://www.lrb.usace.army.mil

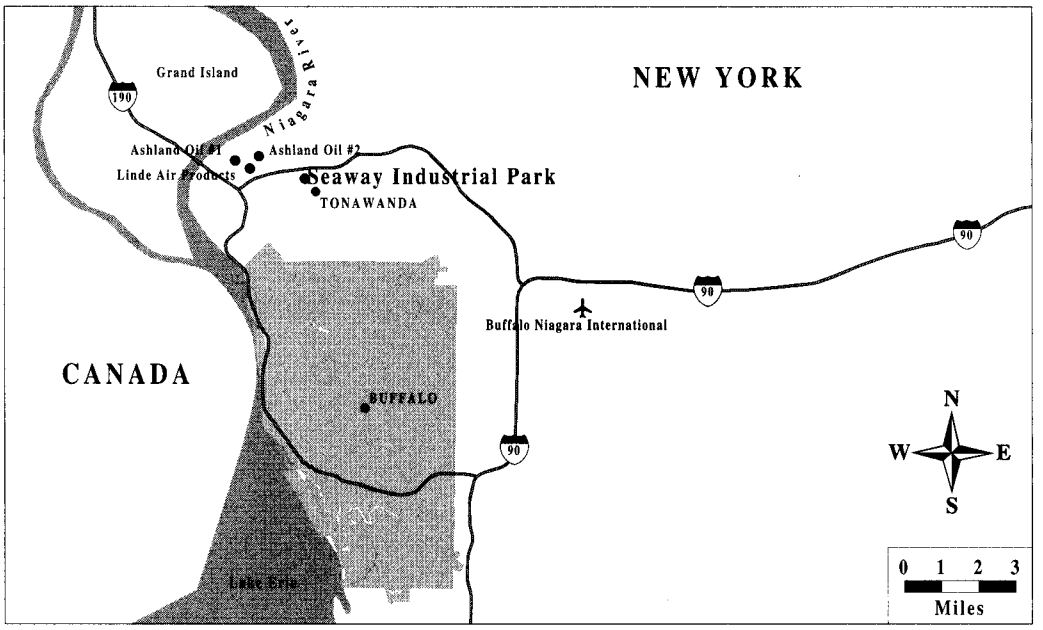
SEAWAY INDUSTRIAL PARK SITE [1]

SITE SUMMARY

The Seaway Industrial Park Site is located in an industrial area of Tonawanda, New York, approximately five kilometers (three miles) northwest of Buffalo. The property is bordered on the north by River Road, on the east and south by a Niagara Mohawk Power Company easement, on the southwest by the Ashland Oil #1 Site, and on the west by United Oil refinery property. The Seaway Industrial Park, owned by the Seaway Industrial Development Company, was used as an industrial landfill.

In the 1970s, the Ashland Oil Company moved radioactively contaminated soil from the Ashland Oil #1 Site to three areas of the Seaway Industrial Park landfill. Subsequent investigations determined that the soil from the Ashland Site contained radioactive contaminants exceeding U.S. Department of Energy (DOE) guidelines.

A remedial investigation of the Seaway Industrial Park Site determined that the primary contaminants of concern are uranium, radium-226, and thorium-230. The area with the greatest concentration of radioactivity is located on the surface. In the other two areas, the radioactive contaminants are buried beneath refuse. A fourth area on the southeastern edge of the Seaway property is contiguous with the radioactive material on the Ashland Oil #1 Site.



Seaway Industrial Park Site

[1] The Seaway Industrial Park Site is one of the 21 Formerly Utilized Sites Remedial Action Program (FUSRAP) sites where cleanup responsibility was transferred to the U.S. Army Corps of Engineers (Corps) in accordance with the Energy and Water Development Appropriations Act for FY 1998. At these 21 sites, the Corps is responsible for remediation and DOE is responsible for long-term stewardship activities, if any are deemed necessary. The cleanup decisions for these sites are not yet final and, therefore, the extent of long-term stewardship required for these sites, if any, is not yet known.

The Corps' remedial action for this site is not yet complete and, therefore, the extent of long-term stewardship required, if any, is not yet known. The Ashland #1 Site, Ashland #2 Site, Seaway Industrial Park Site, and Linde Air Products Site are included in the Tonawanda Site integrated environmental documentation process to comply with requirements of the *Comprehensive Environmental Response, Compensation, and Liability Act* and the *National Environmental Policy Act.*

For additional information about the Seaway Industrial Park Site, please contact:
FUSRAP Public Information Center
Buffalo District
U.S. Army Corps of Engineers
1776 Niagara Street
Buffalo, NY 14207-3199
Phone: 800-833-6390
or visit the Internet website at: http://www.lrb.usace.army.mil

SEPARATION PROCESS RESEARCH UNIT[1]

1.0 SITE SUMMARY

1.1 Site Description and Mission

> ***LONG-TERM STEWARDSHIP HIGHLIGHTS***
>
> *Total Site Area* - 8 hectares (20 acres)
> *Current Landlord* - U.S. Department of Energy, Office of Naval Reactors
> *Expected Future Landlord* - U.S. Department of Energy, Office of Naval Reactors
> *Reason Not Subject to NDAA Requirements* - Cleanup activities will not be completed until 2014. The nature and extent of long-term stewardship activities at the sites are unknown at this time.

The Separations Process Research Unit (SPRU) is a former chemical processing pilot plant at Knolls Atomic Power Laboratory that operated in the 1950s. The unit is located approximately 3.2 kilometers (two miles) east of Schenectady, New York in the northeastern part of Schenectady County. The unit occupies approximately eight hectares (20 acres)of the 68-hectare (170-acre) Knolls Atomic Power Laboratory. The SPRU consists primarily of two interconnected buildings: Building G-2 that housed the separations process systems and Building H-2 that housed the liquid waste processing systems. These buildings are approximately 23 meters (75 feet) apart and are connected by an underground pipe tunnel. Additional onsite facilities consist of the tunnel area, tank farm, and waste storage areas. Portions of the two buildings are used as office areas or waste processing facilities; however, parts of the lower levels of the buildings remain substantially contaminated with radioactive materials. Therefore, these areas are not used and have been physically isolated.

The SPRU was constructed in 1950 by the U.S. Atomic Energy Commission (a predecessor agency to DOE) as a pilot plant for developing and testing two chemical processes, (i.e., the Reduction and Oxidation Process and the Plutonium-Uranium Extraction Process), for extracting uranium and plutonium from irradiated fuel. The facility was operated by the Materials Production Division of the Atomic Energy Commission during the early 1950s. The facility also was used to support operations at the Hanford Site (in the State of Washington) and the Savannah River Site (in the State of South Carolina).
The SPRU has been in standby status since 1953. Until decontamination and decommissioning activities begin, an onsite surveillance and maintenance program is in place to ensure that the facility remains in a stable condition and that it does not present a risk to the public, the environment, or the onsite work force. In January 2000, DOE's Oakland Operations Office awarded a contract for Phase I (characterization) of the SPRU cleanup project, which is to be completed in 2006.

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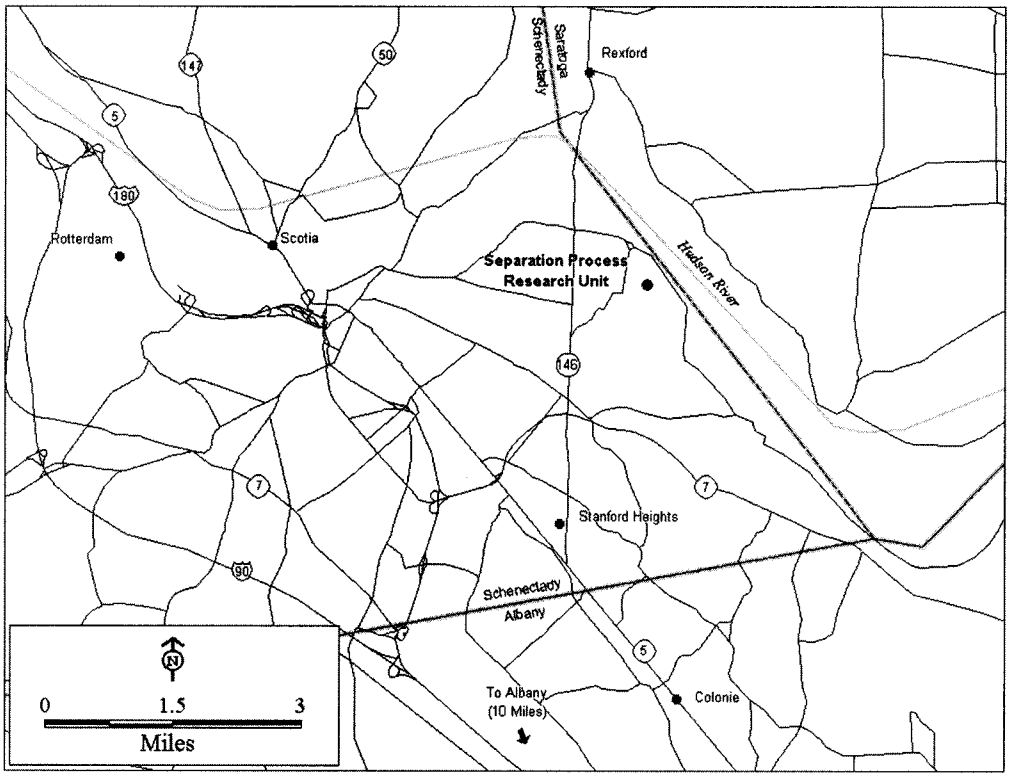
[1]This report is developed in response to a Congressional mandate in the Fiscal Year (FY) 2000 National Defense Authorization Act (NDAA). As directed by the Act, this report addresses current and anticipated long-term stewardship activities at each site, or portions of a site, by the end of calendar year 2006 ("Conference Report on S. 1059, National Defense Authorization Act for Fiscal Year 2000," *Congressional Record*, August 5, 1999).

Based on current planning, cleanup activities at the Separation Process Research Unit site are not expected to be completed until 2014 and, for this reason, the site is not within the scope of this report. The nature and extent of long-term stewardship activities are unknown at this point. This summary of the site is included to provide to assist in documenting the U.S. Department of Energy's (DOE) role at the site.



Separation Process Research Unit

1.2 Site Cleanup and Accomplishments

Activities at SPRU are in the initial characterization phase, and currently there is no long-term surveillance and maintenance planned in the scope of this project. Based on earlier surveys, soil and facilities at SPRU are contaminated with mixed fission products, including plutonium, americium, uranium, strontium, and cesium. DOE has not begun characterization activities for SPRU. To date, only limited remediation of the site has been completed. Liquid has been removed from process tanks and equipment process lines, and interior spaces of buildings have been partially decontaminated. DOE's Office of Environmental Management plans to complete cleanup of SPRU by 2014. The majority of the cleanup is expected to occur between 2006 and 2014.

CURRENT SITE ACCOMPLISHMENTS

- Awarded contract for phase I of site cleanup

BY 2006, DOE WILL

- Complete site and facility characterization
- Complete RCRA Feasibility Investigation

The proposed action is to decontaminate and demolish two buildings and the associated ancillary facility structures, including the underground tank farm and pipe tunnels. Environmental restoration is being accomplished in three phases. Phase I of the cleanup effort involves identifying the specific nature and extent of contamination of the buildings and facilities and of the surrounding environmental media (including surface and subsurface soils, surface water and groundwater); conducting a *Resource Conservation and Recovery Act* Facility Investigation for the solid waste management units and areas of concern attributed to activities conducted at the SPRU; evaluating characterization alternatives and technologies; estimating the occupational and public

health and safety impacts that will be encountered during the conduct of characterization activities; and implementing interim corrective measures, if necessary. Phase II consists of facility decontamination and dismantlement, waste disposal, completion of a corrective measures study, and implementation of interim corrective measures for areas, including groundwater, requiring further corrective actions. Phase III consists of final site surveys.

Surveillance and maintenance of deactivated facilities will continue until decontamination and decommissioning activities are completed. All radiological and hazardous waste (i.e., low-level waste, mixed low-level waste, transuranic waste, and mixed transuranic waste) will be disposed of at offsite locations. Contaminated onsite soil will be remediated. Soil remediation will likely involve excavating the contaminated soil, backfilling these areas with clean fill (i.e., replacing the area with uncontaminated soil), and covering with top soil to grade. Although the site has not been characterized, remediation of water resources has not been planned.

2.0 POTENTIAL LONG-TERM STEWARDSHIP ACTIVITIES

The nature and extent of long-term stewardship activities to be conducted after the completion of site cleanup is unknown at this time.

3.0 EXPECTED FUTURE USES AND SITE RESPONSIBILITY

The cleaned up SPRU areas will remain part of the Knolls Atomic Power Laboratory, which is expected to continue its operating mission for the Naval Nuclear Propulsion Program.

For additional information about the Separation Process Research Unit, please contact:

James Davis III
U.S. Department of Energy, Oakland Environmental Program Division
1301 Clay St., N700
Oakland, CA 94612
Phone: 510-637-1634
james.davisIII@oak.doe.gov
or visit the Internet website at http://www.doe.gov

WEST VALLEY DEMONSTRATION PROJECT[1]

1.0 SITE SUMMARY

1.1 Site Description and Mission

From 1966 to 1972, the West Valley site reprocessed 640 metric tons uranium (MTUs) of commercial and United States Atomic Energy Commission (AEC) spent nuclear fuel to recover uranium and plutonium. The former spent fuel reprocessing site, which is owned by the State of New York, occupies 90 hectares (230 acres) within the 1,320 hectare (3,300 acre) tract of land called the Western New York Nuclear Service Center (WNYNSC). The site is located approximately 48 kilometers (30 miles) south of Buffalo, New York.

SITE HIGHLIGHTS

Total Site Area - 90 hectares (230 acres)
Current Landlord - U.S. Department of Energy; New York State Energy Research and Development Authority
Expected Future Landlord - New York State Energy Research and Development Authority
Reason Not Subject to NDAA Requirements - Decisions not yet made on responsibility for long-term stewardship activities

The reprocessing of spent nuclear fuel was conducted by Nuclear Fuel Services, under contract to the State of New York and under license by the AEC (a predecessor agency to the U.S. Department of Energy [DOE] and the U.S. Nuclear Regulatory Commission [NRC]). The facility was shut down in 1972 for modifications to increase its seismic stability and to expand capacity. In 1976, without restarting the operation, Nuclear Fuel Services withdrew from the reprocessing business and indicated its intent not to renew its lease with the site owner, the New York State Energy Research and Development Authority (NYSERDA). The reprocessing activities resulted in 2,000,000 liters (600,000 gallons) of liquid high-level radioactive waste (HLW), stored below ground in HLW tanks, and other radioactive wastes and residual radioactive contamination. The site is also managing 125 spent nuclear fuel elements until they can be shipped to the Idaho National Engineering and Environmental Laboratory in 2001.

The West Valley site was licensed by the AEC, and then the NRC, until 1981, when the license was suspended to execute the 1980 West Valley Demonstration Project (WVDP) Act (P.L. 96-368). In accordance with the WVDP Act, DOE and NYSERDA entered into a Cooperative Agreement effective October 1, 1980, and amended September 1981. The WVDP Act authorized DOE, in cooperation with NYSERDA, to: (1) carry out a liquid HLW management demonstration project; (2) solidify, transport, and dispose of the HLW at the site; (3) dispose of low-level waste (LLW) and transuranic waste produced by the WVDP, in accordance with applicable license requirements; and (4) decontaminate and decommission facilities used for the WVDP, in accordance with requirements prescribed by the NRC. The NRC is responsible for prescribing decontamination and decommissioning criteria (even though the NRC license is suspended until completion of the Demonstration Project). NYSERDA is responsible for all site facilities and areas outside the scope of the WVDP Act and the

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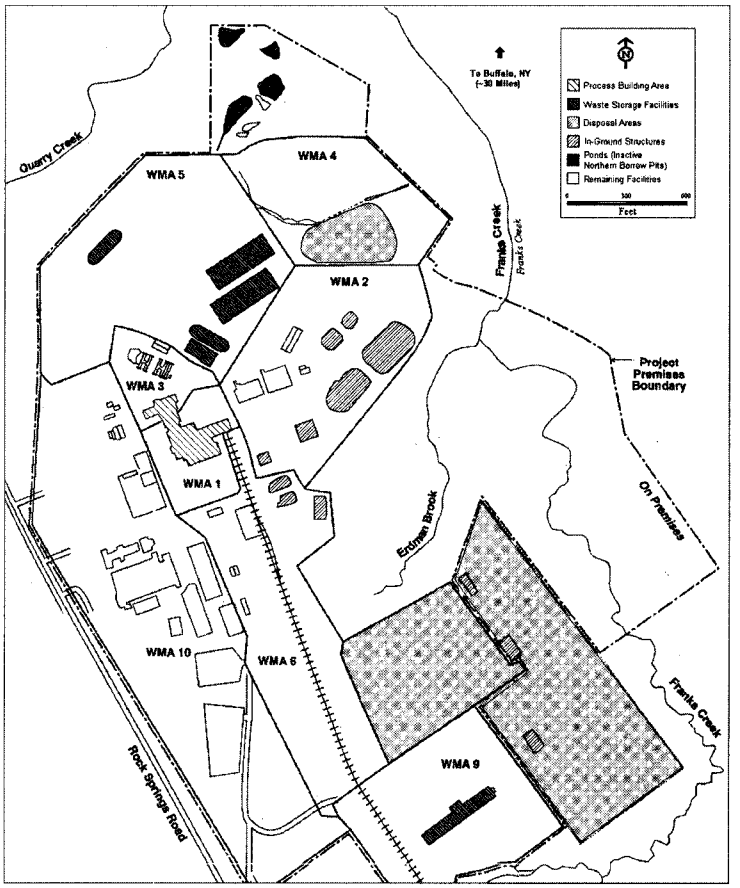
[1]This report is developed in response to a Congressional request in the Fiscal Year (FY) 2000 National Defense Authorization Act (NDAA). As requested by the Act, this report addresses current and anticipated long-term stewardship activities at each site or portion of a site by the end of calendar year 2006 ("Conference Report on S.1059, National Defense Authorization Act for Fiscal Year 2000," *Congressional Record,* August 5, 1999).

DOE does not own property at the West Valley Demonstration Project, and the decision has not been made regarding who will be responsible for long-term stewardship activities at the site. This summary of the site cleanup and future use is provided to assist in documenting DOE's role at the site. DOE does have a current mission at the site and is responsible for decommissioning the facilities in accordance with the *West Valley Demonstration Project Act.* (See Section 2.1.2 of Volume I).

Cooperative Agreement.

1.2 Site Cleanup and Accomplishments

The WVDP is currently removing liquid HLW from underground HLW tanks at the site, vitrifying it, and storing it onsite for eventual offsite disposal in a Federal repository. The primary vitrification campaign began in June 1996 and was completed ahead of schedule in June 1998. Vitrification of the HLW tank heels is currently underway and is scheduled to be completed in FY 2001. Following the vitrification of the HLW and completion of Environmental Impact Statements (EISs) for facility decontamination and waste management, and closure or long-term site management, the equipment and facilities used in carrying out the project will be decontaminated and decommissioned.



West Valley Demonstration Project

The NRC published a draft policy statement on December 3, 1999, describing the Commission's decision to use the License Termination Rule (62 FR 39058, July 21, 1997) as general decontamination and decommissioning criteria for the WVDP. Specific criteria will be prescribed following completion of an EIS for facility closure or long-term management. This EIS is planned to be initiated in the near future.

An EIS for project completion and site closure or long-term management was initiated in 1989. After public review of the draft EIS, NYSERDA, with cooperation from DOE, convened a West Valley Citizen Task Force (CTF) in early 1997 to obtain stakeholder input. CTF recommendations were provided in 1998 as advice to DOE and NYSERDA in the development of a preferred alternative. The CTF generally does not believe the West Valley site is suitable for long-term isolation of waste and, therefore, favors disposal of the waste offsite at suitable and safe disposal facilities. However, the CTF recognizes that some wastes may not be able to be removed from the site in the near future. Currently, DOE and NYSERDA are working together with stakeholders and with NRC to formulate a preferred alternative for closure or long-term management of the site.

The DOE recently announced to the CTF, other stakeholders, and involved agencies its plan to modify the current EIS process by reducing the scope of the existing Project completion and site closure or long-term management EIS (DOE/EIS-0226-D) to include only the evaluation of DOE responsibilities for decontamination and waste management for Project facilities. This will allow the DOE to make decisions on activities for which it is solely responsible under the WVDP Act, and to efficiently transition from HLW vitrification into facility

decontamination and offsite waste disposition. DOE envisions this decontamination and waste management EIS process to be completed within two years. The DOE also announced its plan to initiate a separate EIS to evaluate facility closure, long-term management, and stewardship alternatives for the WVDP and the WNYNSC, because of the difficult regulatory and stakeholder issues associated with agency decision-making on these actions. The DOE plans to prepare this EIS jointly with NYSERDA, and to include the NRC as a cooperating agency and the New York State Department of Environmental Conservation as an involved agency. The outcome of the ongoing discussions between DOE and NYSERDA to determine a preferred alternative will be reflected in this new EIS for facility closure and/or long-term management. Current conservative schedules indicate that this new EIS would be completed in the 2005 timeframe. Federal and/or state long-term stewardship responsibilities, if required as a result of decisions made under the closure or long-term management EIS, will be identified in the Record of Decision.

The major areas for which this two-EIS process will determine a path forward for WVDP project completion and Western New York Nuclear Service Center site closure or long-term management involve the following major facilities and areas:

- **Underground High-Level Waste Storage Tanks**

  There are four underground waste storage tanks at the WNYNSC, that were part of the spent nuclear fuel reprocessing system, including two large carbon steel tanks, each with a capacity of 2.8 million L (750,000 gallons) and two smaller stainless steel tanks, each with a capacity of 51,000 L (13,500 gallons). One of the large tanks was used to store liquid HLW from reprocessing operations, and the other was maintained as an empty spare tank. The WVDP later used the spare tank to house its Supernatant Treatment System ion exchange columns that were used during HLW pretreatment and vitrification operations. During spent fuel reprocessing operations, one of the smaller tanks was used to hold waste from a THOREX reprocessing run, and was later used by the WVDP for receiving wastes from the vitrification waste header system after the THOREX waste was removed. The second smaller tank was not used during reprocessing, but the WVDP later used the tank to contain decontaminated supernatant and decontaminated HLW sludge wash water prior to solidification of these wastes in cement.

  The DOE is currently removing and vitrifying tank heel waste from the HLW tanks, and will continue to do so to the extent technically and economically practical. DOE will make decisions on removing any in-tank components that were installed as part of HLW operations after the decontamination and waste management EIS is prepared and evaluated. Decisions on final disposition of the HLW tanks will be made following completion of the closure or long-term management EIS. Final disposition alternatives to be evaluated will include, at a minimum, exhuming the tanks for offsite disposal or grouting and closing the tanks in place with long-term monitoring and maintenance.

- **Vitrification Facility**

  The DOE constructed a new facility to be used for vitrifying HLW. The new facility was located adjacent to and connected with the former fuel reprocessing building to make use of existing reprocessing facility structure for vitrification support systems and HLW canister storage. The newly constructed vitrification facility consists of a stainless steel-lined concrete cell which houses the vitrification melter and supporting HLW solidification systems, along with ancillary areas around the outside of the cell for control and maintenance of vitrification operations. The interior of the vitrification cell can only be accessed remotely because of high levels of radiation associated with HLW vitrification.

  The WVDP is currently developing plans to flush the vitrification system, and is also segregating and

volume-reducing expended components associated with vitrification. Decisions on vitrification facility decontamination and disposition of system components will be made following preparation of the EIS for decontamination and waste management. Final disposition of the facility structure itself will be decided following completion of the closure or long-term management EIS. Alternatives that may be evaluated for facility disposition include complete removal of the facility, and in-place closure with long-term monitoring and maintenance.

- **Former Spent Nuclear Fuel Reprocessing Building**

The former spent nuclear fuel reprocessing building consists of a series of thick-walled concrete cells and adjacent aisles and areas that housed the mechanical and chemical systems used by Nuclear Fuel Services to process spent nuclear fuel to recover uranium and plutonium for subsequent reuse in the nuclear industry. This facility operated from 1966 through 1972 under a Provisional Operating License issued by the AEC. The building covers an area of approximately 82 x 40 m (270 x 130 ft.) and is several stories tall. Nuclear Fuel Services performed decontamination activities following cessation of reprocessing operations, and the WVDP performed additional decontamination during the 1980's in order to reduce personnel radiation doses and to prepare and install systems in some areas of the building that would support vitrification operations. However, some areas of the building were not decontaminated and remain highly contaminated as a result of fuel reprocessing operations. These areas can only be accessed remotely. In addition, one large cell in the former reprocessing building is being used for interim storage of the vitrified HLW canisters, pending their eventual removal from the site for final disposal.

The DOE is currently performing limited decontamination in certain areas of the building, and is also preparing to access two of the more highly contaminated areas to perform limited waste removal. Decisions on the extent of more comprehensive building decontamination and waste disposal will be made following completion of the decontamination and waste management EIS. Final disposition of the building itself will be made following completion of the closure or long-term management EIS. Alternatives to be evaluated in the closure or long-term management EIS will include, at a minimum, complete removal of the building, and in-place closure with long-term monitoring and maintenance. A leak during reprocessing operations also produced a source of Strontium-90 contamination in a groundwater plume located beneath and downgradient of the building. Decisions on disposition of the reprocessing facility will consider the source of the groundwater contamination, and will be integrated with decisions on management of the contaminated groundwater plume.

- **Nuclear Regulatory Commission-licensed Disposal Area (NDA)**

The Nuclear Regulatory Commission-Licensed Disposal Area (NDA) is a 5.5-acre inactive waste disposal site that was used by Nuclear Fuel Services to dispose of higher activity waste from reprocessing operations. It was subsequently used by DOE from 1982 until 1986 to dispose of some wastes that resulted from systems operations and facility decontamination activities. The NDA is estimated to contain approximately 360,000 cubic feet of waste, and a total of 300,000 curies (decay corrected to year 2000). Estimated disposals of WVDP waste in the NDA account for more than 50% of the total volume of waste disposed, but less than 1% of the curies.

Final decisions on disposition of the NDA will be made following completion of the EIS for closure or long-term management. Alternatives that will be considered include, at a minimum, exhumation and offsite waste disposal, and in-place closure and long-term management.

- **State-licensed Disposal Area (SDA)**

  The State-Licensed Disposal Area (SDA) is a 16-acre inactive waste disposal site that was permitted and operated by the State of New York, via Nuclear Fuel Services, from 1963 until 1975 for commercial receipt and burial of wastes from a wide variety of radioactive waste generators and for disposal of lower activity waste from West Valley spent fuel reprocessing operations. This disposal area is located adjacent to the NDA, and is still managed entirely by the State of New York. It is estimated that the SDA may contain more than 2.5 million cubic feet of waste and more than 200,000 curies (decay corrected to year 2000).

  NYSERDA will make a decision on disposition of the SDA following completion of the closure or long-term management EIS. Alternatives that will be evaluated include, at a minimum, exhumation and offsite waste disposal, or in-place closure and long-term monitoring and maintenance.

2.0 POTENTIAL LONG-TERM STEWARDSHIP ACTIVITIES

Since the EIS for closure or long-term management of the WVDP and the WNYNSC has yet to be prepared, the site end-state has yet to be determined. That EIS will be used to evaluate alternatives that will require long-term surveillance and maintenance, as well as the use of institutional controls. Even though final decisions have not been made regarding long-tem stewardship responsibilities at the site, it is expected that some of the areas and facilities discussed may require long-term stewardship activities.

For example, if decisions are made to close any of the previously discussed structures or facilities in place, it is anticipated that a long-term stewardship program would be required. While not yet defined, this stewardship program would be expected to involve a regimen of actions, including monitoring and maintenance of physical controls, including fencing and signage as well as engineered barriers such as caps, along with an environmental monitoring program to verify continued performance of the closed units and to ensure timely identification of any problems that may develop. Components of a long-term stewardship program will be developed and evaluated in the closure or long-term management EIS, where appropriate, according to the alternatives that will be evaluated in that EIS. DOE recognizes that stewardship requirements and responsibilities must be identified and evaluated as part of decision making for ultimate disposition of WVDP facilities.

The length of time that may be required for stewardship of Project facilities, groundwater contamination, and the disposal areas could vary, based on the nature of the wastes and the radionuclides contained within that waste. The Strontium-90 contamination in the groundwater plume would be expected to decay to background levels within 300 years. However, other longer-lived radionuclides such as Uranium and Plutonium in other units on the site could require perpetual stewardship because of their long half-lives.

3.0 EXPECTED FUTURE USE

NYSERDA owns the entire 3,300 site, including the WVDP. DOE does not anticipate any future Federal use of the site or facilities upon completion of the requirements of the WVDP Act. However, since decisions on the end state of the WVDP have not yet been made, nor the impacts cumulatively assessed, it is premature to assume that DOE will not have any long-term stewardship obligations at the West Valley site. The ultimate future use of the site, as well as the ultimate site steward, will be determined, in part, by any long-term stewardship requirements that are a part of the selected closure or long-term management alternative for the WVDP and WNYNSC.

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Ohio

Long-Term Stewardship Site Highlights

Ashtabula Environmental Management Project (page 3)
Site Size - 14 hectares (35 acres)
Current Landlord - RMI Titanium Corporation
Expected Future Landlord - RMI Titanium Corporation

Battelle Columbus Laboratory - King Avenue (page 7)
Site Size - 2.4 hectares (6 acres)
Current Landlord - DOE Environmental Management Program; Battelle Memorial Institute
Expected Future Landlord - Battelle Memorial Institute

Battelle Columbus Laboratory - West Jefferson (page 9)
Site Size - 440 hectares (1,100 acres)
Current Landlord - DOE Environmental Management Program; Battelle Memorial Institute
Expected Future Landlord - Battelle Memorial Institute

Fernald Environmental Management Project (page 11)
Major Activities - access restrictions; institutional controls; engineered unit maintenance and monitoring
Site Size - 420 hectares (1,050 acres)
Start/End Years - 2007/in perpetuity
Estimated Average Annual Cost FY 2000-2006 - n/a (costs begin in FY 2007)

Luckey Site (page 25)
unknown

Miamisburg Environmental Management Project (page 27)
Major Activities - monitoring; institutional controls
Site Size - 124 hectares (306 acres)
Start/End Years - 2007/in perpetuity
Estimated Average Annual Cost FY 2000 - 2006 $50,000

Painesville Site (page 35)
unknown

Piqua Decommissioned Reactor Site (page 37)
Major Activities - continuation of the environmental radiological monitoring program
Site Size - 0.2 hectares (0.5 acres)
Start/End Years - 1998/2018
Estimated Average Annual Cost FY 2000-2006 - $18,000

Portsmouth Gaseous Diffusion Plant (page 41)
Major Activities - maintaining engineered barriers; monitoring ground and surface water; enforcing institutional controls; restricting access
Site Size -1,497 hectares (3,714 acres)
Estimated Average Annual Cost FY 2000-2006 - $6,258,000

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ASHTABULA ENVIRONMENTAL MANAGEMENT PROJECT[1]

1.0 SITE SUMMARY

1.1 Site Description and Mission

The Ashtabula Environmental Management Project (also formerly known as the RMI Titanium Company Site or Ashtabula) is the location of a former uranium extrusion plant that extruded uranium billets into feedstock for fuel fabrication from 1954 to 1966. The Ashtabula site is located in northern Ashtabula County, Ohio, about five kilometers (three miles) northeast of the center of the City of Ashtabula and 1.6 kilometers (one mile) south of Lake Erie, in a sparsely populated, highly industrialized area.

SITE HIGHLIGHTS

Total Site Area - 14 hectares (35 acres)
Current Landlord - RMI Titanium Corporation
Expected Future Landlord - RMI Titanium Corporation
Reason Not Subject to NDAA Requirements - This site is owned by a private owner, and the DOE's long-term stewardship, if any, is still being assessed.

The Ashtabula site is subdivided into seven major areas, designated as Areas A through G. The physical facilities that comprise the former extrusion plant site consist of 26 buildings in Area B that occupy approximately three hectares (seven acres) of the 14-hectare (35-acre) site. An additional 3.2 hectares (eight acres) of the properties immediately adjacent to the site on the west side are included within the scope of the remediation activities. Of the 26 buildings on the site, RMI owns 13 and the U.S. Department of Energy (DOE) owns the other thirteen. No land at the site is owned by DOE.

The current mission of the site is to complete remediation activities. The historical mission of the Ashtabula site was to receive uranium billets from the Fernald Feed Materials Production Center (near Cincinnati, Ohio) and the Weldon Spring Plant (near St. Louis, Missouri) and extrude them into feed stock for fabrication of fuel and target elements used in nuclear materials production reactors. The Bridgeport Brass Company of Adrian, Michigan owned and operated the site from 1954 to 1961, and extruded uranium for the U.S. Government. The RMI Titanium Company (RMI), formerly Reactive Metals Inc., took over the ownership and operation of the site in 1962. RMI extruded uranium for the U.S. Government until it ceased production in October 1990.

RMI and several other nearby chemical production and metal conversion facilities discharged waste material into Fields Brook, a west-flowing Superfund site that joins the Ashtabula River, which then flows to Lake Erie. Past discharges from these industrial sources have contaminated the sediment in Fields Brook with polychlorinated biphenyls, chlorinated solvents, and heavy metals. In 1983, the U.S. Environmental Protection Agency placed Fields Brook on the National Priorities List (NPL) and identified RMI as one of 32 potentially responsible parties for the cleanup of the contaminated sediments. Because some of the work conducted by RMI supported DOE missions, DOE has assumed responsibility for a proportionate share of the cleanup costs.

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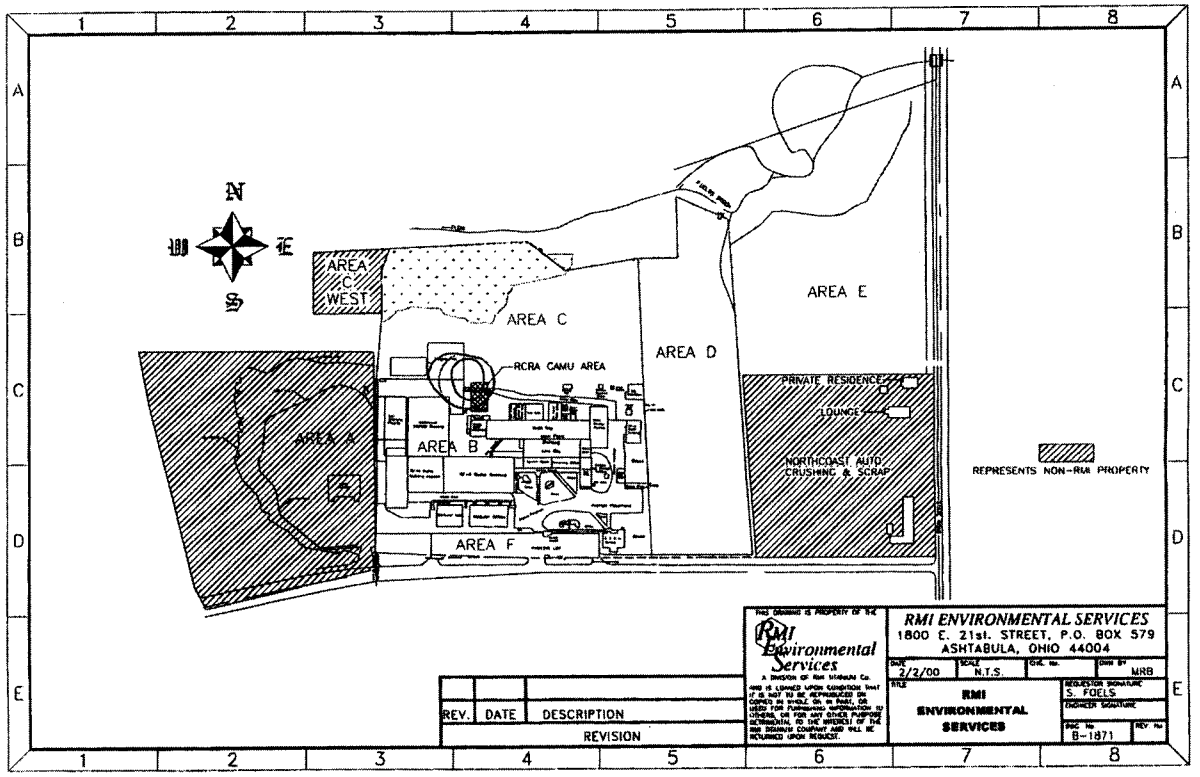
[1]This report is developed in response to a Congressional request in the Fiscal Year (FY) 2000 National Defense Authorization Act (NDAA). As requested by the Act, this report addresses current and anticipated long-term stewardship activities at each site or portion of a site by the end of calendar year 2006 ("Conference Report on S.1059, National Defense Authorization Act for Fiscal Year 2000," *Congressional Record,* August 5, 1999).

The U.S. Department of Energy (DOE) is evaluating potential long-term stewardship responsibility at the Ashtabula Environmental Management Project site. This summary of the site is provided to assist in documenting DOE's role at the site. (See Section 2.1.2 of Volume I).



Ashtabula Environmental Management Project

1.2 Site Cleanup and Accomplishments

The DOE Environmental Management program has managed the cleanup of the Ashtabula Environmental Management Project since 1993. Twenty-six years of handling, extruding, forging, and machining uranium at the facility have resulted in onsite and offsite contamination of buildings and environmental media. Most of the buildings onsite contain some level of uranium contamination, and radioactive contaminants are present in both onsite and offsite soils. Trichloroethylene is present in both soils and groundwater.

As a result of an agreement with the U.S. Nuclear Regulatory Commission (NRC), the Ohio Department of Health is responsible for providing regulatory oversight of all remediation of radioactive contamination at the site. Regulatory oversight for the remediation of non-radioactive contamination is the responsibility of the Ohio Environmental Protection Agency (OEPA).

Groundwater

Groundwater is contaminated with trichloroethylene from a spill that occurred during plant operation, as well as uranium and technetium-99. This area has been designated as a corrective action management unit (CAMU) by the U.S. Environmental Protection Agency (EPA) and will be remediated in accordance with the requirements of the *Resource Conservation and Recovery Act* (RCRA) permit that EPA issued to RMI. Although the pump-and-treat process was originally approved, the current plan is to use prefabricated vertical drains as part of the CAMU.

The process of being remediated using prefabricated vertical drains will continue until al least the end of fiscal year 2005, and possibly longer. Monitoring activities may continue beyond 2005 to ensure that technetium-99 levels have stabilized at an acceptable level, based on regulatory input.

Soil

Soils contaminated with uranium will be remediated to 30 picocuries per gram or less. Soils contaminated with both uranium and technetium-99 will be remediated in accordance with the recently imposed NRC "Unity Rule."[2] Soils contaminated with trichloroethylene will be remediated by 2005 with ex-situ vapor stripping as part of the CAMU.

Results of site characterization have indicated that soils within Areas A, E, and G are within regulatory guidelines for release to RMI without radiological restrictions. These areas have not yet been released by NRC or the Ohio Department of Health. The contaminated soil from Area D was fed through a soil washing plant that was made operational in 1999, which significantly reduced the cost of remediating the site's radiologically contaminated soils. Area D has been conditionally released by NRC, pending final confirmation testing when site cleanup is complete. Assuming release of Areas A, E, and G will be granted, the successful completion of the Area D remediation activities will have reduced the site's contamination footprint to approximately seven hectares (18 acres.) In FY 2000, the low-level waste-contaminated soils in Areas C and C-West were remediated.

Facilities

Major equipment not being used to support decontamination and decommissioning activities was dispositioned in 1999. An extrusion press used to extrude uranium ores was removed from the site in 1998, with approximately two-thirds of the press recycled and the remainder disposed of in the commercial disposal facility, Envirocare of Utah. By 2005, all equipment will be disposed of as low-level waste or released without radiological restrictions, and 21 of the 26 buildings will be demolished. The remaining five buildings will be decontaminated. The under-building slabs will be remediated as part of soil cleanup in 2004 and 2005. Verification of the radiological cleanup will be documented by the termination of the RMI license by the Ohio Department of Health.

2.0 EXPECTED FUTURE USES AND RESPONSIBILITY

The DOE office at the site is expected to be closed in 2005. At that time, the use of the site will be solely the responsibility of the RMI Titanium Company.

RMI will be responsible for managing and monitoring the prefabricated vertical drains and reporting the status to the Ohio Environmental Protection Agency and the DOE. Established groundwater monitoring wells will provide information concerning the progress of the remediation process. In compliance with regulatory requirements, RMI will inspect and operate the prefabricated vertical drains facilities. Monthly reports will be submitted to the Ohio Environmental Protection Agency to document the results of the inspections and well data, satisfy air emission and National Pollution Discharge Elimination System requirements, and describe the progress

[2] The unity rule is contained in 10 CFR Part 20, Appendix B, footnote 4 to the combined Tables 1, 2, and 3. It states that if the identity and concentration of each radionuclide in a mixture are known, the limiting values should be derived as follows: determine for each radionuclide in a mixture, the ratio between the concentration present in the mixture and the concentration other wise established in Appendix B for the specific radionuclide when not in a mixture. The sum of such ratios for all the radionuclides in the mixture may not exceed "1" (i.e., unity").

to date. Copies of these reports will also be forwarded to the appropriate DOE office, as requested. The monthly status reports will be summarized in an annual environmental report that will be submitted to DOE. Long-term stewardship activities will continue at the site until groundwater remediation is complete thereby ending DOE's liability for cleanup.

Once data from the monitoring wells indicate that the cleanup goal has been reached, the Ohio Environmental Protection Agency will verify the result. The designated DOE office will be notified, and long-term stewardship requirements will be completed. In accordance with the current contract, records will be maintained by RMI for an additional three years, at which time guidance will be required from the appropriate DOE office concerning records disposition.

RMI will be responsible for making all future land use decisions. The future use of the site is assumed to be industrial, which is consistent with the surrounding property and zoning.

For additional information about the Ashtabula Environmental Management Project site, please contact:

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BATTELLE COLUMBUS LABORATORY-KING AVENUE[1]

1.0 SITE SUMMARY

1.1 Site Description and Mission

The Battelle Columbus Laboratory-King Avenue site occupies 2.4 hectares (six acres) and is located within the city of Columbus Ohio. The site is bounded by Ohio State University, a high-populated area, and the Olentangy River.

SITE HIGHLIGHTS

Total Site Area - 2.4 hectares (6 acres)
Current Landlord - DOE Environmental Management Program; Battelle Memorial Institute
Expected Future Landlord - Battelle Memorial Institute
Reason Not Subject to NDAA Requirements - DOE is not expected to be responsible for conducting long-term stewardship activities at the site

Between 1943 and 1986, Battelle Memorial Institute (Battelle) performed atomic energy research and development for DOE and its predecessor agencies at two geographically distinct sites: the Battelle Columbus Laboratory-King Avenue site and the West Jefferson Site. This site summary discusses the Battelle Columbus Laboratory-King Avenue site. The Battelle Columbus Laboratory-West Jefferson site is discussed in a separate site summary.

As a part of the government's fuel and target fabrication program, Battelle supported nuclear research activities, which included processing and machining enriched, natural, and depleted uranium and thorium; fabricating fuel elements; analyzing radiochemicals; and studying power metallurgy.

As a result of past activities, 10 buildings and external grounds were contaminated with various contaminants. Even though the types and extent of contamination varied from building to building, depending on the nature of the past activities performed, most of the contamination in the laboratory and metal fabricating areas at the site were due to uranium, thorium, and associated resultant products.

In 1986, DOE established the Columbus Environmental Management Project to decontaminate and decommission the Battelle facilities that were radioactively contaminated as a result of government-sponsored nuclear research. DOE and Battelle shared the cost of most of the remedial actions at the site, with DOE responsible for 90 percent of the costs and Battelle contributing the remaining 10 percent. DOE completed planned decontamination of all nine buildings at the site in 1998. All wastes, primarily uranium and thorium, were shipped offsite for disposal at the Hanford Site in Washington State, or at the commercial disposal facility, Envirocare of Utah. The King Avenue site cleanup activities will be completed by 2000, following the final survey and independent verification of external areas.

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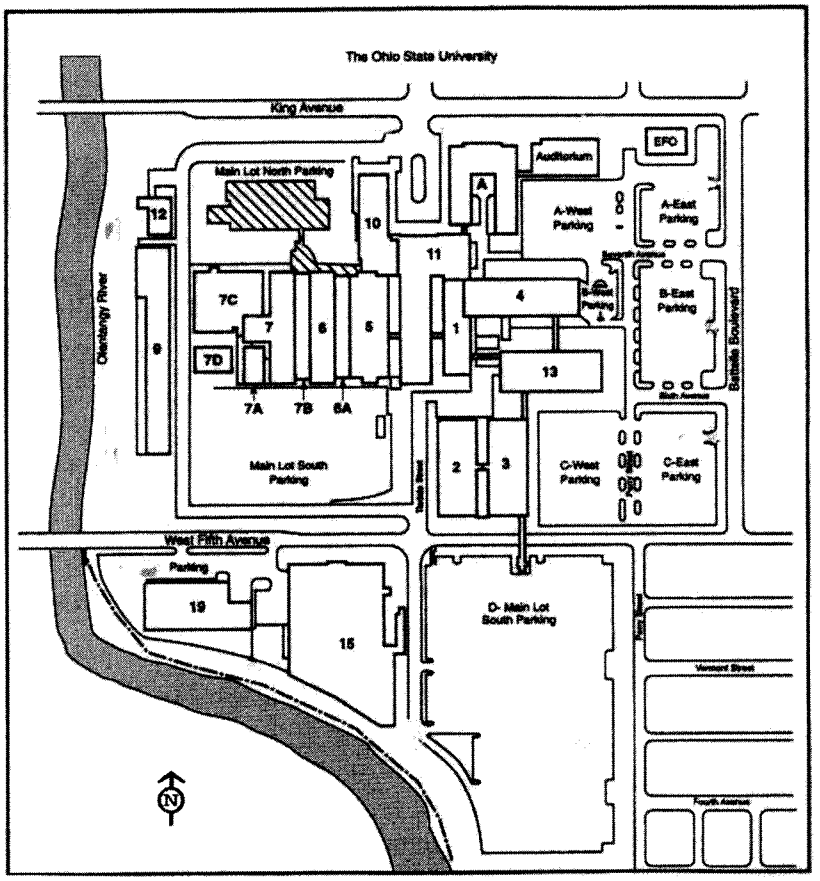
[1]This report is developed in response to a Congressional request in the Fiscal Year (FY) 2000 National Defense Authorization Act (NDAA). As requested by the Act, this report addresses current and anticipated long-term stewardship activities at each site or portion of a site by the end of calendar year 2006 ("Conference Report on S.1059, National Defense Authorization Act for Fiscal Year 2000," *Congressional Record,* August 5, 1999).

Based on current planning, the U.S. Department of Energy (DOE) is not expected to be responsible for long-term stewardship activities at the Battelle Columbus Laboratory-King Avenue site. DOE does not own property at the site and necessary long-term stewardship activities, if any, are expected to be conducted by the Battelle Memorial Institute. This summary of the site is provided to assist in documenting DOE's role at the site. (See Section 2.1.2 of Volume I).



Battelle Columbus - King Avenue

2.0 EXPECTED FUTURE USES AND SITE RESPONSIBILITY

DOE's contractual responsibility at this site is limited to removal of radioactive contamination resulting from historic work for the Federal government. All other concerns are the responsibility of the facility owner. Upon completion of decontamination and decommissioning activities, the buildings were returned to Battelle for reuse without radiological restrictions. No long-term surveillance and monitoring activities are expected at this site. If any long-term stewardship activities are required, Battelle, as facility owner, would be responsible for these activities.

For additional information about the Battelle Columbus Laboratory - King Avenue site, please contact:

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BATTELLE COLUMBUS LABORATORY-WEST JEFFERSON[1]

1.0 SITE SUMMARY

1.1 Site Description and Mission

The West Jefferson site occupies approximately 440 hectares (1,100 acres), roughly eight kilometers (five miles) west of Columbus, Ohio. The site includes three areas: the engineering area in the southeastern portion, the experimental ecology area in the eastern-central portion, and the nuclear sciences area in the northern portion. DOE is responsible for approximately eight hectares (20 acres) of the West Jefferson North area.

SITE HIGHLIGHTS

Total Site Area - 440 hectares (1,100 acres)
Current Landlord - DOE Environmental Management Program; Battelle Memorial Institute
Expected Future Landlord - Battelle Memorial Institute
Reason Not Subject to NDAA Requirements - DOE is not expected to be responsible for conducting long-term stewardship activities at the site

Between 1943 and 1986, Battelle Memorial Institute (Battelle) performed atomic energy research and development for DOE and its predecessor agencies at two geographically distinct sites: the Battelle Columbus Laboratory-King Avenue site and the West Jefferson Site. This site summary discusses the Battelle Columbus Laboratory-West Jefferson site. The Battelle Columbus Laboratory-King Avenue site is discussed in a separate site summary.

In 1986, DOE established the Columbus Environmental Management Project to decontaminate and decommission the Battelle facilities that were radioactively contaminated as a result of government-sponsored nuclear research. DOE will complete remediation activities at the site by the end of 2005. DOE and Battelle have agreed to share the cost of most of the remedial actions at the Battelle Columbus Laboratory-West Jefferson site, with DOE responsible for 90 percent of the costs and Battelle contributing the remaining 10 percent.

Buildings at the West Jefferson site contain 60,000-80,000 curies of radioactivity in the form of metallurgical samples, experimental residue, deposits in drains and piping, and particulate-contaminated hot cell equipment and hot cell interiors. The remediation strategy includes removing highly contaminated equipment and materials from hot cells in the JN-1 Building and reducing the levels of contamination on the interior of the cells. Only when the highly radioactive material is removed from the site can characterization and release surveys of other building areas and grounds take place.

The current plan is to demolish the contaminated structures, minimizing the volume of material which must be handled and disposed of as low-level waste. The cleanup effort will be conducted consistent with the decommissioning plan approved by the U.S. Nuclear Regulatory Commission (NRC) in December 1993.

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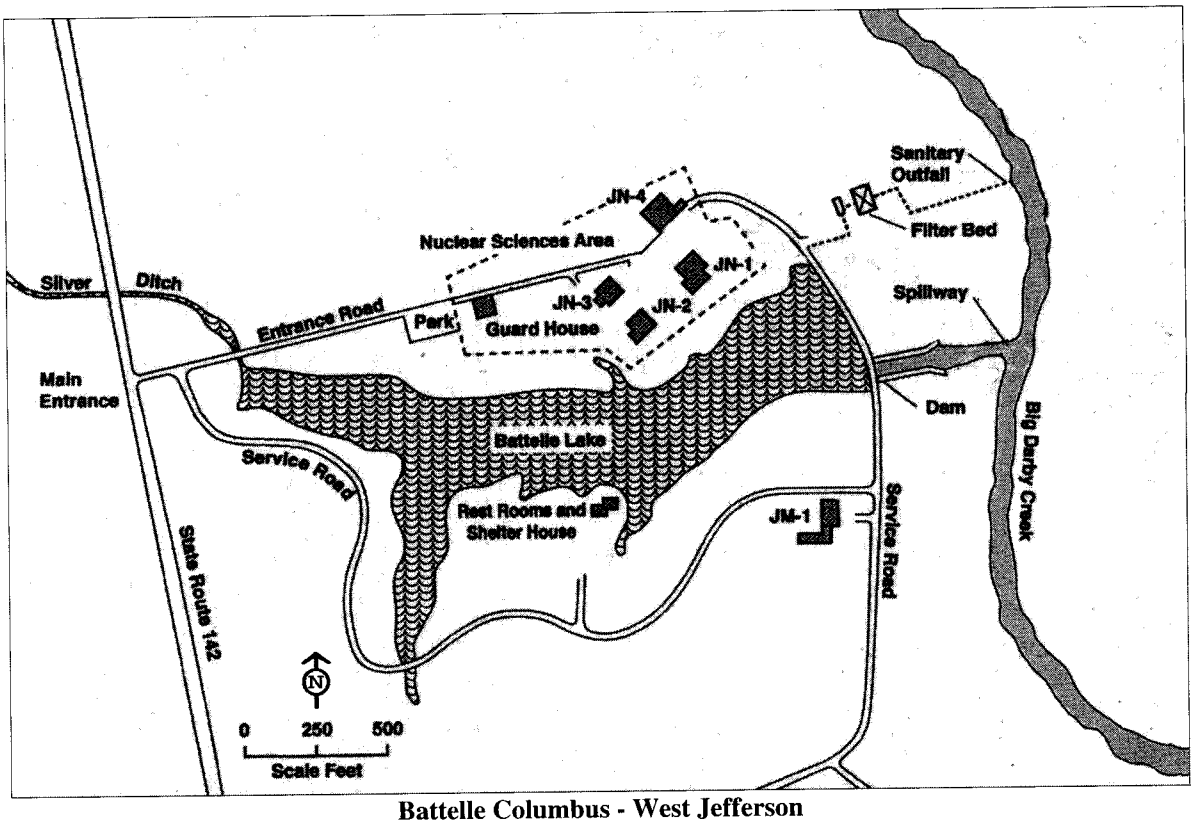
[1]This report is developed in response to a Congressional request in the Fiscal Year (FY) 2000 National Defense Authorization Act (NDAA). As requested by the Act, this report addresses current and anticipated long-term stewardship activities at each site or portion of a site by the end of calendar year 2006 ("Conference Report on S.1059, National Defense Authorization Act for Fiscal Year 2000," *Congressional Record,* August 5, 1999).

Based on current planning, the U.S. Department of Energy (DOE) is not expected to be responsible for long-term stewardship activities at the Battelle Columbus Laboratory-West Jefferson site. DOE does not own property at the site and necessary long-term stewardship activities, if any, are expected to be conducted by the Battelle Memorial Institute. This summary of the site is included to provide background information and potential future long-term stewardship activities at the site. (See Section 2.1.2 of Volume I).



Battelle Columbus - West Jefferson

2.0 EXPECTED FUTURE USES AND SITE RESPONSIBILITY

DOE's contractual responsibility at this site is limited to removal of radioactive contamination resulting from historic work for the Federal government. No long-term surveillance and monitoring activities are expected at this site. If any long-term stewardship activities are required, Battelle, as facility owner, is responsible for these activities. The end-state of the Battelle Columbus Laboratory-West Jefferson site is to return facility to Battelle in a condition suitable for use without radiological restrictions.

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FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

1.0 SITE SUMMARY

1.1 Site Description and Mission

The U.S. Department of Energy's (DOE) Fernald Environmental Management Project (FEMP) is the site of the former uranium metal production plant (the Fernald plant), which supplied high-purity uranium products to the DOE (and predecessor agency) nuclear weapons complex. FEMP is located in a rural area on a 420-hectare (1,050-acre) tract of land overlapping the boundary between Hamilton and Butler Counties near the southwest corner of Ohio. The site is located approximately 27 kilometers (17 miles) northwest of Cincinnati. The Great Miami River flows in a southerly direction, approximately 1.6 kilometers (1 mile) east of the site. Paddy's Run, a small stream, runs southward along the western boundary of the site. FEMP is physically located over the Great Miami Aquifer. The former production facilities and supporting infrastructure comprise approximately 54 hectares (136 acres) of the 420-hectare (1,050-acre) site.

LONG-TERM STEWARDSHIP HIGHLIGHTS

Major Long-Term Stewardship Activities - access restrictions; institutional controls; engineered unit maintenance and monitoring
Total Site Area - 420 hectares (1,050 acres)
Estimated Volume of Residual Contaminants - disposal cell - up to 1.9 million cubic meters (2.5 million cubic yards)
Long-Term Stewardship Start-End Years - 2007-in perpetuity
Average Annual Long-Term Stewardship Cost FY 2000-2006 - n/a (costs begin in 2007)
Landlord - U.S. Department of Energy

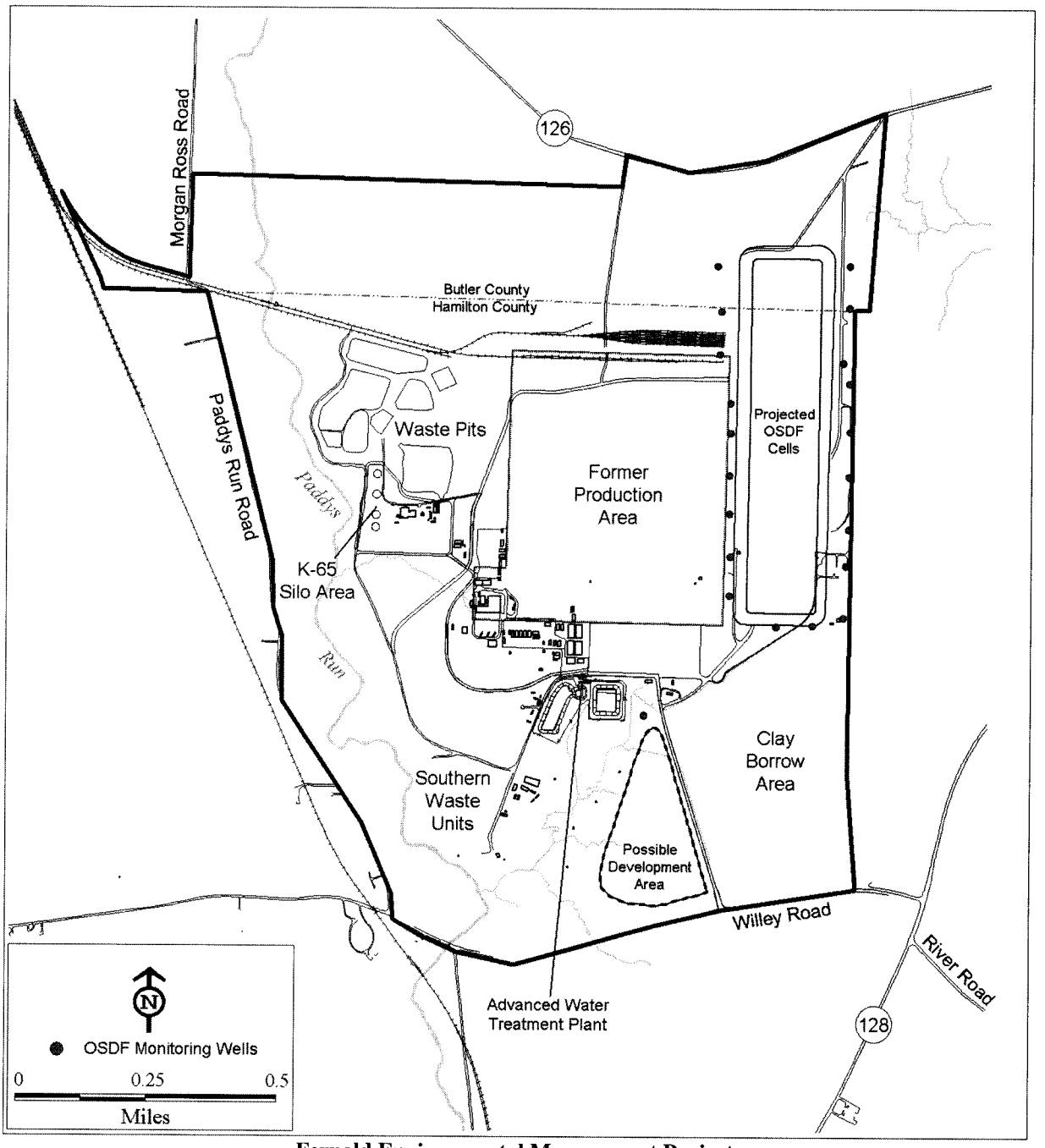
DOE's uranium metal production operation at Fernald was constructed in the early 1950s to convert uranium ore into uranium metal, and to fabricate the uranium metal into target elements for reactors that produced weapons-grade plutonium and tritium. Production operations continued for more than 36 years and yielded more than 227,000 metric tons (500 million pounds) of high-purity uranium products to support United States' nuclear weapons and nuclear weapons materials production. During the 36-year production mission, uranium and other contaminants were released to the air, surface waters, groundwater, and soil. The U.S. Government's reduced need for nuclear weapons materials at the end of the Cold War resulted in DOE formally ceasing uranium production for nuclear weapons on June 19, 1991.

DOE's current primary mission is to remediate the site. DOE's current programs, projects, and activities at FEMP include, but are not limited to, environmental assessments, nuclear materials storage (including uranium, depleted uranium, and enriched uranium), remedial design, remedial action, technology development, base activities, and decontamination and decommissioning activities. DOE expects to complete all planned remediation activities in 2010 and continue a program of long-term stewardship activities indefinitely.

1.2 Site Cleanup and Accomplishments

The Fernald site was placed on the U. S. Environmental Protection Agency's (EPA) National Priorities List in 1989 due to contaminated facilities, soil, and groundwater at the site. In 1990, DOE and EPA signed a Consent Agreement that defined five operable units for organizing remediation activities at the site:

- Operable Unit 1-- the waste pit area, which included six waste pits, a burn pit, and a clearwell used for the disposal of process-related wastes;



Fernald Environmental Management Project

- Operable Unit 2 – other waste areas (also known as the southern waste units), which included five waste units and their associated berms, liners and soils, which were used for the disposal of a variety of waste generated onsite;

- Operable Unit 3 – the former production area, which was the location of the facilities and buildings used to convert uranium ore into metal;

- Operable Unit 4 – the silos, which included four large, cylindrical, above-grade concrete structures that contain radium-bearing residues from the processing of uranium ore; and

- Operable Unit 5 – environmental media, which included contaminated soils and groundwater from across the entire site.

To address the contamination associated with these operable units, DOE has initiated remediation activities such as: groundwater extraction and treatment; building decontamination and decommissioning; excavation and offsite disposal of waste pits and storage silos materials; and the excavation of soils contaminated at levels exceeding the target cleanup levels. The specific remediation activities and accomplishments for each of these contaminated media are described in detail in the following paragraphs.

ACCOMPLISHMENTS

- Constructed a wastewater treatment plant with a 2,900 gallons-per-minute treatment capacity
- Installed 18 extraction wells and 5 reinjection wells
- Pumped 5.6 billion gallons of water and removed 1,538 pounds of uranium from the aquifer
- Excavated 460,262 cubic meters (602,000 cubic yards) of soil and certified through sampling that cleanup goals have been met across 230 hectares (566 acres)
- Provided grant to the City of Cincinnati to supply public water to those downgradient of the FEMP
- Completed safe shutdown of all former processing facilities
- Completed decontamination and decommissioning of 71 facilities

BY 2006 FEMP WILL:

- Complete 7-8 cells of the OSDF
- Install the OSDF final cover.
- Ship all nuclear materials and legacy waste offsite for disposal
- Complete soil excavation and certify that all areas have met the cleanup goal, with the exception of the silos and the Advanced Wastewater Treatment Area
- Decontaminate, decommission, and demolish over 200 facilities onsite
- Complete construction of the silos waste treatment facility

Facilities

Contaminated structures at the Fernald site include facilities and buildings used to convert uranium ore into metal. Most of these structures are located within the 54-hectare (136-acre) former production area at the site. DOE has detected 60 constituents of concern for the buildings onsite, but has identified uranium and technetium-99 as the most significant due to their frequency of detection. By 2006, DOE will have decontaminated, decommissioned, and demolished nearly all of the over 200 above-grade structures located at the Fernald plant. DOE will dispose of all building debris that meets the waste acceptance criteria in the On-Site Disposal Facility (OSDF). Building debris that does not meet the OSDF waste acceptance criteria will be transported offsite for disposal.

Silos 1 and 2 contain radium bearing residues; Silo 3 contains a calcined residue known as cold metal oxides; and the fourth silo was never used. The residues in Silos 1-3 are classified as byproduct materials, in accordance with Section 11(e)2 of the *Atomic Energy Act*. In 1991, DOE placed a layer of soil over the residues in Silos 1 and 2 to reduce the emission of radon gas from the residues. DOE plans to remediate the residues in the silos through a contracting approach where the vendor will be responsible for the full-scale remediation facility design, construction, and system integration testing. The remediation of the residues in all three silos will involve retrieval of the material from the silos, treatment to stabilize waste, packaging of waste, and transportation and disposal at a permitted disposal facility. The treatment facilities for Silos 1 and 2 will be in operation until 2008; however, DOE anticipates that these structures will be removed within a few years of completing the environmental restoration of the majority of the site.

Soil

Soils at the Fernald site were predominantly contaminated by the disposition of uranium from air emissions associated with the uranium foundry operations. To address this contamination, DOE, EPA, and the State of Ohio have established target cleanup levels for remediation based on an incremental excess lifetime cancer risk of 1×10^{-5} for an off-property farmer, and a 1×10^{-6} incremental excess lifetime cancer risk for the onsite recreational user. Although the extent of uranium in soils at concentrations exceeding the background concentration of 3.69 mg/kg includes an area of approximately 7,907 acres (12.4 square miles), DOE estimates that only 300 to 400 of those acres are contaminated above the cleanup level and, thus, will require remediation. DOE expects that very limited excavation of offsite soil areas will be necessary.

Target Cleanup Levels for Constituents of Concern in Soils		
Constituent	**Onsite Cleanup Level**	**Offsite Cleanup Level**
Beryllium	1.5×10^{0} (mg/kg)	6.2×10^{-1} (mg/kg)
Cadmium	8.2×10^{1} (mg/kg)	9.1×10^{-1} (mg/kg)
Radium-226	1.7×10^{0} (pCi/g)	1.5×10^{0} (pCi/g)
Radium-228	1.8×10^{0} (pCi/g)	1.4×10^{0} (pCi/g)
Thorium-228	1.7×10^{0} (pCi/g)	1.5×10^{0} (pCi/g)
Thorium-232	1.5×10^{0} (pCi/g)	1.4×10^{0} (pCi/g)
Uranium, total (leaching coefficient = 325 L/kg [ppm])	8.2×10^{1} (pCi/g)	5.0×10^{1} (pCi/g)
Uranium, total (leaching coefficient = 15 L/kg [ppm])	2.0×10^{1} (pCi/g)	n/a

DOE will excavate any contaminated soil and remediate to concentrations below the target cleanup level. Based on this expectation, DOE has set an "as low as reasonable achievable" goal (ALARA) of 50 parts per million for uranium. In areas where the ALARA goal is achieved, the residual risk will be identical to the incremental excess lifetime cancer risk for the off-property farmer. In areas where the uranium is in a leachable form and could possibly impact groundwater, the cleanup limit was set lower at (10 – 20 parts per million).

Soils at the Fernald site are also contaminated with radium-226, thorium-228, and thorium-232. These radionuclides are generally found in soils in the former production area and waste storage area (i.e., waste pits and silos area). This contamination is located within the boundaries of soil being remediated for uranium contamination and will be excavated with those soils. As a result, no additional remediation strategy is needed to address the radium- and thorium-contaminated soil.

The two predominant non-radiological contaminants of concern are cadmium and beryllium. Except for isolated areas near the silos, all concentrations of cadmium are also located within the area of the uranium contamination. Similarly, beryllium is also generally located within the area of the uranium contamination, with the exception of an area to the northeast of the production area, and an area near the active fly ash pile (south of the retention basins). DOE expects to remediate these additional areas of contamination. The target cleanup levels for the primary constituents found in soil are listed above.

Once excavated, soils that meet the waste acceptance criteria (WAC) for the onsite disposal facility will be disposed of in the OSDF. Soils that do not meet the WAC will either be treated to meet the WAC or shipped offsite for disposal.

Groundwater

The Fernald site is situated over the Great Miami Aquifer, which is a sole-source aquifer that generally flows from west to east, with a component of the flow directed towards the south. DOE has calculated horizontal flow rates in the range of 122 to 304 meters (400 to 1,000 feet) per year. Contaminants are migrating through pathways created by Paddy's Run and its tributaries, eroding through the glacial overburden and exposing the aquifer.

All contaminated areas have been identified, and pump and treat of the groundwater plumes is progressing on schedule. Although total uranium is the primary radiological contaminant of concern, DOE has identified other contaminants of concern. DOE will remove these contaminants through the remediation of the uranium in the aquifer. Uranium target cleanup levels are 20 parts per billion of total uranium. A complete list of the identified contaminants of concern and their associated target cleanup levels is documented in the *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA) Record Of Decision for Operating Unit 5. EPA will certify the groundwater remediation to ensure that all contaminants are below their target cleanup levels at the time of remedy completion.

DOE and the regulators based the target cleanup levels for groundwater on use of the aquifer as a potable water supply and incorporated *Safe Drinking Water Act* standards for all constituents for which these standards were available. The restriction on installation of onsite wells for drinking water is not, therefore, driven by residual risk, but by the application of an additional level of protection for human health. Although DOE expects that groundwater will be fully restored to the target cleanup levels, EPA certification of remedy completion is not expected until the year 2010. Continued operation of some portions of the groundwater extraction system may continue until the year 2010. Although not technically necessary once remediation is completed, groundwater monitoring may be required as part of the CERCLA five-year reviews. The need for monitoring post remediation remains to be negotiated.

Engineered Units

The On-Site Disposal Facility (OSDF) is an above-ground disposal facility for low-level radioactive waste generated onsite. As wastes are generated during the site remediation process, DOE will dispose of those wastes in the OSDF. The waste will primarily be comprised of three broad categories: contaminated soil, facility decontamination and decommissioning (D&D) debris, and ancillary remediation waste. DOE and its regulators have worked to develop waste acceptance criteria (WAC) to strictly control the type of waste disposed onsite. DOE will either treat all waste generated onsite to meet the WAC or will ship the waste offsite for disposal. The volume of waste in the OSDF will be recorded when the final waste is accepted.

The OSDF is located along the eastern border of the site. When all cells are completed, it is expected to measure approximately 1,127 meters by 243 meters (3,700 feet by 800 feet) and have a maximum height of 20 meters (65 feet). DOE constructed the initial cell of the OSDF in December 1997. The final OSDF will consist of seven or eight cells constructed individually so that additional cells are added as the space for remediation waste becomes necessary. Each cell will be constructed with a leachate collection system to collect infiltrating rainwater and inhibit the water from entering the underlying environment. The 2.7-meter (8.75-foot) thick cap and 1.5-meter (5-foot) thick liner are of geocomposite design, meaning that both natural materials (e.g., clay and soil) and man-made materials (e.g., high-density polyethylene liners) will be used in the construction.

The OSDF will have a total onsite disposal capacity of approximately 1.9 million cubic meters (2.5 million cubic yards) of contaminated material and will contain most of the contamination associated with the previous uranium production activities at the site. To date, DOE has consolidated approximately 152,900 cubic meters (200,000 cubic yards) of contamination from across the site in the OSDF.

Disposition of Nuclear Materials

In addition to environmental restoration activities, the Fernald plant stores approximately 3,800 metric tons of nuclear materials onsite. These materials, including low enriched, normal, and depleted uranium , represent remnants from the shutdown of the processing facilities and storage of miscellaneous materials from other DOE facilities. In order for DOE to complete cleanup of the site, these materials must be dispositioned to an offsite location. Most of the material currently stored onsite will be shipped to the Portsmouth Gaseous Diffusion Plant in Portsmouth, Ohio. DOE's disposition plans for the nuclear materials stored onsite are summarized in the following table. As shown in the table, DOE will need to identify a disposition path for 256 metric tons of materials prior to closure of the site.

Material	Beginning Inventory	Metric Tons of Material Shipped to Date		Metric Tons of Planned Shipments			Totals*
		Portsmouth	Other	Portsmouth	Commercial Facility	Unknown	
Normal Uranium	192.9	63.2	1.5	125.9	0.0	2.3	**192.9**
Depleted Uranium	2807.1	2463.2	0.0	343.9	0.0	0.0	**2807.1**
Enriched Uranium	801.3	0.0	0.0	442.5	102.1	253.7	**799.3**
Total	**3801.3**	**2526.4**	**1.5**	**912.3**	**102.1**	**256.0**	**3799.3**

* The difference between the beginning inventory and total dispositioned is due to the loss of material through the vacuuming of loose oxides from metals during repackaging .

1.3 Fernald Site End-State

DOE's cleanup progress has already caused a visible and dramatic change in the appearance of the site, predominantly due to the removal of many of the buildings in the former production area. By 2006, DOE anticipates that nearly all planned cleanup, with the exception of the two silos and treatment plants, will have been completed throughout the 420-hectare (1,050-acre) Fernald site. As a result, the site will look very different than it does in 2000. A majority of the site will be restored to a natural state. DOE expects wetlands, ponds, prairies, and upland forest areas to provide a diverse natural area for wildlife. Nine hectares (23 acres) of the south-central section of the property, located along an existing north-south trending access road, may be made available for development consistent with the recommendation of the FEMP's Community Reuse Organization. However, currently there are no specific plans or identified market interest in the development of this acreage. If this area is not developed, DOE will restore the area to a natural state. The OSDF and its natural buffer area will occupy 50 hectares (123 acres) of the northeastern corner of the property. The OSDF will be covered with a vegetative cap, surrounded by fencing, and rise nearly 20 meters (65 feet) above ground at its highest point.

By 2007, only two building complexes will remain on site: the advanced wastewater treatment (AWWT) plant and the recently constructed silos waste treatment facility. The AWWT will remain in place until approximately 2010 to 2015 when the DOE will be certain that treatment will no longer be necessary. The silos waste treatment facility is expected to be removed in 2010. A power station located on the southwest corner of the OSDF will remain but will also be dismantled by 2010. Along with these facilities are trailers that will house staff that remain to oversee these activities.

1.4 Fernald Stakeholder Involvement

Fernald stakeholders have been actively involved in the remediation process and long-term stewardship planning at FEMP. The three primary stakeholder groups at FEMP include the Fernald Residents for Environmental Safety and Health; the Fernald Citizens Advisory Board; and the Fernald Community Reuse Organization.

The Fernald Residents for Environmental Safety and Health (FRESH) was formed by a group of local concerned citizens in 1984 and has continually played a lead role in providing community input on the characterization and remediation of the Fernald site. Today, DOE holds monthly cleanup progress briefings for all interested stakeholders.

The Fernald Citizens Advisory Board (FCAB) was formed in 1993 to help guide the cleanup activities at the site. Representatives of constituencies affected by the cleanup decisions, including local residents, governments, businesses, universities, and local labor organizations, comprise the advisory board membership. In 1995, the FCAB issued recommendations to DOE on remedial action priorities, cleanup levels, waste disposition alternatives, and future uses for the Fernald property.

In addition, the FCAB recently formed a subcommittee on long-term stewardship. This subcommittee evaluates all facets related to long-term stewardship activities and requirements that will be ongoing following completion of site remediation. Specifically, the subcommittee has addressed its expectations with respect to maintenance and monitoring of the onsite disposal facility, future public use of the FEMP property, record-keeping, establishing an educational facility/museum at the site, and the reinternment of Native American remains. The FCAB continues to be actively involved in the remediation and restoration activities for the Fernald site, with bimonthly full board meetings and monthly meetings of the remediation and stewardship subcommittees.

EXAMPLES OF STAKEHOLDER IMPACTS

The efforts of DOE to encourage stakeholders to become substantively involved early in the decision-making process has resulted in a significant acceleration of the cleanup process and provided for substantial reductions in the cost of cleanup. DOE's initial options for cleanup of the Fernald Site included a range of options, from completing removal of all contamination to removal of relatively little of the existing contamination. As a result of discussions between DOE and stakeholders, DOE elected to perform a more selective removal process that includes exhuming materials contaminated with relatively higher levels of radioactivity and shipping them offsite for disposal, but consolidating a large volume of relatively low-level radioactive contamination in a newly constructed onsite disposal cell.

The creation of the On-Site Disposal Facility was the most visible result of the interactive decision-making process. DOE would not have pursued this option without the early and active involvement of the local community and regulators. The stakeholder involvement process included supporting a trip by local stakeholders to the Nevada disposal site, where much of the waste would have been shipped if complete removal of all contamination was required. DOE also worked with stakeholders to inform them of the risks and costs associated with shipping waste offsite.

The Fernald Community Reuse Organization (CRO) was established by the DOE to assist Fernald workers and the local communities in preparing for the economic and social impacts resulting from the eventual closure of the Fernald site. The CRO is also comprised of a diverse mix of members including local residents, elected officials, economic development specialists, and Fernald workers.

In addition to their work at the site, Fernald stakeholders have been active in DOE national stakeholder groups. For instance, the District Chief for the Ohio EPA, which regulates the Fernald site, is an active member of DOE's Environmental Management Advisory Board's Long-Term Stewardship Committee. The Long-Term Stewardship Committee was formed to provide advice and recommendations to the Assistant Secretary for

Environmental Management (EM) on actions the EM program should take to make the transition from its current programs to long-term stewardship activities for waste, material, and property.

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

As cleanup activities progress at the Fernald site, DOE will begin conducting long-term stewardship activities. After 2010, DOE's primary mission at the site will be the continuation of long-term stewardship activities in perpetuity. Institutional controls at the FEMP site will include ensuring that no residential or agricultural uses occur on the property through deed restrictions, perimeter fencing, and posted signs. Posted signs will indicate the previous DOE mission at the site, the subsequent remediation, and the OSDF restricted area. Long-term stewardship activities will consist of enforcing the land uses, maintaining fences, maintaining trails or other recreational amenities, and periodically replacing signs. In addition, DOE will conduct site-wide air monitoring in accordance with the Integrated Environmental Monitoring Plan.

DOE will restore approximately 900 acres (1050 acres minus the approximately 123 acres occupied by the OSDF) of the native habitats through grading and planting of native Ohio vegetation. DOE anticipates that the public will be granted access to the restored areas by means of pedestrian trails and overlooks. Maintenance of the restored areas may include removing exotic vegetation, measuring the growth of planted vegetation, inventorying wildlife, periodic burning of prairie areas, replacement or repair of water control structures, as necessary, and ensuring that trails and overlooks remain in good condition. Maintenance and monitoring for a minimum of nine years is expected to be a requirement of the FEMP Natural Resource Damages Settlement with the State of Ohio. Depending on the final public use decisions and the possible recreational amenities provided at the restored site, additional long-term stewardship activities may be necessary to maintain the roads and parking lots, to mow along the fence line, and to maintain any public trails provided at the site.

> ***SITE LONG-TERM STEWARDSHIP GOALS***
>
> FEMP adheres to the "Long-Term Stewardship Guiding Principles" established by the Ohio Field Office in April of 2000. These guiding principles state that, "The goal of LTS is to ensure that the level of human and environmental health and safety, achieved by the selected remedies, is maintained." These guiding principles also outline specific goals for stakeholder and regulator involvement, institutional controls, funding, review of remedies, technological opportunities, and pooling resources.

DOE will maintain a secure central repository of the necessary historic and remediation records. The detailed plans for record-keeping are currently being developed. The possible local locations and formats (e.g.,electronic and/or hard copy) of long-term records will be determined in the future. The stakeholders strongly recommend that a copy of all the records be maintained onsite.

2.2 Specific Long-Term Stewardship Activities

Soil

The soil remaining after remediation will not be available for unrestricted public use due to low levels of residual contamination. During the CERCLA remedy selection process, DOE established target cleanup levels in anticipation of a recreational use scenario (because stakeholders had indicated opposition to the site ever being available for residential or agricultural uses). After DOE completes sampling and analyses to confirm that soil concentrations are at or below the remediation levels, the site will be restored to create ecosystems native to southern Ohio. Restrictions on the soil uses will consist of permanent prohibitions against agricultural and residential uses of the property. DOE will conduct long-term stewardship activities, such as enforcing deed

restrictions, replacing signs, and occasional surveillance to ensure these restrictions remain in place; however, no ongoing sampling of soils will be necessary.

Groundwater

Groundwater remedy performance monitoring on the property is scheduled to continue until 2012, when EPA certification of the site groundwater remedy is scheduled to be complete. Limited aquifer monitoring of the remediated areas will continue beyond certification, for an as yet undetermined period, to ensure that contaminant levels remain below target cleanup levels. In 2012, DOE expects that the remedy performance monitoring wells will not be needed and will plug and abandon the wells in place. DOE monitoring of the groundwater beneath the OSDF will continue into the foreseeable future to verify the integrity of the disposal cell.

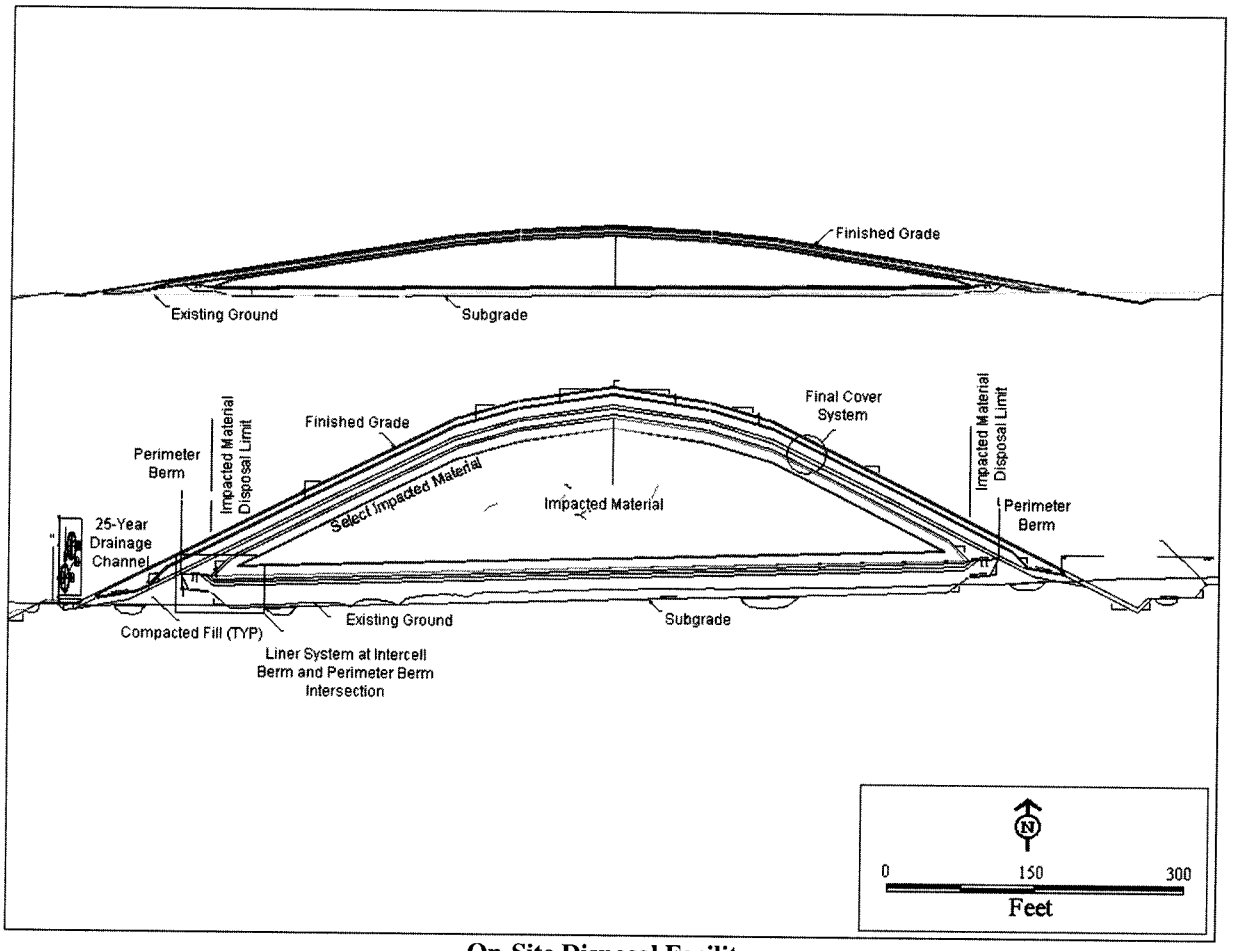
Following EPA certification that cleanup goals are met, all areas of the aquifer will have been restored to levels that potentially allow unrestricted use. However, consistent with the target land use objectives for the site (i.e., restricted use as an undeveloped park), DOE will implement institutional control measures to prevent the use of the aquifer as an on-property drinking water supply. These controls may consist of deed restrictions and/or signs on the property.

Engineered Units

The only engineered unit requiring long-term stewardship activities at the Fernald site is the OSDF. The OSDF will cover approximately 50 hectares (123 acres) in the eastern portion of the site and contain residually contaminated soil, facility debris, and ancillary remediation waste. The primary engineered features of the OSDF include a multi-layer liner system, a leachate collection system, a leak detection system positioned beneath the primary liner, and a multi-layer cap system.

The OSDF Post-Closure Care and Inspection Plan describes routine long-term stewardship activities associated with the OSDF for an initial 30-year post closure period. These activities include routine inspections and ongoing monitoring of the leachate collection system, leak detection system, and groundwater. DOE will conduct CERCLA reviews of the remedy at least every five years and will issue a report summarizing the results of the review to the appropriate regulatory agencies. Maintenance and monitoring of the leachate collection system and vegetative cap of the OSDF will be necessary periodically, as well as occasional maintenance of signs, fencing, and the buffer zone around the OSDF. DOE expects that inspections, monitoring, and maintenance will continue indefinitely after the initial post closure period. However, the extent of long-term stewardship activities will be defined based on the performance of the OSDF during the initial post-closure period and will be determined by DOE and EPA. Monitoring wells are being installed along the boundaries and horizontally underneath the OSDF to monitor for leaks into the underlying groundwater. In addition, detailed tracking records will be kept on the volume and nature of all materials placed in the OSDF.

Other anticipated long-term stewardship activities, such as maintenance of perimeter fencing and signs, are based on stakeholder input and regulatory compliance. Routine monitoring of the OSDF will include the quarterly analysis of groundwater samples collected from within perched water beneath the facility and the aquifer. Each cell will have an upgradient and downgradient aquifer well, in addition to a horizontal till (perched water) well, for a total of 14-16 aquifer wells and 7-8 till wells. Routine inspections will include the leachate collection system, leak detection system, leachate transmission lines, facility cap, and security features.



On-Site Disposal Facility

2.3 Regulatory Regime

CERCLA governs the remediation activities at the site and mandates certain long-term stewardship activities (such as five-year *reviews).* The OSDF has been designed to meet, and is subject to, the *Resource Conservation and Recovery Act* requirements for hazardous waste disposal units, the Uranium Mill Tailings Remedial Action Program for radioactive waste, and the Ohio Solid Waste Disposal Regulations.

2.4 Long-Term Stewardship Technology Development and Deployment

DOE discussions with stakeholders at Site Technology Coordination Group Meetings and other forums have indicated that the site stakeholders are interested in developing real-time, automated technologies for monitoring the OSDF and its associated infrastructure. In response to this need, and to reduce the site's long-term stewardship costs by reducing manpower requirements, DOE has undertaken a project under EM's Office of Technology sponsorship, the Fernald Long-Term Stewardship Technology Project, to focus on the identification, demonstration, deployment, and installation of remote monitoring technologies to assure stakeholders that the site, its facilities, and remedies are secure and performing as designed. The project will seek to deploy technologies and integrated systems that have the capability to provide "real time" monitoring to remote

locations. Even though exact costs/benefits of this approach have not been determined, remote, real time autonomous functioning technologies have at least three key benefits:

- Ensures the systems are functioning as designed;
- Provides the public, stakeholders, and regulators access to information on the performance and conditions of the site and its facilities; and
- Allows a superior level of monitoring and assurance with minimal personnel.

The objective of the project is to have deployed a real-time, automated system for monitoring the initial cell of the OSDF by the end of 2001, when the first cell is scheduled to be closed and capped. Specific technology areas being explored for the OSDF and associated facilities include leachate collection and transmission systems and groundwater monitoring wells. DOE expects that these technologies can be deployed at other similar engineered units in the complex.

While the project intends to focus on the OSDF, the project will also identify, demonstrate, and deploy technologies for other post-closure needs. Other post–closure remote or automated technology needs that may be addressed through this project include monitoring: flora and fauna; security and surveillance; and runoff quality and quantity. In addition, the project may explore developing an alternative leachate treatment technology, a system for long-term data storage, and technologies to extend the life of monitoring wells.

2.5 Assumptions and Uncertainties

Estimates of the long-term stewardship costs at the Fernald site are based on bottoms-up cost estimating techniques using assumed monitoring and inspection frequencies.

Public access decisions for the Fernald site have not been finalized. Agreements that will be made between DOE, regulators, and stakeholders may impact the long-term stewardship activities and associated costs.

DOE assumes that the Federal government will retain ownership of the OSDF in perpetuity.

DOE assumes that the Records of Decision for the site will not be modified and that cleanup will progress as planned in the site baseline.

DOE assumes that the FEMP property will remain in Federal ownership in perpetuity although management of the land may be relinquished to another entity.

DOE assumes that monitoring and maintenance of the OSDF will continue in perpetuity.

DOE assumes that the OSDF will perform as designed.

DOE assumes that public access to the OSDF will remain restricted, although public access to the remainder of the site will be permitted. The extent to which the public will be allowed use of the site and the associated recreational amenities has not yet been determined.

3.0 ESTIMATED LONG-TERM STEWARDSHIP COSTS

DOE has developed a preliminary estimate of the anticipated long-term stewardship costs for FEMP through 2070; however, long-term stewardship costs will continue in perpetuity. Some uncertainty associated with the cost estimates exist because the specific final public access and use for Fernald has not yet been determined. The final public use may result in additional long-term stewardship activities (such as maintaining trails and educational signs) and associated costs. If additional public use amenities are incorporated into the final site plan, the additional long-term stewardship costs are expected to be relatively small compared to the overall long-term stewardship costs for the site.

In general, the cost estimates for long-term stewardship activities cover all technical support, monitoring, and maintenance of the Fernald site to ensure compliance with all applicable Federal and State requirements. The estimate also includes costs for all support activities, including overall project management, accounting, legal, contracts management, health and safety, security, records management, and quality assurance. Specifically, the long-term stewardship costs include:

- Monitoring, sampling and analysis, and reporting (as required per regulations, Records of Decisions (RODs), or other agreements for FEMP) on the leachate removal process, the OSDF, and the balance of the FEMP remediated site (including monitoring the success of the natural restoration of trees, shrubs, and wetlands) (about 25% of total cost);
- Leachate removal/treatment, including all work involved in collecting, removing, and treating OSDF leachate (about 10% of total cost);
- OSDF and "greenfield" maintenance costs, including all personnel, equipment, space, and subcontracts required to maintain the integrity of the OSDF and natural aesthetics of the site (about 10% of total cost);
- Record-keeping (about 35% of total cost); and
- Contractor support costs, leases and utilities (about 20% of total cost).

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	***Amount***	***Year(s)***	***Amount***	***Year(s)***	***Amount***
FY 2000	$0	**FY 2008**	$5,049,000	**FY 2036-2040**	$9,642,000
FY 2001	$0	**FY 2009**	$5,049,000	**FY 2041-2045**	$9,642,000
FY 2002	$0	**FY 2010**	$5,049,000	**FY 2046-2050**	$9,642,000
FY 2003	$0	**FY 2011-2015**	$9,642,000	**FY 2051-2055**	$9,642,000
FY 2004	$0	**FY 2016-2020**	$9,642,000	**FY 2056-2060**	$9,642,000
FY 2005	$0	**FY 2021-2025**	$9,642,000	**FY 2061-2065**	$9,642,000
FY 2006	$0	**FY 2026-2030**	$9,642,000	**FY 2066-2070**	$9,642,000
FY 2007	$5,049,000	**FY 2031-2035**	$9,642,000		

4.0 FUTURE USES

DOE will maintain access restrictions and institutional controls and will monitor and maintain the OSDF for the site indefinitely. DOE will impose limited restrictions on the groundwater; for instance, no drinking water wells will be permitted on the property, and the groundwater within 1,000 feet around the OSDF will be continually monitored. Site acres not occupied by the OSDF will remain in Federal ownership and will have restrictions on land use.

Residential and agricultural uses of the Fernald site will not be permitted, in accordance with the recommendations of the Fernald Citizens Advisory Board (FCAB). DOE has prepared an Environmental Assessment (EA) proposing ecological restoration for 360 hectares (884 acres) of Fernald, with the exception of the OSDF (approximately 50 hectares (123 acres) with the protective buffer area), nine hectares (23 acres) set aside for potential future commercial development, and almost 9 hectares (20 acres) utilized for ecological research projects. DOE will restore the 360 hectares (884 acres) through planting of native vegetation. DOE's decision regarding land use for the nine hectares (23 acres) set aside for development will be re-considered in 2004. If the nine hectares (23 acres) is not used for development, DOE will restore it to a natural state. Final decisions on public access and use are still under discussion with local stakeholders.

For additional information about the Fernald Environmental Management Project, please contact:

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LUCKEY SITE [1]

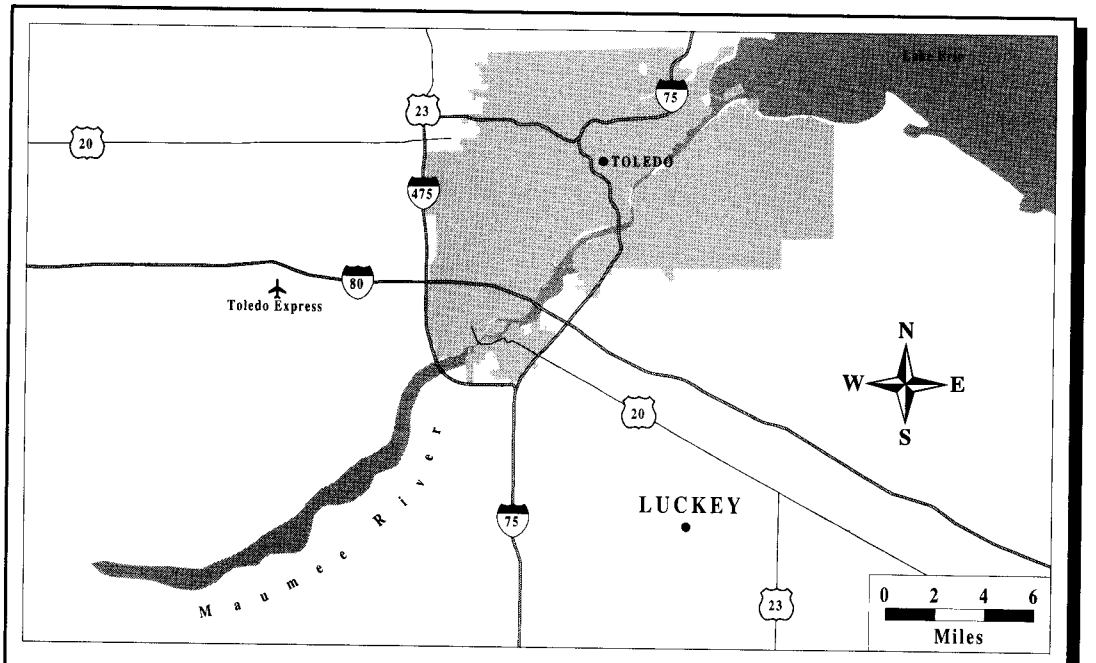
SITE SUMMARY

The Luckey Site encompasses approximately 16 hectares (40 acres), and is located approximately 35 kilometers (22 miles) southeast of Toledo in Luckey, Ohio. The northern portion of the site, which is primarily covered by grasses and brush, is leased for farming. The site includes manufacturing facilities, warehouses, and utility buildings, as well as several active and inactive lagoons and spoil areas.

During the 1940s and 1950s, the Luckey Site was owned and operated by the U.S. government. The U.S. government operated a magnesium processing facility onsite. In the late 1940s, the Atomic Energy Commission (AEC), a predecessor agency to the U.S. Department of Energy (DOE), built a beryllium production facility at the site. For several years, the Brush Beryllium Company (later Brush Wellman), under contract with the AEC, produced beryllium pebbles onsite. Waste solutions and precipitated sludges from the beryllium processing were impounded in three lagoons, formed by excavating the top layer of soil and using the soil to construct dikes.

After the AEC closed the plant in 1959, hazardous sludge and contaminated soils from the lagoons were moved to a 3.4-hectare (8.5-acre) dike-enclosed landfill that was later capped, graded, and seeded.

Later, the Luckey Site was sold to the Aluminum and Magnesium Division of Vulcan Materials Company. In



Luckey Site

[1] The Luckey Site is one of the 21 Formerly Utilized Sites Remedial Action Program (FUSRAP) sites where cleanup responsibility was transferred to the U.S. Army Corps of Engineers (Corps) in accordance with the Energy and Water Development Appropriations Act for FY 1998. At these 21 sites, the Corps is responsible for remediation and DOE is responsible for long-term stewardship activities, if any are deemed necessary. The cleanup decisions for these sites are not yet final and, therefore, the extent of long-term stewardship required for these sites, if any, is not yet known.

the late 1960s, the property was transferred to Goodyear Tire and Rubber Company. It was transferred again in the late 1980s to Motor Wheel Corporation.

Government-sponsored production activities at the site resulted in radioactively contaminated soil. The radiological constituents of concern include uranium and radium-226. In 1992, the Luckey Site was designated for cleanup under the Formerly Utilized Sites Remedial Action Program (FUSRAP). The Corps' remedial action for this site is not yet complete and, therefore, the extent of long-term stewardship required, if any, is not yet known.

For additional information about the Luckey Site, please contact:

FUSRAP Public Information Center
Buffalo District
U.S. Army Corps of Engineers
1776 Niagara Street
Buffalo, NY 14207-3199

MIAMISBURG ENVIRONMENTAL MANAGEMENT PROJECT

1.0 SITE SUMMARY

1.1 Site Description and Mission

The U.S. Department of Energy's (DOE) Miamisburg Environmental Management Project (MEMP, formerly known as the Mound Plant) is located in Miamisburg, Ohio, approximately 16 kilometers (ten miles) southwest of Dayton. Most of the 124-hectare (306-acre) site overlooks the city from a ridge that extends toward downtown Miamisburg from the southern city limits. Mound Road, on the east side of the plant, is lined by residences and provides access to the plant's main gate. A Conrail freight line runs along MEMP's western border, and the old Miami-Erie Canal bed runs west of the track. Approximately half a mile farther west from the MEMP is the Great Miami River.

LONG-TERM STEWARDSHIP HIGHLIGHTS

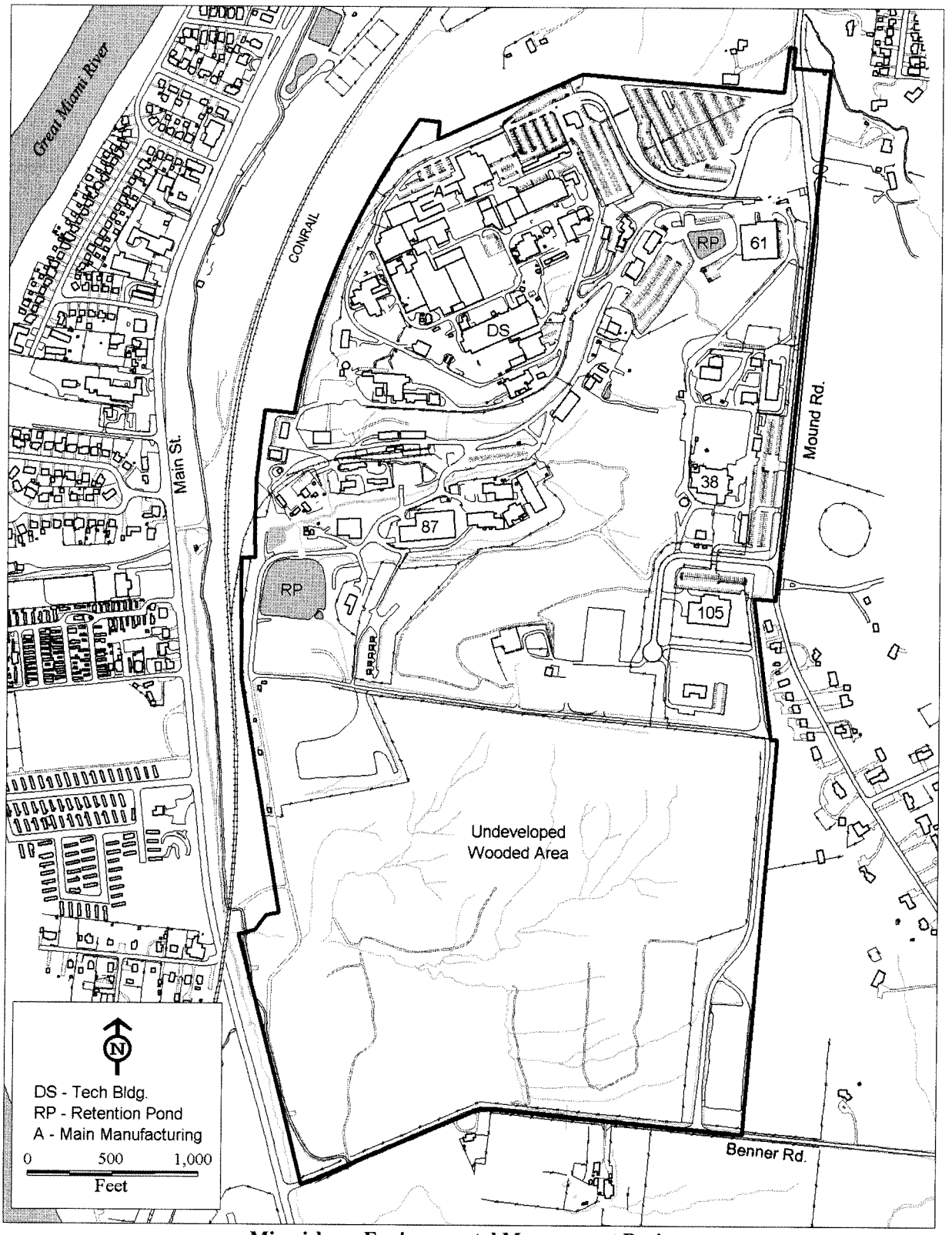
Major Long-Term Stewardship Activities - monitoring; institutional controls
Total Site Area - 124 hectares (306 acres)
Estimated Volume of Residual Contaminants - unknown
Long-Term Stewardship Start-End Years - 2007-in perpetuity
Average Annual Long-Term Stewardship Cost FY 2000-2006 - $50,000
Landlord - U.S. Department of Energy Ohio Field Office; Local Government

In 1946, DOE built the Mound Plant to develop and fabricate nuclear and non-nuclear components for the weapons program. In the 1950s, the MEMP began building detonators, cable assemblies, and other non-nuclear weapons components and products. In 1969, the plant's mission expanded to include retrieving and recycling tritium from dismantled nuclear weapons. In addition, MEMP mission involved the production of components that contained plutonium-238, polonium-210, and tritium, and the processing of large quantities of high explosives. The plant was managed by DOE's Office of Defense Programs until 1995, when the administration of the site was transferred to DOE's Environmental Management (EM) program.

DOE's current mission at MEMP is to "make Mound real property, equipment and facilities available for development as a commercial industrial site as safely, economically and timely as possible." This mission includes extensive environmental restoration, transitioning of property to the local government for economic development, and continued landlord function by DOE's Office of Nuclear Energy (NE). DOE completed the disposition of tritium in 1997. All other nuclear materials will be dispositioned by the end of 2000. NE has an ongoing mission to produce Radio Isotopic Thermal Electric Generators for the National Aeronautics and Space Administration that will continue after the environmental remediation and transfer of the rest of the site is completed. DOE expects its mission at MEMP to be exclusively performing long-term stewardship activities beginning in 2007.

1.2 Site Cleanup and Accomplishments

As a result of DOE's previous operations at the site, some buildings, soils, and groundwater areas are contaminated with radioactive and hazardous chemicals. The U.S. Environmental Protection Agency (U.S. EPA) placed the site on the National Priorities List in 1989 because of chemical contamination present in the site groundwater and due to the site's proximity to a sole source aquifer. DOE signed a Federal Facility Agreement for the remediation of the site with the Ohio and U.S. Environmental Protection Agencies.



Miamisburg Environmental Management Project

Initially, the remediation of MEMP was organized around nine Operable Units (OUs), each of which included several potential release sites. After initiating several remedial investigations at the site, DOE and its regulators adjusted the remediation approach to one that addresses each potential release site independently. This approach is referred to as the "Mound 2000" approach and is intended to streamline remediation decision-making at the site while remaining consistent with the *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA) and the National Contingency Plan. DOE's cleanup activities for the potential release sites are grouped by the environmental media contaminated and are discussed in detail below. DOE expects to complete all remediation activities at MEMP by the end of 2006. Any residual contamination onsite will be below levels satisfactory for an industrial use scenario.

ACCOMPLISHMENTS

- Completed remediation of the Miami-Erie Canal
- Completed disposition of excess legacy RCRA chemicals and legacy mixed low-level waste
- Completed demolition of 50 buildings
- Applied for delisting two non-contiguous parcels, totaling approximately 27 acres, from the National Priorities List. Land and two buildings will be deeded to MMCIC
- Completed disposition of all nuclear materials

BY 2006, MEMP WILL HAVE

- Completed transfer of approximately 296 acres and facilities to MMCIC for reuse as an industrial complex
- Continued operation of the Office of Nuclear Energy's Power Systems Technologies Program on the remaining approximately 10 acres until it is no longer required to support the ongoing mission
- Delisted the entire site (all 306 acres) from the National Priorities List

Soil

Between 1982 and 1988, DOE performed a systematic survey of soils across the site. As a result of the soil sampling, DOE identified 22 areas of soil contamination that would require remediation. These areas were contaminated with several radionuclides, predominantly plutonium-238 and thorium-232. Organic chemicals detected in the soils included trichloroethene, petroleum hydrocarbons, and polynuclear aromatic hydrocarbons. Contaminated soil areas on the site tend to be relatively small areas (around 50 feet in diameter). Approximately half of the soil areas that will require remediation are contaminated with radionuclides, and the remainder are contaminated with chemical or petroleum-based industrial solvents.

DOE will excavate soil with radiological contamination (plutonium, thorium) and dispose of this material offsite as low-level radioactive waste. All residually contaminated soil areas will be within EPA concentrations acceptable for industrial use (i.e., a $1x10^{-4}$ to $1x10^{-6}$ risk level).

Groundwater

Tritium and industrial solvents (including tetrachlorethane, trichoroethene, and 1,2-trans-dichloroethane) have contaminated the Buried Valley Aquifer (BVA), a regional sole-source aquifer. Municipal wells for the City of Miamisburg are approximately three miles up-gradient of the site. The current aerial extent of the groundwater plume is six acres or less; however, no residual groundwater contamination is expected after 2006. DOE is remediating groundwater to MCLs in the BVA and restricting the use of the bedrock aquifer. Currently, DOE is using a hydraulic barrier to mitigate the spread of groundwater contamination in the BVA and utilizing a soil vapor extraction (SVE) system to remove the solvents in the soils. DOE is also evaluating the bedrock groundwater contaminant migration to BVA and removing sources that are contaminating or will contaminate groundwater. The SVE system captures the solvents before the waste precipitates into the groundwater. During the first years of operation, the SVE systems recovered more that 3,000 pounds of solvents.

Facilities

As of 1999, 116 buildings existed within MEMP boundaries. DOE has detected laboratory solvents, radionuclides, and other contaminants in facilities at MEMP. The buildings with the most significant initial contamination and the radionuclides of concern for those facilities are listed below. DOE will either decontaminate and demolish, or decontaminate and transition all facilities to the Miamisburg Mound Community Improvement Corporation (MMCIC), an agent for the City of Miamisburg, for reuse. DOE and its regulators (U.S. EPA and State of Ohio's Environmental Protection Agency) will determine that buildings are protective of human health and the environment prior to transfer to the MMCIC. All remaining facilities, soil, and groundwater will be at or below concentration levels deemed protective of human health and the environment under an industrial use scenario by the U.S. EPA, Ohio EPA, and DOE before transfer. DOE anticipates that the highest residual risk will be from standard industrial hazards, such as solvents in drain lines and asbestos in unmarked building materials. These hazards will be documented, as required under CERCLA Section 120 (h) for land transfers from Federal facilities.

Contaminants Detected in Facilities	
Facility Name	**Radionuclides Detected**
T Building	polonium, plutonium, tritium
SW Building	tritium, actinium, radium, thorium
R Building	polonium, plutonium, tritium
HH Building	tritium, krypton-85, cobalt-60, uranium-233, uranium-234, uranium-235, uranium-238, thorium-230
WD Building	plutonium-238, plutonium-239, tritium, uranium-235, uranium-238, americium-241
Building 38	plutonium-238

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

DOE will be responsible for performing long-term stewardship activities at MEMP. DOE's mission, excluding NE's ongoing activities, will be exclusively long-term stewardship beginning in 2007. The site will have been remediated to achieve U.S. EPA risk-based industrial use standards. DOE will have the responsibility for assuring that the remedy of institutional controls is effective in perpetuity.

By the end of 2006, DOE will have transferred the site to the MMCIC for reuse as a commercial/industrial complex, with the exception of approximately 10 acres identified for NE's ongoing mission activities. DOE will be responsible for landlord costs and eventual safe shutdown and decommissioning and decontamination of those facilities. DOE will place institutional controls, in the form of deed restrictions, on the transferred property to ensure that industrial land use is maintained and to prevent an unacceptable risk to human health or the environment. There are four primary restrictions that DOE will maintain for the site through the use of institutional controls:

- Land use will remain industrial;
- Onsite soils cannot be released offsite without coordination and approval from the State of Ohio;

- Bedrock (shallow) groundwater wells cannot be installed in areas not overlying the regional aquifer. The regional aquifer at the west side of the site remains usable and is currently used for plant potable water; and

- DOE and the regulating agencies will maintain access to the site to ensure the remedy remains effective.

DOE is responsible for monitoring, maintaining, and enforcing these institutional controls as required by the CERCLA Record of Decision (ROD). This responsibility includes the duty to conduct periodic assessments of compliance with the deed restrictions and the duty to enforce the deed restrictions. Annual or periodic reviews of the remedy will also be conducted in compliance with the CERCLA requirements.

After remediation efforts are completed and the land has been transferred, DOE will continue to retain records in accordance with the applicable laws and regulations. Record-keeping and communication requirements have not been finalized for MEMP. The CERCLA ROD calls for including the institutional controls on the deed/title of the property. For example, CERCLA (Section 120) requires that the historical use of the site is disclosed to the new owner. The existing Federal archive retention periods and Federal Facility Act agreements on record-keeping and disposition are likely to be used.

STAKEHOLDER INVOLVEMENT

MEMP staff have had extensive interaction with stakeholders in developing the site future use plans. By the end of 2006, DOE will transfer the site to the Miamisburg Mound Community Improvement Corporation for reuse as a commercial/industrial complex. An existing sales contract and a Memorandum of Understanding detail the expectations of the parties involved in the transfer. The Mound Reuse Committee consists of representatives from a cross section of the community and has been an active participant in site decisions. In addition, an environmental group, the Miamisburg Environmental, Safety, and Health is active with the plant. The Mound Action Committee has open membership to the general public. This organization has been very active in setting mutually agreeable cleanup goals and verification plans. The Miamisburg Mound Community Improvement Corporation, as well as the City of Miamisburg, have been active participants in the development of site closure plans.

2.2 Specific Long-Term Stewardship Activities

Soil

DOE will not conduct specific long-term stewardship activities for soils beyond the site-wide institutional control that restricts relocation of soils to offsite locations without prior approval from the State of Ohio.

Groundwater

In addition to the site-wide institutional controls that restrict the installation of bedrock groundwater wells, some specific long-term stewardship (e.g., groundwater monitoring) activities will be required beyond 2006.

Facilities

DOE will perform long-term stewardship activities for the facilities that have not been demolished at MEMP through the use of the institutional controls being established for the entire site. Facilities remaining on the site will be restricted to industrial use. Institutional controls will be in effect in perpetuity. DOE anticipates monitoring the effectiveness of the institutional controls and any other CERCLA remedy, as required by promulgated rules and Executive Orders.

2.3 Regulatory Regime

CERCLA governs the remediation activities at MEMP and mandates certain long-term stewardship activities (such as five-year reviews). Under CERCLA Section 120, DOE is responsible for monitoring, maintaining, and enforcing the institutional controls required by the CERCLA ROD. This responsibility includes the duty to conduct annual assessments of compliance with the deed restrictions and the duty to enforce the deed restrictions if any non-compliance is detected. Groundwater remediation levels are based on the requirements in the *Safe Drinking Water Act*, and are incorporated as relevant and appropriate requirements for the site remedy.

2.4 Long-Term Stewardship Technology Development and Deployment

Many newer technologies have been applied or tested, using a range of methods from smart sampling/decision making to large scale demonstration projects. The groundwater was remediated using systems proven under the Innovative Technology Research and Development Program. The biggest challenge for the site has been in improving the efficiencies of "muck and truck" excavation approaches for contaminated soils. Several methods for removing thorium and plutonium in soils and for soils segregation have been investigated, but none have been fruitful due to the clay nature of the soils in the area. The largest boosts to remediation decisions at MEMP have resulted from decision-making improvements. In the future, the primary technology needs will be for monitoring the continued effectiveness of the institutional controls.

2.5 Assumptions and Uncertainties

DOE assumes the site will be delisted from the NPL following remediation of all potential release sites.

DOE assumes that institutional controls will be an effective mechanism for maintaining protection of human health and the environment.

DOE assumes that remediation of MEMP will be completed by the end of 2006 and the site will be available for transfer to the MMCIC.

Uncertainty exists regarding the duration of time NE will continue to occupy the area known as the "NE Island."

3.0 Estimated Long-Term Stewardship Costs

Costs for long-term stewardship activities are budgeted at $50,000 per year starting on FY 2007. For the purposes of this report, costs for long-term stewardship activities are estimated out to FY 2070, although long-term stewardship activities are expected to be required in perpetuity. These costs include all long-term stewardship requirements for the entire site, including the area currently identified for use by NE. These costs are associated with the monitoring, maintaining and enforcement of institutional controls required at the site, including land use restrictions and deed easements restricting removal of soil, and the installation of soil and bedrock groundwater wells.

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	***Amount***	***Year(s)***	***Amount***	***Year(s)***	***Amount***
FY 2000	$0	**FY 2008**	$50,000	**FY 2036-2040**	$250,000
FY 2001	$0	**FY 2009**	$50,000	**FY 2041-2045**	$250,000
FY 2002	$0	**FY 2010**	$50,000	**FY 2046-2050**	$250,000
FY 2003	$0	**FY 2011-2015**	$250,000	**FY 2051-2055**	$250,000
FY 2004	$0	**FY 2016-2020**	$250,000	**FY 2056-2060**	$250,000
FY 2005	$0	**FY 2021-2025**	$250,000	**FY 2061-2065**	$250,000
FY 2006	$0	**FY 2026-2030**	$250,000	**FY 2066-2070**	$250,000
FY 2007	$50,000	**FY 2031-2035**	$250,000		

4.0 FUTURE USES

After 2006, approximately 4 hectares (10 acres) of the site will remain as government-owned land and will be used for NE's Integrated Power Systems Program. This land is currently excluded from the sales agreement. The remainder of the site will have no DOE mission except for long-term stewardship. DOE will transfer the site to the MMCIC for reuse as a commercial/industrial complex.

For additional information about the Miamisburg Environmental Management Project, please contact:

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Mr. Brian Nickel
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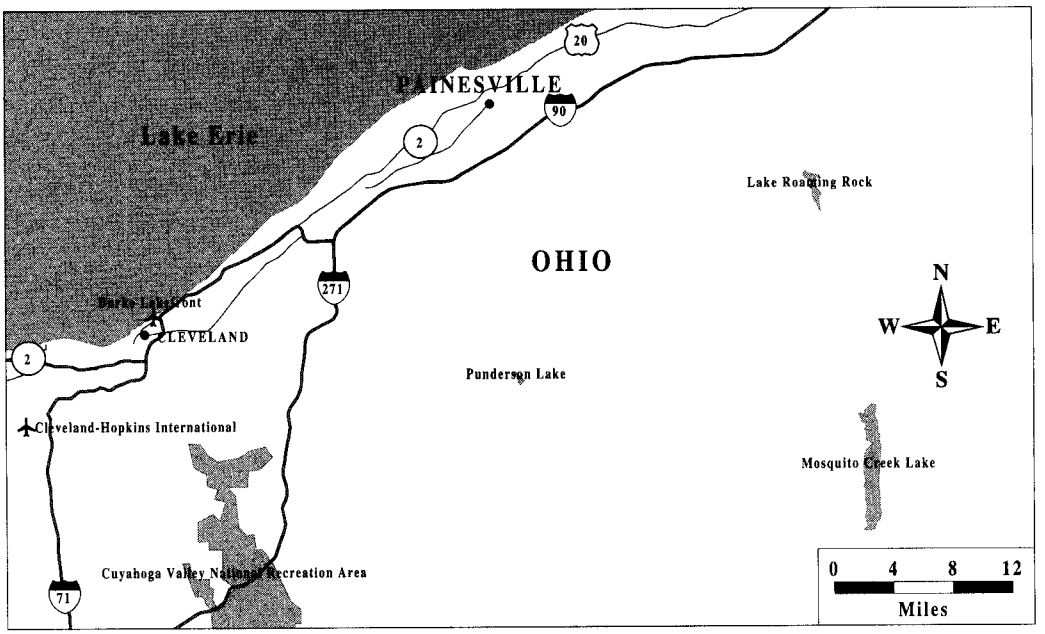
brian.nickel@epa.state.oh.us

PAINESVILLE SITE [1]

SITE SUMMARY

The Painesville Site (formerly the Diamond Magnesium Company) is located in Painesville, OH, approximately 35 kilometers (22 miles) northeast of Cleveland. Approximately one-third of the site was originally covered by large buildings and rail lines. Some of the original buildings have been removed, while others remain and are used by the Uniroyal Chemical Company. The property also includes a waste lake, located west of the buildings, and several lagoons formerly used for sludge and equalization. The site is currently divided between and owned by the Uniroyal Chemical Co. and Lonza, Inc.

The Defense Plant Corporation constructed a magnesium production facility on the U.S. Government-owned Painesville Site, which was operated by the Diamond Magnesium Company, in the early 1940s. From the 1940s through the early 1950s, the Atomic Energy Commission (AEC), a predecessor agency to the U.S. Department of Energy (DOE), shipped radioactively contaminated scrap steel from the Lake Ontario Ordnance Works to the Painesville facility for use in magnesium production processes. Residual radioactive residues from the scrap metal contaminated the soil at the site. The primary contaminants of concern in the soil are uranium, radium-226, and thorium-230.



Painesville Site

[1] The Painesville Site is one of the 21 Formerly Utilized Sites Remedial Action Program (FUSRAP) sites where cleanup responsibility was transferred to the U.S. Army Corps of Engineers (Corps) in accordance with the Energy and Water Development Appropriations Act for FY 1998. At these 21 sites, the Corps is responsible for remediation and DOE is responsible for long-term stewardship activities, if any are deemed necessary. The cleanup decisions for these sites are not yet final and, therefore, the extent of long-term stewardship required for these sites, if any, is not yet known.

In 1992, the site was designated for cleanup under the Formerly Utilized Sites Remedial Action Program (FUSRAP). The Corps' remedial action for this site is not yet complete and, therefore, the extent of long-term stewardship required, if any, is not yet known.

For additional information about the Painesville Site, please contact:

FUSRAP Public Information Center
Buffalo District
U.S. Army Corps of Engineers
1776 Niagara Street
Buffalo, NY 14207-3199
Phone: 800-833-6390
or visit the Internet website at: http://www.lrb.usace.army.mil

PIQUA NUCLEAR POWER FACILITY

1.0 SITE SUMMARY

1.1 Site Description and Mission

The Piqua Nuclear Power Facility is located in southwestern Ohio in the city of Piqua in Miami County, north of Dayton. It is situated on land owned by the U.S. Department of Energy (DOE) about 274 meters (900 feet) southeast of the Piqua Municipal Power Station near the Great Miami River. The north and east sides of the decommissioned facility are bounded by a limestone quarry owned by Armco Steel Company.

LONG-TERM STEWARDSHIP HIGHLIGHTS

Major Long-Term Stewardship Activities - continuation of the environmental radiological monitoring program
Total Site Area - 0.2 hectare (0.5 acre)
Estimated Volume of Residual Contaminants - facilities unknown
Long-Term Stewardship Start-End Years - 1998-2018
Average Annual Long-Term Stewardship Cost FY 2000-2006 - $18,000
Landlord - U.S. Department of Energy, Grand Junction Office

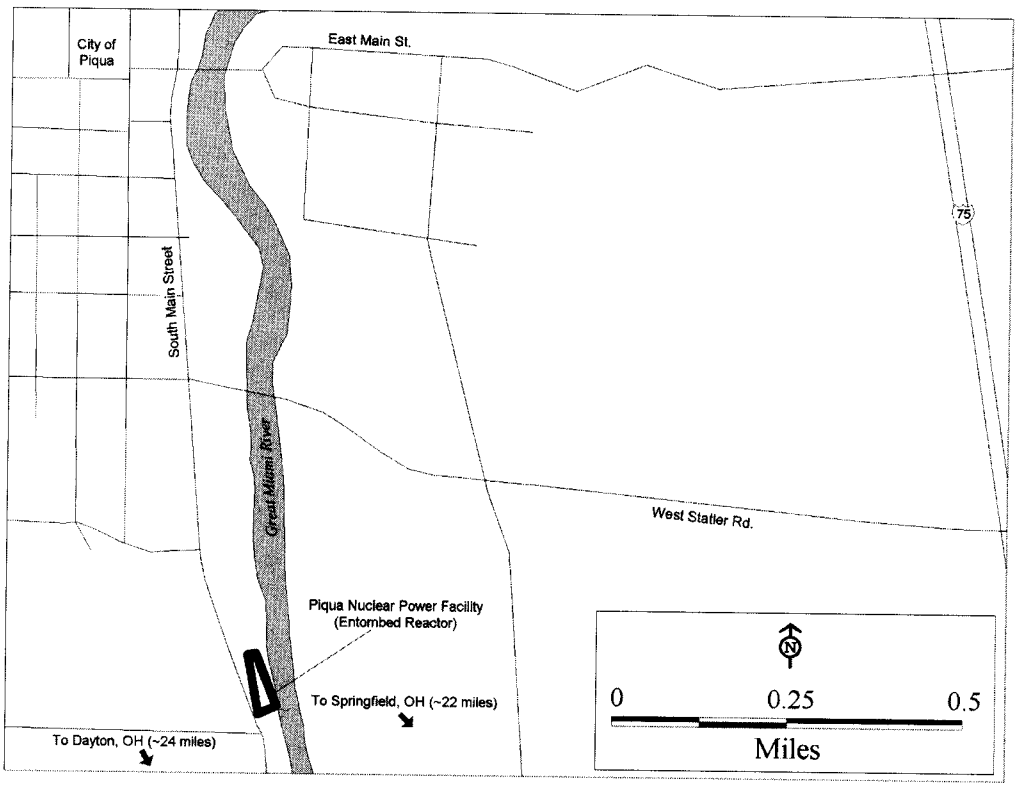
The Piqua site originally contained a 45.5-megawatt thermal organically cooled and moderated reactor. It was built and operated as a demonstration project by the U. S. Atomic Energy Commission (AEC), a predecessor agency of DOE, between 1963 and 1966. The Piqua Nuclear Power Facility was owned by the AEC and was operated by the City of Piqua, Ohio, under contract to AEC. During its brief period of operation, the Piqua Nuclear Power Facility experienced numerous technical difficulties, and its operations were discontinued by the AEC in 1966. In December 1967, the AEC decided to terminate its contract with the City of Piqua for the operation and maintenance of the facility. Between 1967 and 1969, the facility was decommissioned by the AEC, dismantled, and placed in a safe condition for retirement.

1.2 Site Cleanup and Accomplishments

A 1968 agreement between the AEC and the City of Piqua identified specific items to be accomplished in dismantling and decommissioning the Piqua Nuclear Power Facility. The City of Piqua accepted responsibility for the onsite deactivation activities and agreed that the reactor vessel and other radioactive parts of the reactor would remain in place.

The reactor fuel and coolant, and most of the radioactive materials were physically removed from the site. Contaminated piping and equipment inside the reactor building were removed or decontaminated. The reactor vessel, the concrete shielding, and fixed components within the reactor vessel were left in place. The main floor of the reactor building was covered by a waterproof material and a layer of concrete to render the areas containing the radioactive material inaccessible to water and personnel.

Currently, the Piqua Nuclear Power Facility consists of the reactor building and a connecting auxiliary building. The reactor building is a vertical, cylindrical, steel containment structure housing the reactor vessel, steam generating equipment, and other components of the reactor heat transfer system. An auxiliary building houses supporting auxiliary equipment, such as the heating and ventilation system. The above-ground facilities are presently used by the City of Piqua for offices, meeting rooms, and storage areas. The below-ground portion of the facility, extending from the surface to a depth of 30.5 meters (100 feet), consists of a massive reinforced concrete structure containing the retired reactor complex.



Piqua Nuclear Power Facility

The reactor vessel is contained within both a cavity liner and an eight-foot thick concrete biological shield. The radioactive materials remaining onsite are integral parts of the reactor structure (i.e., contaminated steel and concrete), not surface contamination. The reactor vessel is housed within the below-grade, reinforced concrete structure that originally served as the Piqua Nuclear Power Facility containment building. Thickness of concrete, steel, and other materials in the vicinity of the stored radioactive materials were dictated primarily by shielding considerations for the operational plant. Because of the original design considerations, the structure can be expected to retain its integrity for an indefinite period of time. The minimum design life objective for the various seals, supplementary closures, and weatherproofing measures installed during the dismantling of the facility is 100 years.

There is currently no known contamination in evidence at the site outside of the containment structure.

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

The City of Piqua, which leases the Piqua Nuclear Power Facility property, is responsible for ongoing day-to-day surveillance of the physical nonnuclear aspects of the site. The City is required to promptly report to DOE any condition which it has reason to believe is causing or may cause a radiological hazard to persons or property in, on, or about the premises, and to cooperate with DOE in protecting all persons and property from any such hazards.

The Piqua Nuclear Power Facility was transferred to the DOE Grand Junction Office in 1998. This office is responsible for continuation of the environmental radiological monitoring at the Site. DOE will conduct the monitoring annually unless circumstances warrant variance. During yearly monitoring, DOE representatives will also visually inspect the Piqua Nuclear Power Facility to confirm site integrity and to determine the need, if any, for maintenance or additional monitoring. DOE also maintains site records in a permanent site file at its Grand Junction Office in Grand Junction, Colorado. These records are available to government agencies or the public.

2.2 Specific Long-Term Stewardship Activities

Facilities

The reactor fuel, coolant, and most of the radioactive materials were removed from the site. The reactor vessel and the spaces between the vessel and cavity liner were filled with dry quartz sand. Iron, cobalt, carbon, and beryllium remain within this containment structure. The former structure is currently under surveillance and maintenance. DOE will be responsible for conducting any necessary remediation should releases be detected.

STAKEHOLDER INVOLVEMENT

Community interaction has been minimal since decommissioning was completed. Copies of the annual inspection report for the Piqua Nuclear Power Facility are distributed to the local library and any stakeholder that requests one.

2.3 Regulatory Regime

DOE holds title to the land and the entombed radioactive materials and is responsible for custody and long-term care of the facility and those materials. In 1968, the AEC entered into a 50-year contract and lease agreement with the City of Piqua. Under terms of this agreement, DOE (and its predecessor agencies) lease the land containing the Piqua Nuclear Power Facility to the City at no cost.

Long-term stewardship activities at the Piqua Nuclear Power Facility are structured to protect human health and safety by ensuring compliance with exposure limits established by Title 10 of the *Code of Federal Regulations*, Part 835. Long-term stewardship activities will continue until the radioactivity within the isolated areas decays to safe levels or can be removed safely.

2.4 Assumptions and Uncertainties

DOE assumes that the annual collection and analysis activities and visual inspections of the containment structure will continue until 2018. The Department does not anticipate any further action beyond 2018. Because the site is already conducting long-term stewardship, activities are well known and are not expected to change dramatically.

3.0 Estimated Long-Term Stewardship Costs

The following table shows the estimated costs of DOE's long-term stewardship activities for the Site. The costs include the annual collection and analysis of radiological smears, sump water and sludge samples, facility tap water samples, radiation surveys, and radon samples; and visual inspection of the containment structure. These activities are expected to conclude in fiscal year (FY) 2018. This estimate reflects the current site agreements and monitoring frequencies and assumes no further action beyond this date. Because the site is already conducting long-term stewardship activities, costs are based on actual costs.

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	***Amount***	***Year(s)***	***Amount***	***Year(s)***	***Amount***
FY 2000	$20,300	**FY 2008**	$17,700	**FY 2036-2040**	$0
FY 2001	$18,200	**FY 2009**	$17,700	**FY 2041-2045**	$0
FY 2002	$17,800	**FY 2010**	$1,7700	**FY 2046-2050**	$0
FY 2003	$17,200	**FY 2011-2015**	$84,700	**FY 2051-2055**	$0
FY 2004	$17,400	**FY 2016-2020**	$0	**FY 2056-2060**	$0
FY 2005	$17,700	**FY 2021-2025**	$0	**FY 2061-2065**	$0
FY 2006	$17,600	**FY 2026-2030**	$0	**FY 2066-2070**	$0
FY 2007	$17,800	**FY 2031-2035**	$0		

4.0 FUTURE USES

Title to the land on which the reactor and auxiliary buildings were located has been transferred to DOE. DOE leases the land and facilities back to the City of Piqua. This arrangement will continue until the radioactive materials left in place decay to safe levels. At that time, DOE will reconvey the title to the land and facilities to the City. Because the use of the property carries an absolute prohibition against breaching the barrier that encloses the radioactive source, future use of the site is limited to controlled access. The site is controlled by the City of Piqua, which maintains security for the site. No drilling or other intrusive activities are allowed within the footprint of the reactor building.

For more information about the Piqua Nuclear Power Facility, contact:

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PORTSMOUTH GASEOUS DIFFUSION PLANT[1]

1.0 SITE SUMMARY

1.1 Site Description and Mission

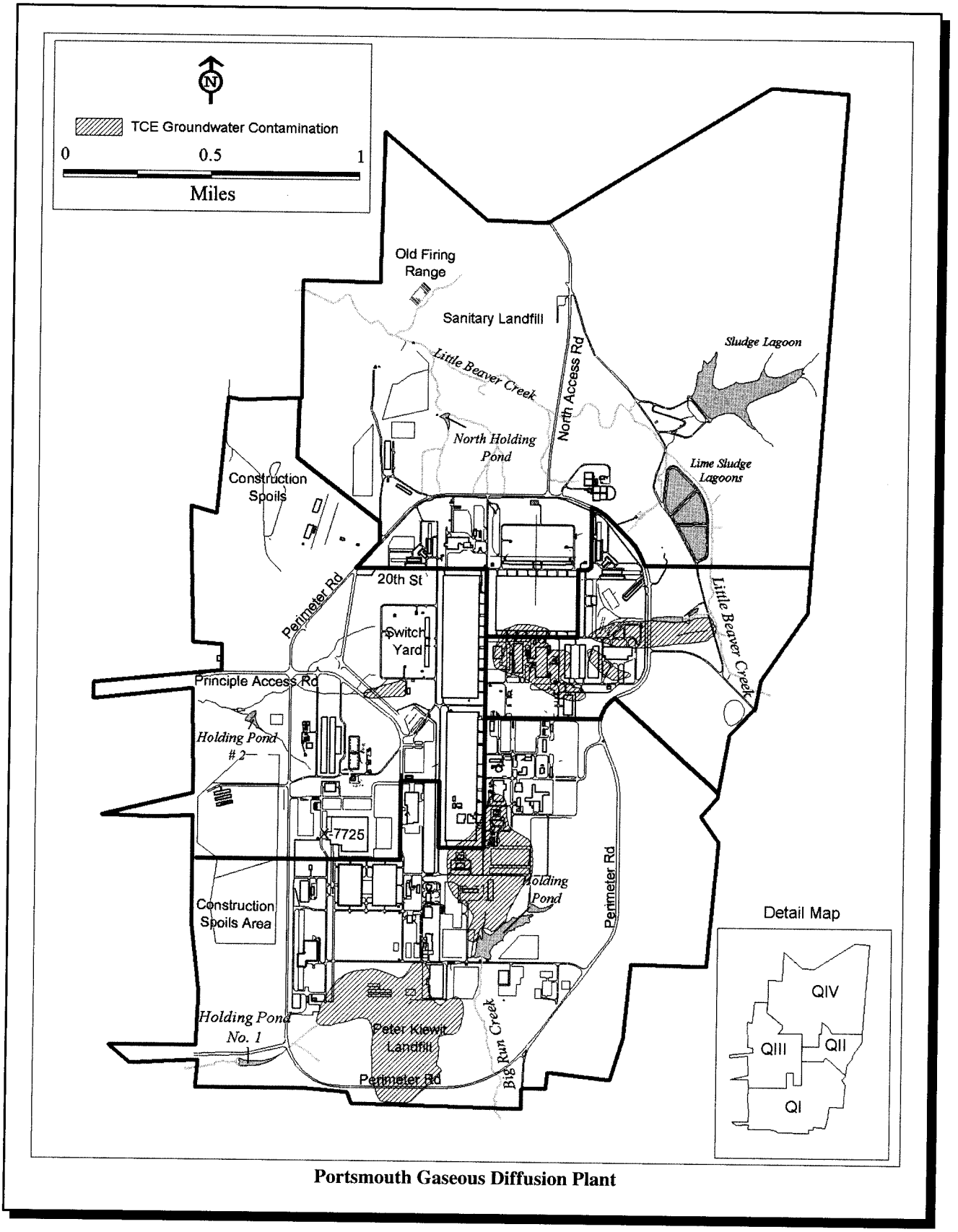
The Portsmouth Gaseous Diffusion Plant is located on a 1,497 hectare (3,714-acre) reservation owned by the U.S. Department of Energy (DOE), approximately 112 kilometers (70 miles) south of Columbus, Ohio and 6.5 kilometers (four miles) west of the Village of Piketon. The majority of plant operations are located within a fenced, security-controlled area inside the perimeter road that comprises 54 hectares (135 acres) in the south-central area of the reservation. The plant began operating in the mid-1950s, supplying enriched uranium through a gaseous diffusion process for both government and commercial nuclear fuel needs. In 1992, Congress passed the *Energy Policy Act* and, under its provisions, DOE leased the uranium enrichment operations at Portsmouth to the United States Enrichment Corporation (USEC). However, the Act required DOE to retain responsibility for remedial action of environmental releases and for decontamination and decommissioning of facilities. Uranium enrichment operations and related waste disposal activities at Portsmouth resulted in mostly onsite contamination of the environment with radiological and chemical substances. A consent order/consent decree was reached with the U.S. Environmental Protection Agency (EPA) and the State of Ohio in 1989, marking the year that remediation began under the *Resource Conservation and Recovery Act* of 1976 (RCRA) corrective action process. DOE is currently conducting remediation activities and anticipates completion by 2035.

LONG-TERM STEWARDSHIP HIGHLIGHTS

Major Long-Term Stewardship Activities - maintaining engineered barriers; monitoring ground and surface water; enforcing institutional controls; restricting access
Total Site Area - 1,497 hectares (3,714 acres)
**Estimated Volume of Residual Contaminants* - groundwater 26,124,000 cubic meters (34,162,000 cubic yards); surface water/sediments unknown; engineered units 1,276,000 cubic meters (1,600,000 cubic yards); facilities unknown
Portions in Long-Term Stewardship as of 2006 - 4
Average Annual Long-Term Stewardship Cost FY 2000-2006 - $6,258,000
Landlord - U.S. Department of Energy, Office of Nuclear Energy (plant leased to United States Enrichment Corporation)
*The estimated volume indicates only the known amounts of residual contaminants. For certain areas discussed for this site, exact volume is not known at this point. For specific discussions, please see Section 3.0.

Currently, the site supports four missions: 1) continued enrichment of uranium by USEC for use in commercial nuclear facilities; 2) ongoing environmental restoration and related waste management activities by DOE's Office of Environmental Management; 3) site landlord activities by DOE's Office of Nuclear Energy; and 4) the surveillance and maintenance of contaminated facilities until decontamination and decommissioning is completed. Once remedial actions are complete, the long-term stewardship activities will consist of maintaining engineered barriers, monitoring ground and surface water, enforcing institutional controls, and restricting access.

[1]In June 2000, United States Enrichment Corporation (USEC) announced that it will cease uranium enrichment operations at the Portsmouth Gaseous Diffusion Plant in June 2001. The U.S. Department of Energy (DOE) is evaluating this situation. The analysis for this site was developed prior to the USEC's announcement and, therefore, does not reflect cessation of uranium enrichment processing. If operation of the plant is discontinued, the additional decontamination, decommissioning, and other cleanup activities required would dramatically impact the scope and schedule of activities discussed in this site summary.



Portsmouth Gaseous Diffusion Plant

The historic mission of the Portsmouth plant was to produce materials for nuclear weapons development. The plant began full operations in 1955 and produced highly-enriched uranium (HEU) for the nuclear weapons complex until 1964. From 1964 until the present, the plant has produced HEU and low-enriched uranium (LEU) for use in civilian nuclear power research, the U.S. Navy nuclear power program, and commercial nuclear utilities. In the early 1980s, DOE initiated a gas centrifuge uranium enrichment program, but the facilities never conducted full operations.

ACCOMPLISHMENTS

- Sitewide description of current conditions completed in lieu of a RCRA facility assessment
- All facility investigations completed under RCRA
- All groundwater plumes contained onsite through completion of interim measures
- Four Records of Decision approved
- All RCRA corrective actions for Quadrant III completed (west side)
- Completed 14 RCRA closures, five solid waste closures, and six interim actions
- Five groundwater treatment facilities constructed and operational
- Fifteen technology demonstrations conducted at the Portsmouth site
- Completed one decontamination and decommissioning project
- Five-year RCRA Part B permit approved by Ohio Hazardous Waste Facility Board in 1995
- 4.9 million kilograms (10.9 million pounds) of low-level and mixed waste shipped to Envirocare
- 0.5 million kilograms (1.2 million pounds) of low-level radioactive waste shipped to Hanford
- 1.4 million kilograms (3.1 million pounds) of PCB and RCRA liquids, waste oils shipped to *Toxic Substances Control Act* Incinerator
- Two million kilograms (4.3 million pounds) of recyclables shipped for recycling

BY 2006 PORTSMOUTH WILL HAVE

- Completed all assessments and agency-required remedial actions (prior to decontamination and decommissioning)
- Shipped all DOE Environmental Management waste for final disposition

1.2 Site Cleanup and Accomplishments

Uranium enrichment operations and related waste disposal activities at Portsmouth resulted in onsite contamination of the environment with radiological and chemical substances. Specifically, contaminants included chlorinated solvents, such as trichloroethylene (TCE), and solvents mixed with low concentrations of radionuclides, metals, and polychlorinated biphenyls (PCBs), which were disposed in onsite landfills and surface impoundments. Additional sources of contamination are uranium deposits in process equipment and radionuclides in buildings, cooling towers, burial grounds, and wastewater ponds. TCE is the primary contaminant of concern in the onsite groundwater. DOE has identified only minimal levels of radiological contamination offsite in some stream sediments, but not at concentrations that pose public health risks.

Currently, DOE is conducting cleanup activities under the conditions established in a Federal Facility Agreement signed by DOE, EPA, and the Ohio Environmental Protection Agencies (OEPA). The Federal Facility Agreement integrates cleanup activities being conducted at the site under RCRA and the *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA) regulations. The site has not been placed on the National Priorities List and, therefore, CERCLA is not the primary driver of cleanup activities. To facilitate remedial action, the Portsmouth site is divided into four quadrants. While characterization will continue at Portsmouth until 2002, DOE's efforts to date have identified contaminated groundwater, soil, surface water/sediments, engineered landfills, and facilities as the major focus of current and future cleanup activities.

Under the RCRA corrective action process, a number of potential release sites have been characterized and classified as requiring remediation, no further action, or requiring further consideration at the designated time of decontamination and decommissioning. The units that have been characterized and designated 'no further action' are essentially open for future unrestricted use in line with DOE decisions regarding the overall Portsmouth site designated future land use. The units that have, or will, receive remediation will enter a thirty-

year post-closure period (as defined by RCRA), accompanied by various land restriction notations, and are discussed in Section 2.0.

In general, DOE plans to remove well-defined areas of soil contamination for offsite shipment and disposal; close and cap landfill areas; and contain and remediate groundwater as much as possible through in-situ treatment and passive treatment technologies to meet risk levels appropriate for its planned future use. Groundwater treatment systems will be abandoned in place following completion of remediation. Multiple landfills containing sanitary, hazardous, or low-level radioactive waste will be closed and capped. Facilities that pose unacceptable risks or are unsuitable for reuse will be demolished. A proposed onsite disposal facility, not yet sited or constructed, is assumed to be used to dispose of low-level radioactive waste and debris that are generated as a result of decontamination and decommissioning activities. DOE assumes that all cleanup activities will be completed by 2035 and that each area of the site will be remediated to anticipated future use levels. Stakeholders have recommended that the industrialized portions of the reservation remain industrial, while areas outside the current industrialized zone be utilized in a recreational fashion.

For purposes of this report, the four quadrants divide the site into portions, roughly coinciding with groundwater flow direction. Contamination and cleanup issues specific to each quadrant are discussed in more detail in Section 3.0.

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

When site cleanup is complete, residual contamination will exist in the form of capped soil areas, landfills and groundwater plumes with limited concentrations of some contaminants remaining above regulatory levels. Many cleanup decisions regarding facilities and surface water/sediments will not be made until USEC (or future operator) ceases uranium processing operations. Long-term stewardship activities at Portsmouth will include maintaining engineered barriers, monitoring ground and surface water, enforcing institutional controls, and restricting access.

DOE will monitor and maintain multi-layer caps to ensure they continue to isolate subsurface contamination from rainwater infiltration. In addition, DOE will monitor up-gradient diversion trenches, collection drains, groundwater extraction wells, and phytoremediation sites. The operation and maintenance of these engineered controls will be ensured through a systematic surveillance and maintenance program (Environmental Restoration Surveillance and Maintenance Program Plan), as well as ongoing ground and surface water monitoring data collected and reported on a regular basis (Integrated Groundwater Monitoring Plan). In addition, the remediated units are subject to five-year technical reviews to determine the efficacy of the remedy and determine if repair, modification, or further action is warranted.

STAKEHOLDER INVOLVEMENT

A Future Site Use Workshop was held with local stakeholders on September 7, 1995, to get initial input from the public on potential reuse options for the Portsmouth site. Continued discussions have been held regularly with the Southern Ohio Diversification Initiative and the Community Reuse Organization, which is comprised of representatives from the four surrounding counties. Until completion of the environmental program, the site will continue its public participation efforts by conducting public meetings, disseminating stakeholder newsletter updates, printing fact sheets, and issuing news releases to inform and involve the public. The creation of a Site-Specific Advisory Board, Citizens Task Force or Working Group, to coordinate with the local Community Reuse Organization, will be recommended to obtain full stakeholder input into decisions on the overall reuse of the site.

Institutional controls will include legal conditions and/or covenants that restrict the use of property, prohibit groundwater use, and notify zoning authorities of residual contamination. In addition, DOE or the State of Ohio will require a permit to ensure that any party disturbing the remediated area utilize the appropriate safeguards and precautions. Access restrictions at Portsmouth are maintained by a full time security force, which also repairs and replaces the fences and gates, as necessary. DOE, along with the EPA and OEPA, are committed to maintaining the necessary land use controls, including institutional controls for as long as they are necessary to ensure that unacceptable exposures to residual contamination do not occur.

Record keeping activities will primarily follow current procedures. DOE and the Federal Facilities Agreement with EPA and OEPA require all information that is used in decision making be maintained in the administrative record. These documents include remedial investigations, feasibility studies, proposed plans, and decision documents (i.e., Records of Decision). Associated correspondence, data, and some post-decision document information is also included. The administrative record will need to be reviewed to identify information relevant to long-term stewardship activities and to store the information in retrievable form for the long term.

2.2 Long-Term Stewardship Technology Development and Deployment

The Portsmouth site has been very active in the development and deployment of emerging and innovative technologies. As a direct result of numerous pilot scale demonstrations, several Portsmouth units were subject to full-scale and successful remediation with the previously unproven technology. Several of the technologies, particularly the non-mechanical biological systems (phytoremediation and enhanced biodegradation) have become an important component of the long-term stewardship program because of their relatively long treatment horizon, and the need for vigilant monitoring to determine their long-term effectiveness. The five-year technical review will be used to systematically evaluate sampling data, as well as other important information to determine the overall efficacy of the technology/remediation and to determine if further action is warranted.

2.3 Assumptions and Uncertainties

While DOE has conducted significant characterization activities at Portsmouth, there is uncertainty associated with projected amounts of residual contamination and required long-term stewardship activities. The possibility exists that contaminated environmental media not yet identified will be discovered in the future as a result of routine operations, maintenance activities, or decontamination and dismantlement activities at the Portsmouth site. Upon discovery of a new contaminant source by DOE, EPA, or OEPA, that contaminant source will be evaluated and appropriate response actions taken in accordance with the Federal Facility Agreement. In addition, DOE and other signatories to the Federal Facility Agreement have postponed decisions indefinitely on cleanup activities for contaminated surface water/sediments and facilities. The final decisions regarding these contaminated media will affect the cleanup "end state" of the Portsmouth site and, consequently, the long-term stewardship activities. Applicable to all contaminated media, once final remedial action has been taken, DOE assumes a 30 year post-closure period (as defined by RCRA), accompanied by various land restriction notations, to ensure continued protection of human health and the environment.

2.4 Estimated Site-Wide Long-Term Stewardship Costs

Estimated costs for long-term stewardship activities at the Portsmouth site are identified in the table below. The long-term stewardship costs include maintaining engineered barriers, monitoring ground and surface water, enforcing institutional controls, and restricting site access. The significant costs are associated with groundwater operations, followed by monitoring, with only a small portion of the costs attributed to surveillance and maintenance. For instance, a small annual cost is associated with plugging abandoned wells and installing new groundwater monitoring wells. The change in costs over the life of the program reflect an anticipated reduction in groundwater monitoring and, eventually, groundwater pump-and-treat costs. An independent long-term

stewardship project structure is not scheduled to become operational at the Portsmouth site until fiscal year (FY) 2008. However, there are several areas scattered throughout the site where long-term stewardship activities are currently being conducted and managed as part of ongoing cleanup projects. These expenses have been extracted from the current cleanup project for FY 2000 through 2007 and consist mainly of groundwater monitoring and pump-and-treat activities.

The principal uncertainties which affect the costs for long-term stewardship activities are the final selection of remediation technologies (including cleanup levels) and the time required to achieve the targeted cleanup levels. For purposes of this report, long-term stewardship costs are shown until FY 2070; however, it is anticipated that long-term stewardship activities will be required in perpetuity.

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	*Amount*	*Year(s)*	*Amount*	*Year(s)*	*Amount*
FY 2000	$6,764,000	**FY 2008**	$5,602,000	**FY 2036-2040**	$6,975,000
FY 2001	$6,764,000	**FY 2009**	$5,580,000	**FY 2041-2045**	$6,975,000
FY 2002	$6,764,000	**FY 2010**	$5,580,000	**FY 2046-2050**	$6,975,000
FY 2003	$5,697,000	**FY 2011-2015**	$27,879,000	**FY 2051-2055**	$6,975,000
FY 2004	$5,839,000	**FY 2016-2020**	$13,950,000	**FY 2056-2060**	$6,975,000
FY 2005	$5,939,000	**FY 2021-2025**	$13,950,000	**FY 2061-2065**	$6,975,000
FY 2006	$6,041,000	**FY 2026-2030**	$13,950,000	**FY 2066-2070**	$6,975,000
FY 2007	$6,168,000	**FY 2031-2035**	$9,765,000		

3.0 PORTION OVERVIEW

The Portsmouth site consists of four portions that will require long-term stewardship activities as of 2006. For purposes of this report, a "portion" is defined as a geographically contiguous and distinct area (which may involve residually contaminated facilities, engineered units, soil, groundwater, and/or surface water/sediment) for which cleanup, disposal, or stabilization will have been completed and long-term stewardship activities will be required as of 2006. While DOE is conducting separate RCRA cleanup actions in each quadrant, it projects that long-term stewardship activities will commence for parts of each quadrant by 2000. Specific long-term stewardship activities are identified during the cleanup process and in the final RCRA regulatory decision documents.

The Portsmouth site consists of four portions: (1) Quadrant I, (2) Quadrant II, (3) Quadrant III, and (4) Quadrant IV. Each portion is listed in Table 3-1, with accompanying discussion of cleanup and long-term stewardship activities in Sections 3.1 through 3.4. The predominant mechanism for migration of contamination at the site is leaching of contaminants from source areas and transport via subsurface flow to surface water. In response, DOE has grouped sources of contamination into quadrants according to the direction of groundwater flow. Each quadrant has contamination and long-term stewardship issues associated with soil, groundwater, surface water/sediments, engineered units, and/or facilities.

Long-Term Stewardship Information		
Portion	***Long-Term Stewardship Start Year***	***Long-Term Stewardship End Year***
Quadrant I	2000	In Perpetuity
Quadrant II	2000	In Perpetuity
Quadrant III	2000	In Perpetuity
Quadrant IV	2000	In Perpetuity

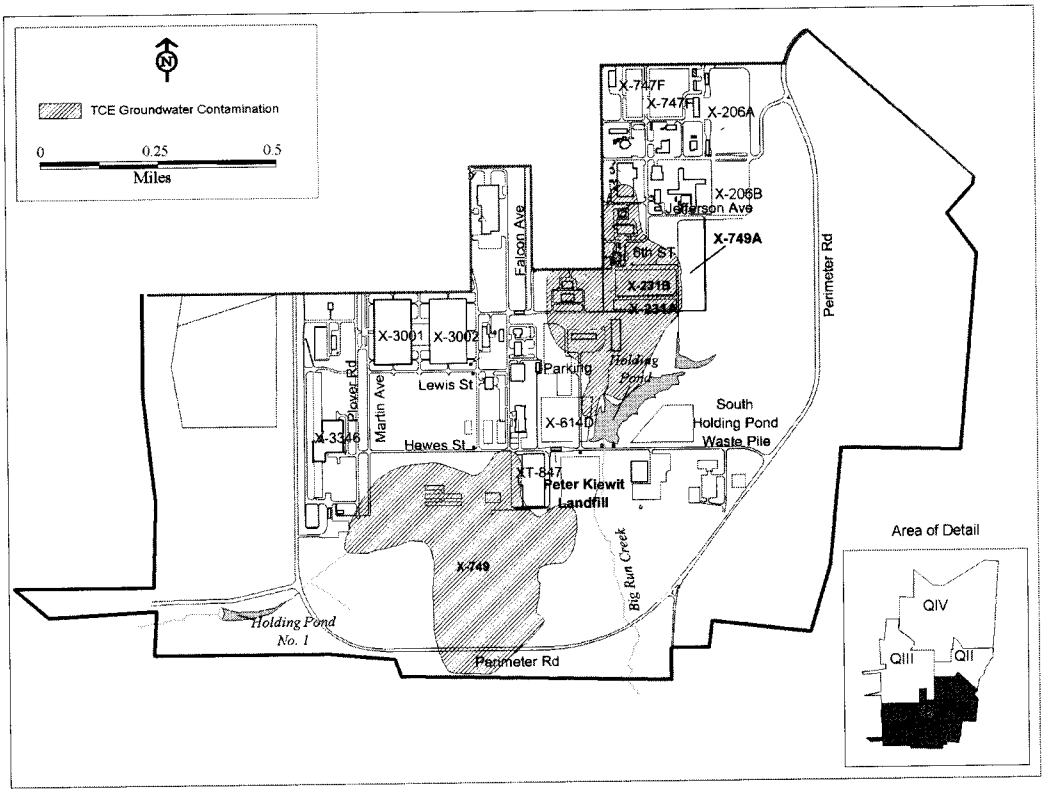
3.1 Quadrant I Portion

QUADRANT I PORTION HIGHLIGHTS

Major Long-Term Stewardship Activities - maintaining engineered units; monitoring ground and surface water; enforcing institutional controls
Portion Size - 425 hectares (1,054 acres)
Estimated Volume of Residual Contaminants - groundwater 26 million cubic meters (34 million cubic yards); surface water/sediments unknown; engineered units 38,000 cubic meters (50,000 cubic yards); facilities unknown
Long-Term Stewardship Start-End Years - 2000-in perpetuity
Average Annual Long-Term Stewardship Costs FY 2000-2006 - $1,565,000

This quadrant comprises 425 hectares (1,054 acres) of the southern portion of the Portsmouth reservation, both inside and outside of the fenced security perimeter around the industrialized area. Quadrant I boundaries were established with respect to ground and surface water flow and drainage patterns. The Quadrant contains both operational and non-operational support facilities that relate to the uranium enrichment process, including the onsite laboratory, various administrative buildings, a coal-fired steam plant, as well as waste disposal units and holding ponds. The main historic sources of contamination include waste burial sites and associated groundwater plumes. The primary contaminant for this portion is trichloroethene (TCE), as well as the long lived radioactive isotope technetium-99 (Tc-99). Past waste disposal practices, such as the land application of waste solvents to encourage biodegradation, as well as contaminants emanating from landfills, have contaminated soil, groundwater, and surface water/sediments. To date, the site has completed several interim actions to isolate the contamination within the confines of the property boundaries. The following units are continuing sources of contamination to groundwater: the Oil Biodegradation Plots (X-231A/B); Contaminated Material Disposal Facility (X-749 Landfill); and the Peter Kiewitt Landfill. The primary contaminants for these units are TCE, as well as the long-lived radioactive isotope Tc-99. The following sections describe cleanup and long-term stewardship activities for each of the contaminated media, including groundwater, surface water/sediments, engineered units, and facilities. Based on soil samples taken during the characterization effort, contaminants are no longer present at leaching levels established by the Ohio EPA, and, consequently, the soil is no longer a source of groundwater contamination. Residually contaminated soil is confined to the engineered units and, therefore, will be discussed accordingly.

As in the case of all cleanup activities at Portsmouth, Quadrant I activities are driven by the requirements of the Cleanup Alternative Studies/Corrective Measures Studies process under RCRA corrective actions with Ohio EPA, unless otherwise specified. Cleanup is implemented under a RCRA consent decree with Ohio EPA and a consent order with the U.S. EPA that includes radiological cleanup. DOE will determine both cleanup remedies and post-cleanup long-term stewardship activities through this process. After remediation is complete, DOE is committed to maintaining necessary land use controls to ensure that unacceptable exposures to residual contamination do not occur. Specific requirements for Quadrant I will be documented in a surveillance and maintenance program.



Quadrant I Portion

3.1.1 Groundwater

Groundwater under Quadrant I is divided into two water-bearing units: one shallow in unconsolidated soil, and one deeper in the bedrock sandstone units. Groundwater contamination in Quadrant I includes relatively well-defined plumes emanating from two general areas. The first plume centers around five separate facilities and is referred to as the Five-Unit Groundwater Investigative Area. Only two (the Oil Biodegradation Plots) of the five areas are considered continuing sources of contamination. The second groundwater plume, known as the Contaminated Material Disposal Facility/former Goodyear Training Facility area, consists primarily of TCE and encompasses an area south of the Five-Unit plume. The former Goodyear Training Facility is no longer considered a source of groundwater contamination. The Contaminated Material Disposal Facility is hydrologically isolated and, therefore, anticipated to no longer be a source of groundwater contamination. The contamination, such as TCE, originated from the source areas, leaching vertically and spreading laterally through the subsurface. However, DOE does not expect the groundwater to migrate along deep pathways outside the current zone of groundwater contamination at concentrations exceeding preliminary remediation goals. DOE currently estimates almost 26 million cubic meters (34 million cubic yards) of groundwater are contaminated within the plumes.

Cleanup activities applicable to groundwater have focused on controlling the sources of groundwater contamination. These activities are expected to reduce contaminant concentrations but will not restore a majority of the groundwater to drinking water regulatory standards. For instance, in April 1994, DOE constructed a 328-meter (1,077-foot) long subsurface barrier wall near the southern DOE property line to prevent groundwater containing TCE from moving outside the Portsmouth boundary (known as the X-749 Interim Remedial Measure

(IRM) Containment Wall). Also, a single 457-meter (1,500-foot) horizontal well was installed to drain contaminated groundwater from beneath the location of the former Goodyear Training Facility. In addition, DOE has constructed a phytoremediation (group of fast-growing pheatophytic trees) plot near the Hazardous Materials Landfill and the former Goodyear Training Facility area to treat and minimize the migration of groundwater simultaneously. Beginning in April 1992, contaminated groundwater from the drainage trenches and extraction wells discharged to the X-622 Groundwater Treatment Facility (the carbon filtration unit removes volatile organic compounds from contaminated groundwater pumped from the Oil Biodegradation Plot (X-231 B) and the Contaminated Material Disposal Facility (X-749 Landfill) remediation areas). Target cleanup levels are to achieve a risk level of 1×10^{-4} for carcinogens and a hazard index of 1.0 for noncarcinogens, assuming exposures for onsite workers in the industrialized area of the site.

Groundwater Long-Term Stewardship Activities

Long-term stewardship activities for groundwater in Quadrant I consist primarily of treatment and monitoring. DOE also conducts surveillance and maintenance on up-gradient diversion trenches, collection drains, groundwater extraction wells, and phytoremediation sites. Groundwater from collection drains and extraction wells are treated at one or more water treatment plants before final discharge. DOE operates and maintains the groundwater treatment facilities. In addition, DOE documents groundwater monitoring data and prepares performance reports, such as the RCRA Annual Groundwater Report and other annual regulatory reports. Institutional controls will include legal conditions and/or covenants that restrict the use of property, prohibit groundwater use, and notify zoning authorities of residual contamination. In addition, DOE or the State of Ohio requires a permit to ensure that any party disturbing the remediated area utilize the appropriate safeguards and precautions. Frequent, regular sampling of groundwater is assured as part of the post-closure agreements for remediated units and groundwater areas.

3.1.2 Surface Water/Sediments

Creeks, drainage ditches, and holding ponds are the main surface water features at the Portsmouth site. All surface water eventually discharges into the Scioto River that flows south into the Ohio River. There are two major surface water drainages in Quadrant I: 1) the Southwest Drainage Ditch that flows into the X-2230M holding pond; and 2) the Big Run Creek that receives discharge from the X-230K holding pond. The Southwest Drainage Ditch receives water from storm sewers and groundwater discharge, and its flow is low to intermittent. Big Run Creek is the primary surface drainage and is continually supplied by a combination of groundwater discharge, stormwater runoff, and some industrial plant effluents (non-contact cooling water) through the X-230K holding pond. The principal contaminants in Quadrant I surface water and sediments are polycyclic aromatic hydrocarbons (PAHs), which are found primarily in sediments due to PAHs relatively insoluble compounds, and radionuclides. DOE estimates that contaminated surface water and sediments possibly exists in the 11,000 lineal feet of drainage ditches that are in Quadrant I.

DOE has not planned any cleanup activities specifically addressing contaminated surface water/sediments for two reasons. First, isolation of contaminated soil and remediation of groundwater in Quadrant I already address two major sources of surface water contamination. Second, the major source of PAHs in surface water is ongoing industrial plant operations that are expected to continue for the foreseeable future. Consequently, DOE has postponed any decisions regarding PAH remediation until uranium processing operations have ceased.

DOE is conducting two surface water monitoring programs to identify any potential contaminant discharges on- and offsite: 1) National Pollutant Discharge Elimination System (NPDES) permit monitoring; and 2) Portsmouth Groundwater Monitoring Program. The former program is mandated by the State of Ohio and regulates all plant effluent discharged to the environment. DOE voluntarily conducts the latter program to facilitate comparison of monitoring data collected upstream and downstream so that the effect of the contaminated groundwater plumes

on the creeks can be isolated. While target cleanup levels are not applicable, NPDES permit discharge criteria establish contaminant limitations at permitted outfalls, and Ambient Water Quality Criteria apply to the receiving streams. As a best management practice, DOE staff also sample quarterly for radioactivity.

Surface Water/Sediments Long-Term Stewardship Activities

Based on the postponement of the remedial decision, long-term stewardship activities for surface water and sediment in Quadrant I consist of enforcing institutional controls and continuing the surface water monitoring programs. Institutional controls will include legal conditions and/or covenants that restrict the use of property and notify zoning authorities of residual contamination. In addition, DOE or the State of Ohio will require a permit to ensure that any party disturbing the remediated area utilize the appropriate safeguards and precautions. DOE and other stakeholders have decided that the non-industrialized portions of the reservation could be utilized for permitted recreational activities (such as hunting). However, fishing or other activities likely to result in extended exposure to contaminated surface water and sediments are prohibited. In addition, five-year reviews of surface water and sediment sampling data are conducted to determine if unacceptable exposures are likely, and to determine the necessity of additional corrective action.

3.1.3 Engineered Units

Quadrant I contains five engineered units, occupying 202,000 square meters (2,178,000 square feet), that have released contaminants into the groundwater. The engineered units include the Oil Biodegradation Plots (X-231A and B), the Contaminated Materials Disposal Facility (known as X-749 Landfill), the Peter Kiewit Landfill, and the Classified Materials Burial Ground (X-749A).

Specifically, the Oil Biodegradation Plots consist of two areas (approximately 5,017 square meters (54,000 square feet) and 3,400 square meters (37,000 square feet), respectively) that were used for the disposal of waste contaminated with volatile organic compounds (VOCs), PCBs, inorganic constituents, and low levels of uranium and technetium. Data resulting from investigation of the units indicated that TCE and technetium exceed leaching levels established by the Ohio EPA, and uranium is present above its background concentration. TCE was found at various depths in the oil plots, but uranium and technetium are generally confined to depths of less than two meters (six feet). The soil was treated and then covered with a clean soil layer and graded to promote precipitation runoff. Capping of the two former Oil Bidegradation Plots will be completed by August 2003. Only 25,100 square meters (270,000 square feet) of residual contamination will remain associated with the Oil Biodegradation Plots.

The landfills are unlined trenches that were built and operated during the 1950s and 1970s. The Contaminated Materials Disposal Facility (X-749 Landfill) was used to dispose solid waste and low-level radioactive contaminated waste and equipment. In general, wastes were placed in trenches approximately five meters (15 feet) deep and covered with earthen material. The Peter Kiewit Landfill was originally used as a salvage yard and trash disposal area during initial construction of the Portsmouth plant and, subsequently, as a sanitary landfill. The landfill closed in 1968. The Classified Materials Burial Ground, which occupies approximately two hectares (six acres), was used from 1955 until 1993 for burial of classified, nonhazardous materials. Wastes were buried in wooden boxes and steel or fiber drums in four-meter (14-foot) deep trenches that were backfilled to surface grade with a minimum of two meters (six feet) of soil.

DOE has undertaken a series of activities to clean up the contamination associated with engineered units in Quadrant I. These areas have been hydrologically isolated with engineered, multi-layered caps covering the buried waste and extraction wells around each unit capturing contaminated groundwater. Drainage trenches were installed to intercept and collect contaminated leachate. DOE also installed subsurface barrier walls around the Contaminated Materials Disposal Facility and along the southern perimeter of Quadrant I to prevent further

contaminant migration. Currently, DOE estimates that 232,000 square meters (2.5 million square feet) of area associated with engineered units is underlain by groundwater containing TCE at concentration above the maximum contaminant level of five parts per billion. DOE estimates that 38,000 cubic meters (50,000 cubic yards) of contaminated soil will remain contained in the engineered units.

Engineered Units Long-Term Stewardship Activities

Long-term stewardship activities for engineered units in Quadrant I consist of surveillance and maintenance of capped burial grounds. Institutional controls will include legal conditions and/or covenants that restrict the use of property (including excavation of soil) and notify zoning authorities of residual contamination. In addition, DOE or the State of Ohio will require a permit to ensure that any party disturbing the remediated area utilize the appropriate safeguards and precautions. The land use controls include State advisories on natural resources; access controls including fences, locked gates, and security guards; signs; and other security measures. DOE will continue to maintain access control of the reservation well into the foreseeable future, and will maintain cooperation with other governmental agencies to ensure deed restrictions are preserved for future land users. The engineered units, consisting of multi-layered caps, and subsurface barrier systems, are designed to standards ensuring extreme longevity. Rigorous surveillance and maintenance programs are required through the designated post closure period, and five-year reviews are conducted to ensure the ongoing efficacy of the engineered remedies.

3.1.4 Facilities

There are numerous active and inactive facilities located in Quadrant I. The facilities are, or were previously, associated with uranium processing operations at Portsmouth. The buildings and subsurface structures are mostly steel and concrete construction. Generally, contamination is fixed and confined to the surface areas of the various units. DOE is maintaining both active and inactive facilities until it makes final decisions regarding their decontamination and decommissioning. To date, DOE has not conducted any facility cleanup operations in Quadrant I. However, DOE assumes that all of the gaseous diffusion process buildings will be demolished down to their concrete slabs. Demolition rubble will be used for in-place backfill in cavities and/or will be left on the slabs-on-grade and covered with a vegetative layer. All below-grade structures with utility lines conduit, trenches, etc. will be capped off and left in place. DOE assumes that decommissioning activities will generate low-level mixed waste, low-level radioactive waste, hazardous waste, polychlorinated biphenyl waste, asbestos waste, and sanitary waste. All low-level radioactive waste is assumed to be disposed of in the proposed onsite disposal facility. Small levels of fixed radioactive contamination will remain on building structures (mainly concrete). However, post-remediation analyses will ensure that contamination left onsite will not pose an unacceptable risk to human health and the environment. Additional residual contamination, such as characterized groundwater contamination plumes or PAHs in the surface water/sediment systems, could remain after demolition at levels acceptable for the various established land use agreements, or as part of an ongoing monitoring/remediation strategy under the long-term stewardship program.

Facilities Long-Term Stewardship Activities

At this time, the long-term stewardship activities required for facilities are unclear. DOE will maintain the facilities in a safe and stable condition until final disposition decisions are made. To the extent that the decisions result in additional areas of residual contamination, DOE will apply the appropriate engineered and institutional controls to maintain the safety and health of humans and the protection of the environment. DOE will maintain access control of the reservation well into the foreseeable future and will maintain cooperation with other governmental agencies to ensure deed restrictions are preserved for future land users.

3.1.5 Estimated Long-Term Stewardship Costs for Quadrant I

Anticipated long-term stewardship activities for Quadrant I will include monitoring and maintaining engineered units, monitoring ground and surface water, and enforcing institutional controls. The costs below were derived by prorating the sitewide long-term stewardship budget and, therefore, should be considered an approximation for Quadrant I. While cleanup will not be complete for Quadrant I prior to 2006, groundwater pump and treat, groundwater monitoring, and limited surveillance and maintenance activities will be underway. Costs for these activities are reflected in the table below (FY 2000-FY 2010). For purposes of this report, long-term stewardship costs are shown until FY 2070; however, it is anticipated that long-term stewardship activities will be required in perpetuity.

Long-Term Stewardship Costs (Constant Year 2000 Dollars)							
FY 2000 - FY 2010	***FY 2011 - FY 2020***	***FY 2021 - FY 2030***	***FY 2031 - FY 2040***	***FY 2041 - FY 2050***	***FY 2051 - FY 2060***	***FY 2061 - FY 2070***	***Estimated Total***
$16,684,500	$16,736,682	$11,009,491	$6,515,095	$5,391,522	$5,391,514	$5,391,494	$67,120,000

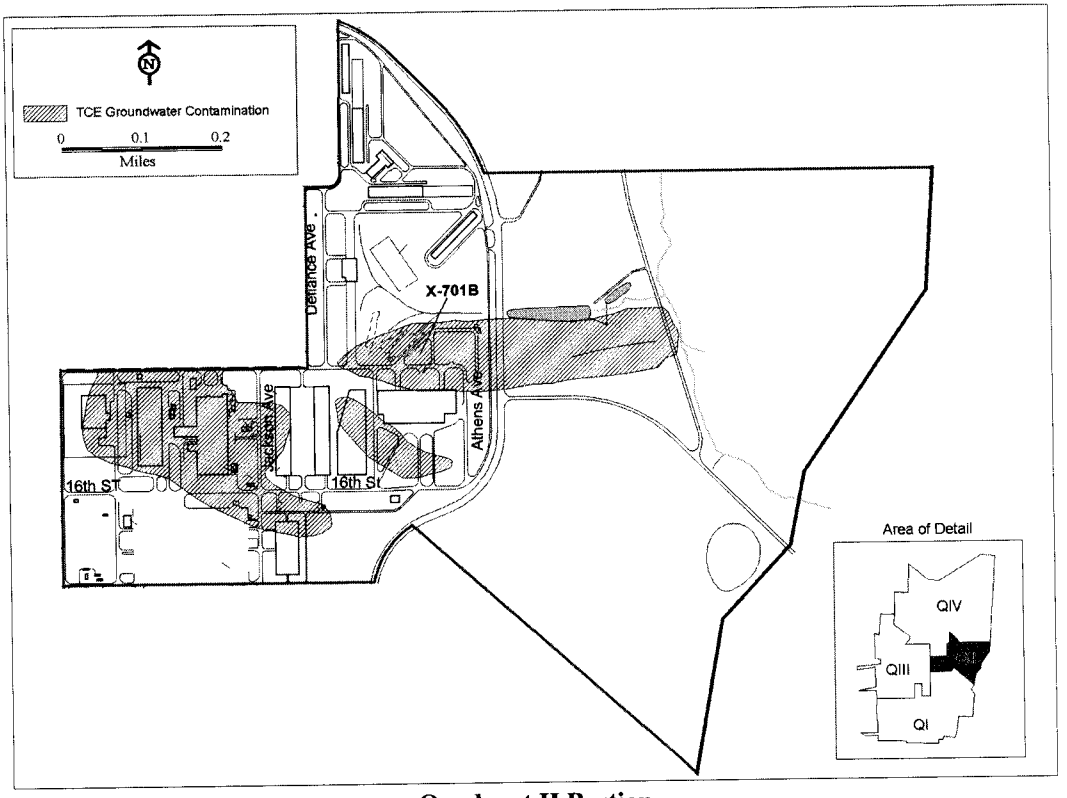
3.2 Quadrant II Portion

QUADRANT II PORTION HIGHLIGHTS

Major Long-Term Stewardship Activities - maintaining engineered units; monitoring ground and surface water; enforcing institutional controls
Portion Size - 145 hectares (360 acres)
Estimated Volume of Residual Contaminants - groundwater 100,000 cubic meters (131,000 cubic yards); surface water/sediments unknown; engineered units 38,000 cubic meters (50,000 cubic yards); facilities unknown
Long-Term Stewardship Start-End Years - 2000-in perpetuity
Average Annual Long-Term Stewardship Costs FY 2000-2006 - $1,565,000

This quadrant comprises 145 hectares (360 acres) of the northeastern part of the Portsmouth site, encompassing areas both inside and outside of the security perimeter around the industrialized area. This portion of the site contains a large number of support buildings related to the uranium enrichment process, particularly buildings that were used to fabricate and repair the multitude of mechanical components used in the process. As part of the maintenance and repair process, components were routinely cleaned and decontaminated with solvents. In general, spent solvents, mainly TCE, which were contaminated by long-lived radioisotopes, were released to the holding pond and retention basins via process piping from nearby fabrication and maintenance buildings. Currently, the main source of contamination include the capped waste burial site, and associated groundwater plumes. The cap covers a holding pond and retention basin that were used to neutralize solutions and wastewater from plant operations. These contaminants leached from the soils into the groundwater. The following sections describe cleanup and long-term stewardship activities for each of the contaminated media, including groundwater, surface water/sediments, engineered units, and facilities. Residually contaminated soil is confined to the engineered units and, therefore, will be discussed accordingly.

DOE will determine both cleanup remedies and post-cleanup long-term stewardship activities in accordance with RCRA, CERCLA, and other requirements (e.g., Federal Facility Agreement). After remediation is completed, DOE is committed to maintaining necessary land use controls to ensure that unacceptable exposures to residual contamination do not occur. Specific requirements for Quadrant II will be documented in a surveillance and maintenance program plan.



Quadrant II Portion

3.2.1 Groundwater

Groundwater under Quadrant II is divided into two water-bearing units: one shallow in unconsolidated soil and one deeper in the bedrock sandstone units. Groundwater contamination in Quadrant II includes relatively well-defined plumes emanating from the capped Holding Pond and Retention Basins, as well as an area of the plant associated with several operational and nonoperational plant facilities (known as the Seven-Unit plume). The contaminant that 'drives the risk' for both areas is TCE. Secondary contaminants include long-lived radioisotopes, such as technetium-99. Currently, concentrations of chemicals (primarily organic) within these groundwater plumes exceed the preliminary remediation goals. The contamination originates from the source areas, leaching vertically and spreading laterally throughout the subsurface. However, DOE does not expect the groundwater to migrate along deep pathways outside the current zone of groundwater contamination at concentrations exceeding preliminary remediation goals. DOE currently estimates that over 146 hectares (360 acres) of this quadrant are underlain by 100,000 cubic meters (131,00 cubic yards) of groundwater, with TCE concentrations above the maximum concentration levels for groundwater (five parts per billion).

Cleanup activities applicable to groundwater have focused on controlling the sources of groundwater contamination. These activities are expected to reduce contaminant concentrations but not restore a majority of the groundwater to drinking water regulatory standards. In addition, DOE has constructed drainage trenches and installed both vapor extraction and oxidant injection/extraction wells to collect, extract, and contain the groundwater plumes. Target cleanup levels are to achieve a risk level of $1x10^{-4}$ for carcinogens and a hazard index of 1.0 for noncarcinogens, assuming exposures for onsite workers in the industrialized area of the site.

Groundwater Long-Term Stewardship Activities

Long-term stewardship activities for groundwater in Quadrant II primarily consist of treatment and monitoring. DOE also conducts surveillance and maintenance on up-gradient diversion trenches, collection drains, and groundwater extraction wells. Groundwater from the collection drains and extraction wells are treated at one or more water treatment plants before final discharge. Groundwater at two RCRA hazardous waste units will continue to be monitored. In Quadrant II, groundwater is sampled from 26 wells in the Holding Pond and Retention Basin area and three wells in the Neutralization Pit area. All wells are sampled quarterly or semiannually and results are published in an annual report (i.e., RCRA Annual Groundwater Report). Surface water samples are collected to monitor potential contaminant discharge from groundwater to surface water. Currently, an Integrated Groundwater Monitoring Plan (IGWMP) is being developed to consolidate hazardous waste, solid waste, and corrective action monitoring into a single plan.

Institutional controls will include legal conditions and/or covenants that restrict the use of property, prohibit groundwater use, and notify zoning authorities (or anyone searching property records) of residual contamination. In addition, DOE or the State of Ohio will require a permit to ensure that any party disturbing the remediated area utilize the appropriate safeguards and precautions. The land use controls include State advisories on natural resources; access controls, including fences, locked gates, and security guards; signs; and other security measures. In addition, groundwater is systematically sampled and the results reported. Five-year reviews are conducted to determine the efficacy of the various selected remedies.

3.2.2 Surface Water/Sediments

Creeks, drainage ditches, and holding ponds are the main surface water features at the Portsmouth site. All surface water eventually discharges into the Scioto River that flows south into the Ohio River. There are two major surface water drainages in Quadrant II: 1) the East Drainage Ditch; and 2) Little Beaver Creek. Most surface runoff, storm sewer water, and groundwater discharge in the quadrant through the East Drainage Ditch to Little Beaver Creek. Runoff from the Recirculating Cooling Water Pump House and Cooling Tower area flows into the Northeast Drainage Ditch in Quadrant IV before eventually draining into Little Beaver Creek. The principal contaminants in Quadrant II surface water are PAHs that are found primarily in sediments due to PAHs' relatively insoluble compounds. DOE estimates that contaminated surface water/sediments cover 2,023 hectares (5,000 acres) on and off the Portsmouth site.

DOE has not planned any cleanup activities specifically addressing contaminated surface water/sediments for two reasons. First, isolation of contaminated soil and remediation of groundwater in Quadrant II already address two major sources of surface water contamination. Second, the major source of PAHs in surface water is ongoing industrial plant operations that are expected to continue for the foreseeable future. Consequently, DOE has postponed any decisions regarding PAH remediation until uranium processing operations have ceased.

DOE is conducting two surface water monitoring programs to identify any potential contaminant discharges onsite and offsite: 1) National Pollutant Discharge Elimination System (NPDES) permit monitoring; and 2) Portsmouth Groundwater Monitoring Program. The former program is mandated by the State of Ohio and regulates all plant effluent discharged to the environment. DOE voluntarily conducts the latter program to facilitate comparison of monitoring data collected upstream and downstream so that the effect of the contaminated groundwater plumes on the creeks can be isolated. While target cleanup levels are not applicable, NPDES permit discharge criteria establish contaminant limitations at permitted outfalls, and Ambient Water Quality Criteria apply to the receiving streams.

Surface Water/Sediments Long-Term Stewardship Activities

Based on the postponement of the remedial decision, long-term stewardship activities for surface water and sediments in Quadrant II consist of enforcing institutional controls and continuing the surface water monitoring programs. Institutional controls will include legal conditions and/or covenants that restrict the use of property and notify zoning authorities of residual contamination. In addition, DOE or the State of Ohio will require a permit to ensure that any party disturbing the remediated area utilize the appropriate safeguards and precautions. The land use controls include State advisories on natural resources; access controls including fences, locked gates, and security guards; signs; and other security measures. DOE and other stakeholders have decided that the non-industrialized portions of the reservation could be utilized for permitted recreational activities (such as hunting). However, fishing or other activities likely to result in extended exposure to contaminated surface water and sediments are prohibited. In addition, five-year reviews of surface water and sediment sampling data are conducted to determine if unacceptable exposures are likely, and to determine the necessity of additional corrective action.

3.2.3 Engineered Units

Quadrant II contains one engineered unit, the former Holding Pond and Retention Basins (X-701B), containing residual contamination. Originally, this area consisted of one unlined holding pond 61 meters by 15 meters (200 feet by 50 feet) and two unlined retention basins (67 meters by 20 meters (220 feet by 65 feet) and 67 meters by 14 meters (220 feet by 45 feet)). The holding pond was used from 1954 to 1988 to neutralize solutions and wastewater containing acids, metals, and solvents originating from the Chemical Cleaning Facility (X-700) and the Decontamination Building (X-705). Beginning in 1972, the wastewater was treated using a lime mixture to neutralize the acids, causing sludges and solids to settle in the holding pond. When the holding pond reached capacity, sludges and solids were dredged and placed in the two adjacent retention basins. RCRA cleanup began in 1989 and consisted of two phases. As part of the first phase, sludge was excavated from the holding pond and two retention basins. The sludge was dewatered, place in containers, and transported to onsite storage. The retention basins were backfilled, graded, and seeded. Phase II consisted of constructing a groundwater pump-and-treat system and in-situ treatment of the soils in the bottom of the holding pond. After treatment, a permanent, multi-layer clay cap will be placed over the holding pond and retention basins. Currently, DOE estimates that the engineered unit covers 12,140 square meters (130,680 square feet) and contains approximately 38,000 cubic meters (50,000 cubic yards) of residually contaminated soil (both in the vadose and saturated zone), consisting primarily of TCE, PCBs, and radiological contamination.

DOE has undertaken a series of activities to hydrologically isolate the engineered unit. Specifically, drainage trenches and oxidant injection/extraction wells have been installed in the areas of highest contamination around the former holding pond and retention basins to intercept and collect contaminated leachate. All collected groundwater is treated at pump-and-treat facilities before final discharge.

Engineered Units Long-Term Stewardship Activities

Long-term stewardship activities for the engineered unit in Quadrant II will consist of surveillance and maintenance of engineered controls (i.e., capped burial ground), as well as institutional controls. Institutional controls will include legal conditions and/or covenants that restrict the use of property and notify zoning authorities (or anyone searching property records) of residual contamination. In addition, DOE or the State of Ohio will require a permit to ensure that any party disturbing the remediated area utilize the appropriate safeguards and precautions. The land use controls include State advisories on natural resources; access controls including fences, locked gates, and security guards; signs; and other security measures. DOE will maintain access control of the reservation well into the foreseeable future, and will maintain cooperation with other governmental agencies to ensure deed restrictions are preserved for future land users. The engineered unit,

consisting of a multi-layered cap and subsurface barrier systems, is designed to standards ensuring extreme longevity. Rigorous surveillance and maintenance programs are required through the designated post closure period, and five-year reviews will be conducted to ensure the ongoing efficacy of the engineered remedies.

3.2.4 Facilities

There are numerous active and inactive facilities located in Quadrant II. The facilities are, or were previously, associated with uranium processing operations at Portsmouth. The buildings and subsurface structures are generally of steel and concrete construction. Radiological contamination is fixed. Potential for other classes of contaminants exist, but the full nature and extent of subsurface contamination under these facilities will not be investigated until final decisions regarding decontamination and decommissioning have been made. DOE is maintaining both active and inactive facilities in a manner safe for the workforce until those decisions are made. To date, DOE has not conducted any facility cleanup operations in Quadrant II. However, DOE assumes that all of the gaseous diffusion process buildings will be demolished down to their concrete slabs. Demolition rubble will be used for in-place backfill in cavities and/or will be left on the slabs-on-grade and covered with a vegetative layer. All below-grade structures with utility lines conduit, trenches, etc. will be capped off and left in place. DOE assumes that decommissioning activities will generate low-level mixed waste, low-level radioactive waste, hazardous waste, polychlorinated biphenyl waste, asbestos waste, and sanitary waste. All low-level radioactive waste is assumed to be disposed of in the proposed onsite disposal facility, which is anticipated to be sited and constructed in the near future. Small levels of fixed radioactive contamination will remain on building structures (mainly concrete). However, post-remediation analyses will ensure that contamination left onsite will not pose an unacceptable risk to human health and the environment. All other contamination, most probably consisting of environmental media contaminated with chlorinated hydrocarbons, will be managed in a fashion consistent with the overall site remediation strategy.

Facilities Long-Term Stewardship Activities

At this time, the long-term stewardship activities required for facilities are unclear. DOE will maintain the facilities in a safe and stable condition until final disposition decisions are made. To the extent that the decisions result in additional areas of residual contamination, DOE will apply the appropriate engineered and institutional controls to maintain the safety and health of humans and the protection of the environment. DOE will maintain access control of the reservation well into the foreseeable future, and will maintain cooperation with other governmental agencies to ensure deed restrictions are preserved for future land users. Rigorous surveillance and maintenance programs are required through the designated post-closure period, and five-year reviews will be conducted to ensure the ongoing efficacy of the engineered remedies.

3.2.5 Estimated Long-Term Stewardship Costs for Quadrant II

Anticipated long-term stewardship activities for Quadrant II will include monitoring and maintaining engineered units, monitoring ground and surface water, and enforcing institutional controls. The costs below were derived by prorating the sitewide long-term stewardship budget and, therefore, should be considered an approximation for Quadrant II. While cleanup will not be complete for Quadrant II prior to 2006, groundwater pump and treat, groundwater monitoring, and limited surveillance and maintenance activities will be underway. Costs for these activities are reflected in the table below (FY 2000-FY 2010). For purposes of this report, long-term stewardship costs are shown until FY 2070; however, it is anticipated that long-term stewardship activities will be required in perpetuity.

Long-Term Stewardship Costs (Constant Year 2000 Dollars)							
FY 2000 - FY 2010	*FY 2011 - FY 2020*	*FY 2021 - FY 2030*	*FY 2031 - FY 2040*	*FY 2041 - FY 2050*	*FY 2051 - FY 2060*	*FY 2061 - FY 2070*	*Estimated Total*
$16,684,500	$17,851,775	$11,743,004	$6,949,167	$5,750,736	$5,750,727	$5,750,705	$70,480,000

3.3 Quadrant III Portion

QUADRANT III PORTION HIGHLIGHTS

Major Long-Term Stewardship Activities - monitoring ground and surface water; enforcing institutional controls
Portion Size - 365 hectares (900 acres)
Estimated Volume of Residual Contaminants - groundwater 24,000 cubic meters (31,000 cubic yards); surface water/sediments unknown; facilities unknown
Long-Term Stewardship Start-End Years - 2000-in perpetuity
Average Annual Long-Term Stewardship Costs FY 2000-2006 - $1,565,000

This quadrant comprises 365 hectares (900 acres) of the western side of the Portsmouth site. The Quadrant contains two of the three main process buildings, as well as major electrical switching yards and large concrete storage pads for staging containers of depleted uranium feedstock planned for future reprocessing and additional uranium recovery. The main source of historical contamination is the Waste Oil Handling Facility (X-740). The facility was the location of a drum crusher and open-sided storage shed that was used to manage spent oils and solvents. Operations at the now closed facility resulted in release of contaminants into the groundwater. The primary contaminant is TCE. The contaminated groundwater is being addressed through a phytoremediation system that simultaneously contains and treats the groundwater plume to acceptable levels. Data collected during the RCRA Facility Investigation show that Quadrant III has no soil that exceeds leach based values. The contaminated media present in Quadrant III include groundwater, surface water/sediments, and facilities. The following sections describe cleanup and long-term stewardship activities for each of these media in more detail.

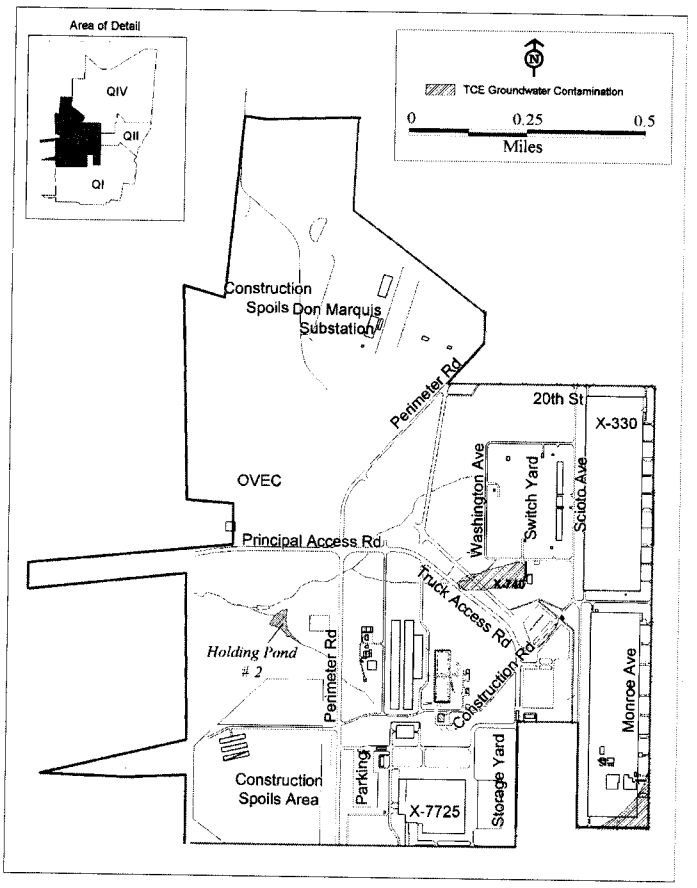
DOE will determine both cleanup remedies and post-cleanup long-term stewardship activities in accordance with RCRA and CERCLA regulations, as well as the Federal Facility Agreement. After remediation is completed, DOE is committed to maintaining necessary land use controls to ensure that unacceptable exposures to residual contamination do not occur. Specific requirements for Quadrant III will be documented in a surveillance and maintenance program.

3.3.1 Groundwater

Groundwater under Quadrant III is divided into two water bearing units: one shallow in unconsolidated soil and one deeper in the bedrock sandstone units. Groundwater contamination in Quadrant III includes a single well-defined plume emanating from the Waste Oil Handling Facility (X-740). Currently, concentrations of chemicals (primarily organic) within the groundwater plume exceed the preliminary remediation goals. The contamination originates from the source area, leaching vertically and spreading laterally through the subsurface. However, DOE does not expect the groundwater to migrate along deep pathways outside the current zone of groundwater contamination at concentrations exceeding preliminary remediation goals. DOE currently estimates that one hectare (three acres) of this quadrant is underlain by 24,000 cubic meters (31,000 cubic yards) of groundwater with TCE concentrations above the maximum concentration levels for groundwater (five parts per billion).

Cleanup activities applicable to groundwater have focused on controlling the sources of groundwater contamination. These activities are expected to reduce contaminant concentrations but not restore a majority of the groundwater to drinking water regulatory standards. In 1999, DOE constructed a phytoremediation (group

of fast-growing pheatophytic trees) plot of three hectares (seven acres) near the Waste Oil Handling Facility area to treat and minimize the migration of groundwater simultaneously. Target cleanup levels are to achieve a risk level of $1x10^{-4}$ for carcinogens and a hazard index of 1.0 for noncarcinogens, assuming exposures for onsite workers in the industrialized area of the site.



Quadrant III Portion

Groundwater Long-Term Stewardship Activities

Long-term stewardship activities for groundwater in Quadrant III consist of surveillance and maintenance of the phytoremediation plot, as well as maintaining institutional controls and monitoring groundwater. Institutional controls will include legal conditions and/or covenants that restrict the use of property, prohibit groundwater use, and notify zoning authorities (or anyone searching property records) of residual contamination. In addition, DOE or the State of Ohio will require a permit to ensure that any party undertaking a disturbance of the remediated area utilize the appropriate safeguards and precautions. The land use controls include State advisories on natural resources, access controls, signs, and security measures. In addition, groundwater is systematically sampled and the results reported. Five-year reviews are also conducted to determine the efficacy of the selected remedy.

3.3.2 Surface Water/Sediments

Creeks, drainage ditches, and holding ponds are the main surface water features at the Portsmouth site. All surface water eventually discharges into the Scioto River that flows south into the Ohio River. There are two major surface water drainages in Quadrant III: 1) the West Drainage Ditch, which is the primary surface drainage; and 2) an un-named intermittent tributary of Little Beaver Creek, which drains the northwestern part of Quadrant III. The principal contaminants in Quadrant III surface water and sediments are PAHs, with secondary contamination consisting of low-level radiological contamination (technetium-99 and uranium). The PAHs are most likely a result of general anthropomorphic activities, such as fuel combustion, and the installation and repair of petroleum-based road surfaces. The uranium and other radioisotopes have been released through routine, ongoing plant activities and transported into the surface drainage system via general overland flow dynamics. DOE estimates that contaminated surface water and sediments cover 5,050 lineal feet on and off the Portsmouth site.

DOE does not plan to conduct cleanup activities specifically addressing contaminated surface water/sediments for two reasons. First, isolation of contaminated soil and remediation of groundwater in Quadrant III already

address the major sources of surface water contamination. Second, the major source of PAHs in surface water is ongoing industrial plant operations that are expected to continue for the foreseeable future. Consequently, DOE has postponed any decisions regarding PAH remediation until uranium processing operations have ceased.

DOE is conducting two surface water monitoring programs to identify any potential contaminant discharges onsite and offsite: 1) National Pollutant Discharge Elimination System (NPDES) permit monitoring; and 2) Portsmouth Groundwater Monitoring Program. The former program is mandated by the State of Ohio and regulates all plant effluent discharged to the environment. DOE voluntarily conducts the latter program to facilitate comparison of monitoring data collected upstream and downstream so that the effect of the contaminated groundwater plumes on the creeks can be isolated. While target cleanup levels are not applicable, NPDES permit discharge criteria establish contaminant limitations at permitted outfalls, and Ambient Water Quality Criteria apply to the receiving streams.

Surface Water/Sediments Long-Term Stewardship Activities

Long-term stewardship activities for surface water and sediment in Quadrant III consist of enforcing institutional controls and continuing the surface water monitoring programs. Institutional controls will include legal conditions and/or covenants that restrict the use of property and notify zoning authorities of residual contamination. In addition, DOE or the State of Ohio will require a permit to ensure that any party disturbing the remediated area utilize the appropriate safeguards and precautions. DOE and other stakeholders have decided that the non-industrialized portions of the reservation could be utilized for permitted recreational activities (such as hunting). However, fishing or other activities likely to result in extended exposure to contaminated surface water and sediments are prohibited. In addition, five-year reviews of surface water and sediment sampling data are conducted to determine if unacceptable exposures are likely, and to determine the necessity of additional corrective action.

3.3.3 Facilities

There are numerous active and inactive facilities located in Quadrant III. The facilities are, or were previously, associated with uranium processing operations at Portsmouth. The buildings and subsurface structures are mostly steel and concrete construction. Generally, radiological contamination is fixed. Potential for other classes of contaminants exist, but the full nature and extent of subsurface contamination under these facilities will not be investigated until final decisions regarding decontamination and decommissioning have been made. DOE is maintaining both active and inactive facilities in a manner safe for workers or other potentially exposed individuals until it makes final decisions regarding their decontamination and decommissioning. To date, DOE has not conducted any facility cleanup operations in Quadrant III. However, DOE assumes that all of the gaseous diffusion process buildings will be demolished down to their concrete slabs. Demolition rubble will be used for in-place backfill in cavities and/or will be left on the slabs-on-grade and covered with a vegetative layer. All below-grade structures with utility lines conduit, trenches, etc. will be capped off and left in place. DOE assumes that decommissioning activities will generate low-level mixed waste, low-level radioactive waste, hazardous waste, polychlorinated biphenyl waste, asbestos waste, and sanitary waste. All low-level radioactive waste is assumed to be disposed of in the proposed onsite disposal facility anticipated for the site. Small levels of fixed radioactive contamination will remain on building structures (mainly concrete). However, post-remediation analyses will ensure that contamination left onsite will not pose an unacceptable risk to human health and the environment. All other contamination, most probably consisting of environmental media contaminated with chlorinated hydrocarbons, will be managed in a fashion consistent with the overall site remediation strategy.

Facilities Long-Term Stewardship Activities

At this time, the long-term stewardship activities required for facilities are unclear. DOE will maintain the facilities in a safe and stable condition until final disposition decisions are made. To the extent that the decisions result in additional areas of residual contamination, DOE will apply the appropriate engineered and institutional controls to maintain the safety and health of humans and the protection of the environment. DOE will maintain access control of the reservation well into the foreseeable future and will maintain cooperation with other governmental agencies to ensure deed restrictions are preserved for future land users.

3.3.4 Estimated Long-Term Stewardship Costs for Quadrant III

Anticipated long-term stewardship activities for Quadrant III will include monitoring ground and surface water and enforcing institutional controls. The costs below were derived by prorating the sitewide long-term stewardship budget and, therefore, should be considered an approximation for Quadrant III. While cleanup will not be complete for Quadrant III prior to 2006, groundwater pump and treat, groundwater monitoring, and limited surveillance and maintenance activities will be underway. Costs for these activities are reflected in the table below (FY 2000-FY 2010). For purposes of this report, long-term stewardship costs are shown until FY 2070; however, it is anticipated that long-term stewardship activities will be required in perpetuity.

Long-Term Stewardship Costs (Constant Year 2000 Dollars)							
FY 2000 - FY 2010	***FY 2011 - FY 2020***	***FY 2021 - FY 2030***	***FY 2031 - FY 2040***	***FY 2041 - FY 2050***	***FY 2051 - FY 2060***	***FY 2061 - FY 2070***	***Estimated Total***
$16,684,500	$2,380,319	$1,565,788	$926,588	$766,791	$766,791	$766,787	$23,858,000

3.4 Quadrant IV Portion

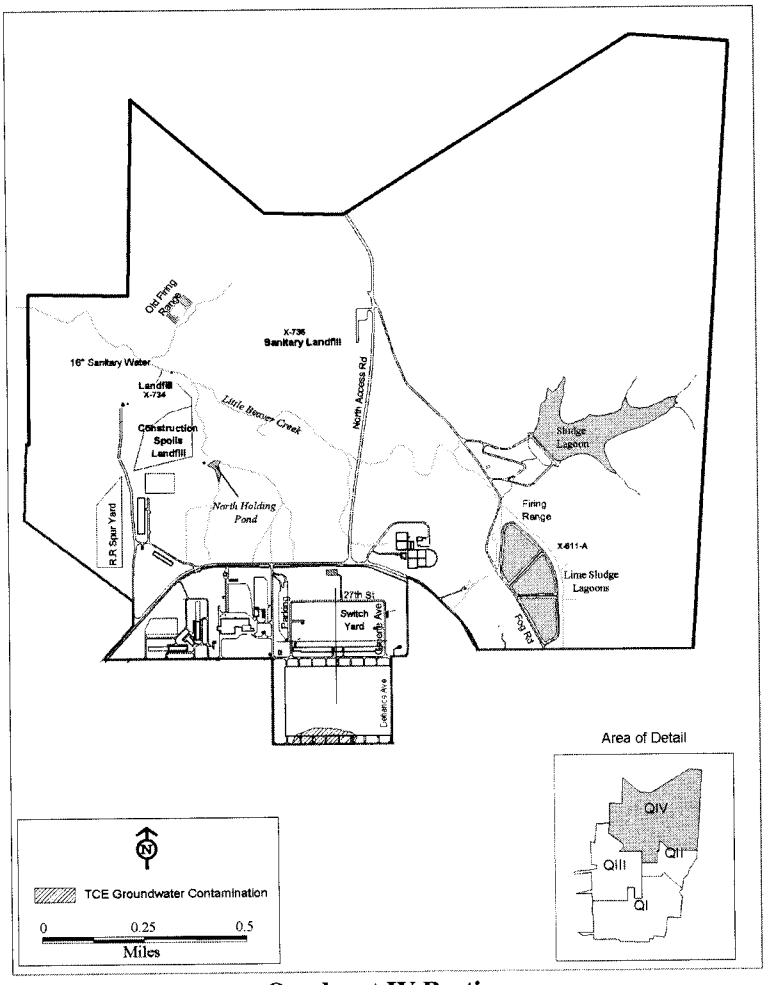
This quadrant of the Portsmouth site comprises 570 hectares (1,400 acres) and is located in the northern portion of the site encompassing areas both inside and outside of the security perimeter around the industrialized area. Quadrant IV contains one of the three main uranium processing buildings, electrical switch yards, concrete staging pads for processed uranium tails containers, as well as several landfill units. The main sources of contamination have been confined to the capped landfill units, including the Lime Sludge Lagoons (X-611A), the Sanitary Landfill (X-735), the Hazardous Materials Landfill, and the Construction Spoils Landfill (X-734). DOE has not identified any groundwater contamination related to the landfills. Due to past waste management practices, the primary contaminants for this portion are TCE, PCBs, PAHs, and various metals. The following sections describe cleanup and long-term stewardship activities for the contaminated media, including surface water/sediments, engineered units, and facilities. Residually contaminated soil is confined to the engineered units and, therefore, will be discussed accordingly.

QUADRANT IV PORTION HIGHLIGHTS

Major Long-Term Stewardship Activities - maintaining engineered units; monitoring ground and surface water; enforcing institutional controls
Portion Size - 570 hectares (1,400 acres)
Estimated Volume of Residual Contaminants - surface water/sediments unknown; engineered units 1.2 million cubic meters (1.5 cubic yards); facilities unknown
Long-Term Stewardship Start-End Years - 2000-in perpetuity
Average Annual Long-Term Stewardship Costs FY 2000-2006 - $1,565,000

DOE will determine both cleanup remedies and post-cleanup long-term stewardship activities in accordance with RCRA and CERCLA regulations, as well as the Federal Facility Agreement. After remediation is completed,

DOE is committed to maintaining necessary land use controls to ensure that unacceptable exposures to residual contamination do not occur. Specific requirements for Quadrant IV will be documented in a surveillance and maintenance program plan.



Quadrant IV Portion

3.4.1 Surface Water/Sediments

Creeks, drainage ditches, and holding ponds are the main surface water features at the Portsmouth site. All surface water eventually discharges into the Scioto River that flows south into the Ohio River. There are two major surface water drainages in Quadrant IV: 1) Little Beaver Creek, which is the primary surface drainage; and 2) the North and Northeast Drainage Ditches. The principal contaminants in Quadrant IV surface water and sediment are PAHs and radionuclides (uranium and technetiumc-99). The PAHs are most likely a result of general anthropomorphic activities, such as fuel combustion, and the installation and repair of petroleum based road surfaces. The uranium and other radioisotopes have been released through routine, ongoing plant operations and transported into the surface drainage system via general overland flow dynamics. DOE estimates that contaminated surface water/sediments cover 20,000 lineal feet on and off the Portsmouth site.

DOE has no immediate plan to conduct cleanup activities specifically addressing contaminated surface water/sediments for two reasons. First, isolation of contaminated soil and remediation of groundwater in Quadrant IV already address the major sources (the land based disposal units) of surface water contamination. Second, the major source of PAHs in surface water is ongoing industrial plant operations that are expected to continue for the foreseeable future. Consequently, DOE has postponed any decisions regarding PAH remediation until uranium processing operations have ceased.

DOE is conducting two surface water monitoring programs to identify any potential contaminant discharges onsite and offsite: 1) National Pollutant Discharge Elimination System (NPDES) permit monitoring; and 2) Portsmouth Groundwater Monitoring Program. The former program is mandated by the State of Ohio and regulates all plant effluent discharged to the environment. DOE voluntarily conducts the latter program to facilitate comparison of monitoring data collected upstream and downstream so that the effect of the contaminated groundwater plumes on the creeks can be isolated. While target cleanup levels are not applicable,

NPDES permit discharge criteria establish contaminant limitations at permitted outfalls, and Ambient Water Quality Criteria apply to the receiving streams.

Surface Water/Sediments Long-Term Stewardship Activities

Based on the postponement of the remedial decision, long-term stewardship activities for surface water and sediment in Quadrant IV consist of enforcing institutional controls and continuing the surface water monitoring programs. Institutional controls will include legal conditions and/or covenants that restrict the use of property and notify zoning authorities of residual contamination. In addition, DOE or the State of Ohio will require a permit to ensure that any party disturbing the remediated area utilize the appropriate safeguards and precautions. DOE and other stakeholders have decided that the non-industrialized portions of the reservation could be utilized for permitted recreational activities (such as hunting). However, fishing or other activities likely to result in extended exposure to contaminated surface water and sediments are prohibited. In addition, five-year reviews of surface water and sediment sampling data are conducted to determine if unacceptable exposures are likely and to determine the necessity of additional corrective action.

3.4.2 Engineered Units

Quadrant IV contains three engineered units, which occupy approximately 404,686 square meters (4,356,000 square feet), that have the potential to release contaminants into groundwater. The major units include the Lime Sludge Lagoons (X-611A), Sanitary Landfill (X-735), Hazardous Materials Landfill (part of the Sanitary Landfill), and the Construction Spoils Landfill (X-734). Contaminants that were believed to have been present in the land disposal units include beryllium, PCBs, PAHs, and TCE.

Specifically, the Lime Sludge Lagoons consisted of three unlined sludge retention lagoons constructed in 1954 to receive waste lime sludge from the Water Treatment Plant (X-611). Located northeast of the main plant facility near Little Beaver Creek, the lagoons received sludge until 1960. For one to two years, the lagoons also received recirculating cooling water and chromium-contaminated lime sludge. The unit was capped in 1996 because of physical hazard concerns associated with the open lagoons, as well as sampling data indicating chromium, PCBs, and beryllium were present. The vegetative layer of the cap was designed to develop into a modified prairie ecosystem. The Sanitary Landfill (X-735) was used by the site to dispose of routine, non-contaminated garbage until it was closed in 1997. As part of the Sanitary Landfill, the Hazardous Waste Landfill received material from a contaminated sludge lagoon that was closed in Quadrant III. The Construction Spoils Landfill (X-734) was used to dispose of general construction debris (concrete, wood debris, scrap equipment) and was closed as part of the larger landfill area in 1999 and 2000. The larger associated landfill was used to dispose of fly ash from the coal fired steam plant, asbestos waste, and other undocumented material prior to enactment of formal environmental legislation. Each of the units above has been covered with a multi-layer cap (except for the Construction Spoils Landfill, which will be capped by the end of 2000), and DOE has identified no groundwater contamination emanating from the landfills. Currently, DOE estimates that 1.2 million cubic meters (1.5 million cubic yards) of contaminated soil remain.

Engineered Units Long-Term Stewardship Activities

Long-term stewardship activities for engineered units in Quadrant IV consist of surveillance and maintenance of engineered controls as well as institutional controls. DOE conducts surveillance and maintenance of capped burial grounds to ensure the integrity of the multi-layer caps. Institutional controls will include legal conditions and/or covenants that restrict the use of property and notify zoning authorities of residual contamination. In addition, DOE or the State of Ohio will require a permit to ensure that any party disturbing the remediated area utilize the appropriate safeguards and precautions. The land use controls include State advisories on natural resources, access controls, signs, and security measures. DOE will maintain access control of the reservation

well into the foreseeable future, and will maintain cooperation with other governmental agencies to ensure deed restrictions are preserved for future land users. The engineered units, consisting of multi-layered caps, are designed to standards ensuring extreme longevity. Rigorous surveillance and maintenance programs are required through the designated post closure period, and five-year reviews are conducted to ensure the ongoing efficacy of the engineered remedies.

3.4.3 Facilities

There are numerous active and inactive facilities located in Quadrant IV. The facilities are, or were previously, associated with uranium processing operations at Portsmouth. The buildings and subsurface structures are mostly steel and concrete construction. Generally, radiological contamination is fixed and confined to surface areas. Potential for other classes of contaminants exist, but the full nature and extent of subsurface contamination under these facilities will not be investigated until final decisions regarding decontamination and decommissioning have been made. DOE is maintaining both active and inactive facilities until it makes final decisions regarding their decontamination and decommissioning. To date, DOE has not conducted any facility cleanup operations in Quadrant IV. However, DOE assumes that all of the gaseous diffusion process buildings will be demolished down to their concrete slabs. Demolition rubble will be used for in-place backfill in cavities and/or will be left on the slabs-on-grade and covered with a vegetative layer. All below-grade structures with utility lines conduit, trenches, etc. will be capped off and left-in place. DOE assumes that decommissioning activities will generate low-level mixed waste, low-level radioactive waste, hazardous waste, polychlorinated biphenyl waste, asbestos waste, and sanitary waste. All low-level radioactive waste is assumed to be disposed of in the proposed onsite disposal facility. Small levels of fixed radioactive contamination will remain on building structures (mainly concrete). However, post-remediation analyses will ensure that contamination left onsite will not pose an unacceptable risk to human health and the environment.

Facilities Long-Term Stewardship Activities

At this time, the long-term stewardship activities required for facilities are unclear. DOE will maintain the facilities in a safe and stable condition until final disposition decisions are made. To the extent that the decisions result in additional areas of residual contamination, DOE will apply the appropriate engineered and institutional controls to maintain the safety and health of humans and the protection of the environment. DOE will maintain access control of the reservation well into the foreseeable future and will maintain cooperation with other governmental agencies to ensure deed restrictions are preserved for future land users.

3.4.4 Estimated Long-Term Stewardship Costs for Quadrant IV

Anticipated long-term stewardship activities for Quadrant IV will include monitoring and maintaining engineered units, monitoring ground and surface water, and enforcing institutional controls. The costs below were derived by prorating the sitewide long-term stewardship budget and, therefore, should be considered an approximation for Quadrant IV. While cleanup will not be complete for Quadrant I prior to 2006, groundwater pump and treat, groundwater monitoring, and limited surveillance and maintenance activities will be underway. Costs for these activities are reflected in the table below (FY 2000-FY 2010). For purposes of this report, long-term stewardship costs are shown until FY 2070; however, it is anticipated that long-term stewardship activities will be required in perpetuity.

Long-Term Stewardship Costs (Constant Year 2000 Dollars)							
FY 2000 - FY 2010	***FY 2011 - FY 2020***	***FY 2021 - FY 2030***	***FY 2031 - FY 2040***	***FY 2041 - FY 2050***	***FY 2051 - FY 2060***	***FY 2061 - FY 2070***	***Estimated Total***
$16,684,500	$4,574,029	$3,008,824	$1,780,534	$1,473,469	$1,473,467	$1,473,461	$30,468,000

4.0 FUTURE USES

Future land use at the Portsmouth site will be a combination of controlled access, mixed industrial, open space, and recreational. The capped area, comprised of the engineered units, will have deed restrictions and will be unsuitable for any other future use. An estimated 54 hectares (135 acres) of land will be designated industrial use only and will remain enclosed within a security fence. The remainder of the reservation lying outside of the security fence and perimeter road will be designated recreational or commercial land use. In accordance with the lease agreement between DOE and USEC, USEC will continue to use industrial facilities to produce enriched uranium. DOE assumes that USEC, or a successor organization, will continue enriched uranium production at the site. For this purpose, other DOE facilities may be re-industrialized.

For additional information about the Portsmouth Gaseous Diffusion Plant site, please contact:

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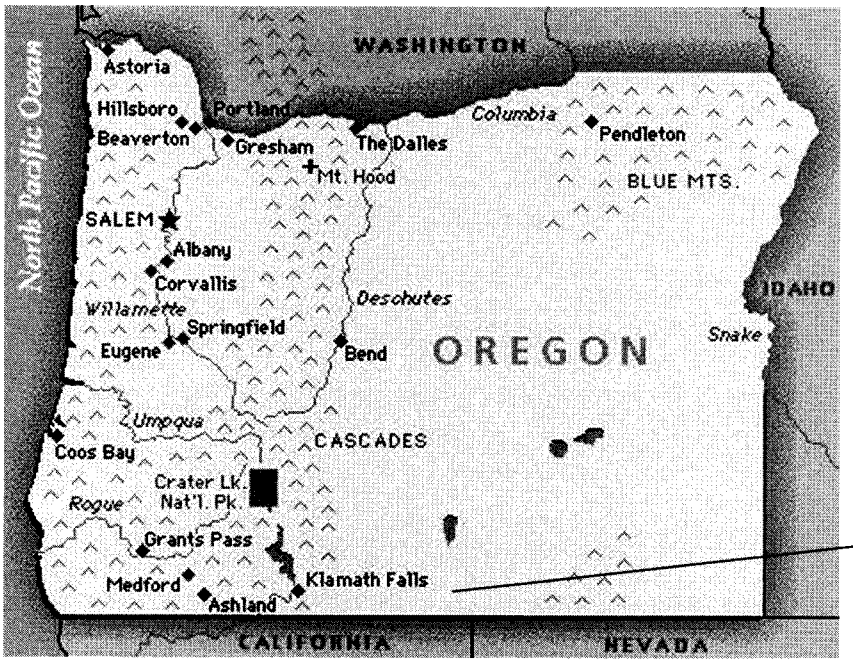
U.S. Department of Energy
Portsmouth Enrichment Office
3930 U.S. 23, Perimeter Road
Piketon, OH 45661
Phone: 740-897-5524

Oregon



Lakeview Site and Lakeview Mill

Long-Term Stewardship Site Highlights

Lakeview Mill (page 3)
Major Activities - institutional controls; groundwater monitoring; deed restrictions
Site Size - 104 hectares (258 acres)
Start/End Years - 2000/in perpetuity
Estimated Average Annual Cost FY 2000-2006 - $47,000

Lakeview Site (page 7)
Major Activities - disposal cell monitoring; institutional controls
Site Size - 16 hectares (40 acres)
Start/End Years - 1995/in perpetuity
Estimated Average Annual Cost FY 2000-2006 - $111,000

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LAKEVIEW MILL

1.0 SITE SUMMARY

1.1 Site Description and Mission

The Lakeview Mill is the location of a former uranium milling site that operated from 1958 to 1974. The site is located on 104 hectares (258 acres) of land in Lake County, Oregon, about two kilometers (one mile) north of the city of Lakeview and approximately 26 kilometers (16 miles) north of the California-Oregon border.

LONG-TERM STEWARDSHIP HIGHLIGHTS

Major Long-Term Stewardship Activities - institutional controls; groundwater monitoring; deed restrictions
Total Site Area - 104 hectares (258 acres)
Estimated Volume of Residual Contaminants - groundwater 4.5 million cubic meters (5.9 million cubic yards)
Long-Term Stewardship Start-End Years - 2000-in perpetuity
Average Annual Long-Term Stewardship Cost FY 2000-2006 - $47,000
Landlord - U.S. Department of Energy, Grand Junction Office

As a result of past milling operations, contamination at the site consisted of uranium mill tailings; radium, thorium, and uranium in soils; and building debris. Initially, the tailings pile covered approximately 10 hectares (30 acres) of the 104-hectare (258-acre) site; six evaporation ponds occupied another 28 hectares (69 acres); and onsite windblown contamination occupied another 10 hectares (25 acres). Beginning in June 1986, approximately 722,000 cubic meters (944,000 cubic yards) of the contaminated materials were relocated offsite to the disposal cell at the nearby Lakeview Site. The U.S. Department of Energy (DOE) completed surface remediation activities at the Lakeview Mill in October 1989.

The current mission of the Lakeview Mill is performing long-term stewardship activities, including monitoring the groundwater. The site is subject to Title I of the *Uranium Mill Tailings Radiation Control Act of 1978* (UMTRCA). As such, DOE is responsible for remediation and performing long-term stewardship activities. Most of the land is privately owned and used for industrial purposes by the Precision Pine Company. A local government entity owns one small portion of the land.

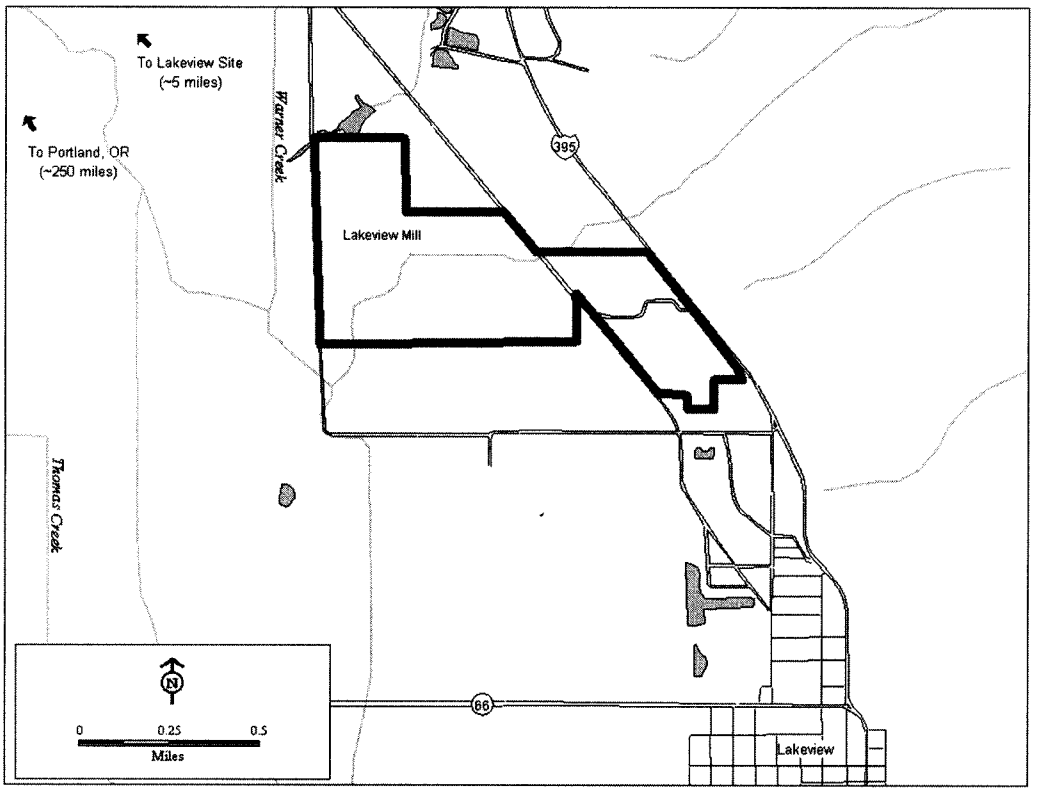
The historic mission of the site was to process uranium for the U.S. national defense program. The mill was built in 1958, and was operated by the Lakeview Mining Company until 1961. In 1968, the Atlantic Richfield Company acquired the mill and began cleanup in 1974. By 1977, the mill buildings and the surrounding areas had been decontaminated to meet the state regulations then in effect. The mill was sold in 1978 to the Precision Pine Company, which used the site as a lumber mill, and a stockpile facility for sawdust and scrap waste. Further efforts to clean up the site were initiated when UMTRCA designated the Lakeview Mill for remediation by DOE.

1.2 Site Cleanup and Accomplishments

The milling operations at the Lakeview Mill site caused both surface and subsurface (groundwater) contamination. The principal environmental concern at Lakeview Mill site, as at other uranium mill sites, was the migration of low-level radioactive materials and other hazardous substances from the residual mill tailings to the surrounding soil, surface water, and groundwater. Because uranium mill tailings are typically piled without covers, the toxic heavy metals and radioactive thorium and radium they commonly contain can easily be spread by wind and water.

Approximately 722,000 cubic meters (944,000 cubic yards) of contaminated materials (uranium mill tailings and contaminated structures) were relocated to the disposal cell at the Lakeview Site (also known as the Collins

Ranch disposal site) 11 kilometers (7 miles) away. Relocation was required because possible seismic and geothermal activity in the area precluded stabilizing the residual radioactive material in place. The disturbed areas at the Lakeview Mill were graded and revegetated, and the soil was remediated to applicable U.S. Environmental Protection Agency (EPA) standards.



Lakeview Mill

Approximately 4.5 million cubic meters (5.9 million cubic yards) of groundwater are contaminated with materials generated from processing ores to recover uranium, including molybdenum, radium, arsenic, and net gross alpha. The groundwater plume covers 47 hectares (116 acres) and extends within the shallow alluvial/lacustrine aquifer beneath the former mill site. Adjacent surface water has not been degraded by site contaminants. Beyond the contaminant plume, groundwater is used for domestic, industrial, and agricultural purposes. However, regional groundwater is naturally highly mineralized as a result of active hydrothermal processes, and is of generally poor quality. Therefore, the groundwater exceeds EPA numerical limits without the Lakeview Mill contamination taken into account. Consequently, EPA approved the application of supplemental standards, as defined in Title 40 of the *Code of Federal Regulations* Part 192.22; no groundwater remediation is required. As a "best management practice," groundwater monitoring will continue in perpetuity to ensure the protection of human health and the environment.

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

DOE's Grand Junction Office is responsible for long-term surveillance and maintenance activities at the Lakeview Mill. These activities include groundwater monitoring and ensuring that institutional controls are

maintained. DOE conducts routine sampling of surface water (to ensure groundwater contaminants do not migrate) and groundwater, and enforces deed restrictions on the use of groundwater.

On August 22, 2000, a proposed groundwater protection strategy was finalized and submitted to the State of Oregon for signature (U.S. Nuclear Regulatory Commission signature approval will follow). This cooperative agreement between DOE and the State of Oregon will implement institutional controls for the site's contaminated groundwater. The groundwater protection strategy will provide for an upgrade to the City of Lakeview's domestic water line, the implementation of groundwater use restrictions, and long-term monitoring of the area's groundwater.

DOE maintains and updates the specific records and reports required to document long-term stewardship activities at the Lakeview Mill. The site records are kept in permanent storage at the DOE Grand Junction Office in Colorado. The types of records maintained include site characterization data, remedial action design information, the site completion report, the groundwater compliance plan, annual inspection reports, and groundwater monitoring results.

STAKEHOLDER INVOLVEMENT

Since the remedial action was completed, community interaction has been minimal. Copies of the annual inspection report for the Lakeview Mill and other sites are distributed to the local library and to any stakeholders that request them. The report is also published on the DOE Grand Junction Office website at www.doegjpo.com.

2.2 Specific Long-Term Stewardship Activities

Groundwater

Long-term stewardship activities for groundwater are expected to begin in 2000 to ensure continued protection of human health and the environment. DOE will conduct groundwater monitoring once every two years through 2013, then once every five years in perpetuity.

2.3 Regulatory Regime

The *Uranium Mill Tailings Radiation Control Act of 1978* (UMTRCA) authorized DOE to care for the uranium mill tailings disposal sites under a general license issued by NRC for the long-term care of residual radioactive material disposal cells (contained at Title 10 of the *Code of Federal Regulations,* Section 40.27). However, for the actual processing site where the residual radioactive materials were relocated off the processing site, NRC will not license the site. Compliance with EPA groundwater standards will require NRC concurrence.

Several regulations govern the long-term stewardship activities at of the Lakeview Mill, including the *UMTRCA*; the *Atomic Energy Act of 1954,* as amended; EPA groundwater protection standards, including Subparts B and C of Title 40 of the *Code of Federal Regulations,* Part 192 - *Standards for Cleanup of Land and Buildings Contaminated with Residual Radioactive Materials from Inactive Uranium Processing Sites*; a cooperative agreement between DOE and the State of Oregon; and the *National Environmental Policy Act of 1969,* as amended.

2.4 Assumptions and Uncertainties

EPA approved application of supplemental standards, as defined in Title 40 of the *Code of Federal Regulations* Part 192.22, and therefore, no groundwater remediation is required. DOE assumes that as a "best management practice," groundwater monitoring will continue in perpetuity to ensure protection of human health and the environment.

3.0 ESTIMATED LONG-TERM STEWARDSHIP COSTS

Estimated long-term stewardship costs for the Lakeview Mill are identified in the table below. Cost estimates are based on the actual costs of long-term stewardship activities at this site. The costs in fiscal year (FY) 2000 include a one-time payment to the State of Oregon for an alternate water supply, in accordance with the groundwater compliance action plan to restrict the use of groundwater. Costs from FY 2000 through 2013 include groundwater monitoring once every two years; thereafter, costs include groundwater monitoring once every five years. For purposes of this report, long-term stewardship costs are shown until FY 2070; however, it is anticipated that long-term stewardship will be required in perpetuity.

Site Long-Term Stewardship Costs (Constant Year 2000 dollars)					
Year(s)	***Amount***	***Year(s)***	***Amount***	***Year(s)***	***Amount***
FY 2000	$260,000	**FY 2008**	$0	**FY 2036-2040**	$11,000
FY 2001	$18,000	**FY 2009**	$11,000	**FY 2041-2045**	$11,000
FY 2002	$14,000	**FY 2010**	$0	**FY 2046-2050**	$11,000
FY 2003	$14,000	**FY 2011-2015**	$22,000	**FY 2051-2055**	$11,000
FY 2004	$11,000	**FY 2016-2020**	$11,000	**FY 2056-2060**	$11,000
FY 2005	$11,000	**FY 2021-2025**	$11,000	**FY 2061-2065**	$11,000
FY 2006	$0	**FY 2026-2030**	$11,000	**FY 2066-2070**	$11,000
FY 2007	$11,000	**FY 2031-2035**	$0		

4.0 FUTURE USES

The Lakeview Mill was returned to the owners, Precision Pine Company, for industrial purposes and future use is assumed to continue to be industrial/commercial.

For more information about the Lakeview Mill, please contact:

Art Kleinrath, Long-Term Surveillance and Maintenance Program Manager
U.S. Department of Energy ,Grand Junction Office
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Phone: 970-248-6037
or visit the Internet website at http://www.doegjpo.com

LAKEVIEW SITE

1.0 SITE SUMMARY

1.1 Site Description and Mission

The Lakeview Site (also known as Collins Ranch Disposal site) is the location of a disposal cell built by the U.S. Department of Energy (DOE) to retain uranium mill tailings and contaminated building debris and soils from former operations at the nearby Lakeview Mill. The disposal site is approximately 11 kilometers (seven miles) northwest of the town of Lakeview in Lake County, Oregon, and 11 kilometers (seven miles) north of the Lakeview Mill. The disposal site is on 16 hectares (40 acres) of land owned by DOE and the disposal cell occupies 6.5-hectares (16-acres) of the site. Approximately 722,000 cubic meters (944,000 cubic yards) of contaminated materials were relocated from the mill site and vicinity properties, consolidated, and disposed in the Lakeview disposal cell during 1986 through 1988. DOE completed surface remediation activities in June 1988.

LONG-TERM STEWARDSHIP HIGHLIGHTS

Major Long-Term Stewardship Activities - disposal cell monitoring; institutional controls
Total Site Area - 16 hectares (40 acres)
Estimated Volume of Residual Contaminants - disposal cell 722,000 cubic meters (944,000 cubic yards)
Long-Term Stewardship Start-End Years - 1995-in perpetuity
Average Annual Long-Term Stewardship Cost FY 2000-2006 - $111,000
Landlord - U.S. Department of Energy, Grand Junction Office

DOE's current mission at the Lakeview Site is performing long-term stewardship activities, including monitoring and maintenance of the disposal cell. The disposal cell is subject to Title I of the *Uranium Mill Tailings Radiation Control Act of 1978* (UMTRCA). As such, DOE is responsible for any remediation and for performing long-term stewardship activities at the site, which began in 1995. The Lakeview Site did not have a historic mission prior to its use as a disposal site beginning in 1986.

1.2 Site Cleanup and Accomplishments

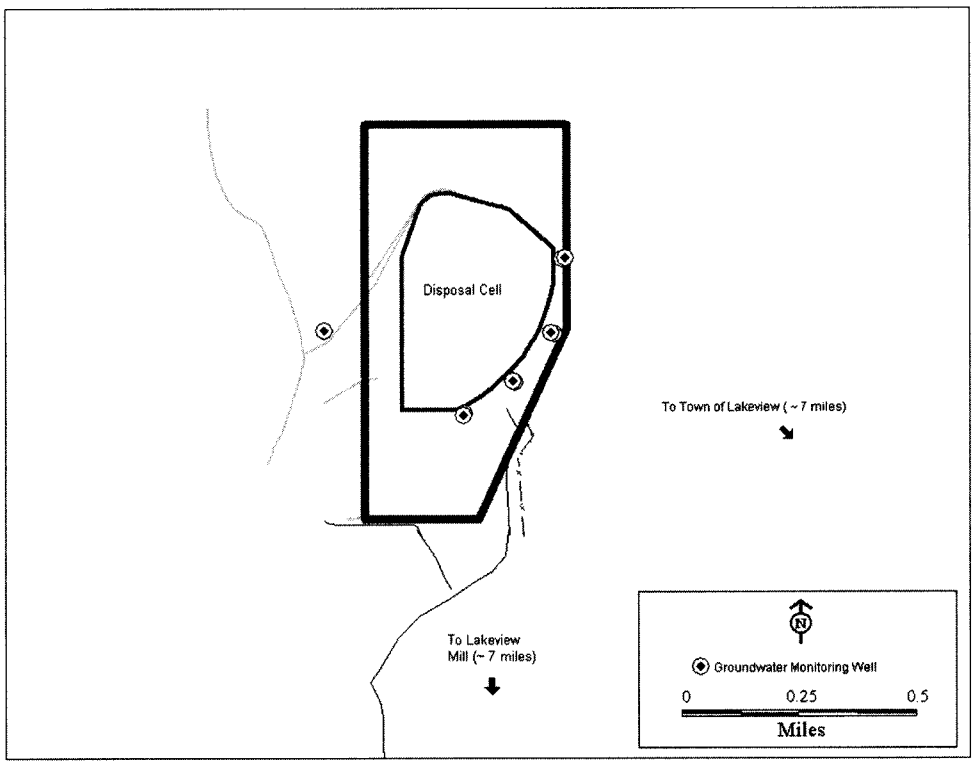
As a result of past milling operations at the Lakeview Mill, contamination at the site consisted of uranium mill tailings, radium, thorium, and uranium in soils and building debris. The contaminants were relocated and disposed in the disposal cell at the Lakeview Site. The disposal cell contains 668,000 dry metric tons (736,000 tons) of contaminated material, with a total radioactive activity of 42 curies of radium-226. The disposal cell was covered with a 46-centimeter (18-inch) thick radon barrier and a 30-centimeter (12-inch) thick rock erosion protection layer to meet U.S. Environmental Protection Agency (EPA) standards for longevity, radon control, and groundwater protection. The up-slope was covered with ten centimeters (four inches) of top soil and planted with native grasses. DOE received concurrence, in September 1995, from the U.S. Nuclear Regulatory Commission (NRC) that the site conformed to design standards (Title 40 of the *Code of Federal Regulations,* Part 192).

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

In September 1995, the long-term care of the disposal site was assigned to DOE's Grand Junction Office. Under the provisions of the site-specific long-term surveillance plan, DOE conducts annual inspections of the site to evaluate the condition of surface features; performs site maintenance, as necessary; maintains institutional controls; and monitors the disposal cell. Annual inspections of the disposal site are conducted to detect

progressive change caused by slow-acting natural processes and to identify potential problems before extensive maintenance, repairs, or corrective actions are needed. DOE does not plan to conduct significant maintenance at the Lakeview Site. However, DOE will perform minor maintenance (e.g., replace signs, fix fence) or repair, as needed or determined from site inspections. Groundwater monitoring is not required for contamination purposes, but monitoring is required to measure the disposal cell's initial performance.



Lakeview Site

The Lakeview Site is surrounded by a wire fence with a locked gate to prevent unauthorized access. Warning signs are posted on the site perimeter at increments of about 152 meters (500 feet) to inform the public of the site's function and ownership. In addition, DOE staffs a 24-hour phone line for reporting any site concerns. No drilling or other intrusive activities are allowed on the property unless authorized by DOE. Because of the remote location of the disposal site, purposeful intrusion is not expected to be a problem. However, if intrusion, vandalism, or other factors (e.g., grazing) become a problem, then site security will be re-evaluated.

DOE maintains and updates the specific records and reports required to document long-term stewardship activities at the Lakeview Site. DOE submits an annual report to the NRC that documents the results of the site's long-term surveillance plan, as required by NRC regulations in Title 10 of the *Code of Federal Regulations*, Part 40, Appendix A, Criterion 12. Site records are kept in permanent storage at the DOE Grand Junction Office in Colorado, and real property records are retained at the DOE Albuquerque Office in New Mexico. Types of records maintained include site characterization data, remedial action design information, the site completion report, long-term monitoring plans, annual inspection reports, and current and historic monitoring data.

2.2 Specific Long-Term Stewardship Activities

Engineered Units

The site contains one disposal cell which measures approximately 320 meters (1,050 feet) by 244 meters (800 feet) and requires long-term surveillance and maintenance to ensure continued protection of human health and the environment. Long-term stewardship activities for the disposal cell includes conducting annual inspections and performing minor maintenance, as needed. To demonstrate the initial performance of the disposal cell, annual groundwater monitoring will occur from 1998 to 2003, after which monitoring will take place once every five years. However, recent studies suggest that the rock cover on the disposal cell may disintegrate in 130 to 270 years, which may be less than the applicable 200 to 1,000 year long-term performance criteria. Therefore, DOE will continue to monitor the riprap (rock layer) durability and will take appropriate action, as necessary, in consultation with NRC.

> ***STAKEHOLDER INVOLVEMENT***
>
> Community interaction has been minimal since the remedial action was completed. Copies of the annual inspection report for the Lakeview Site and other sites are distributed to the local library and any stakeholders that requests them. Annual inspection reports are also published on the DOE Grand Junction Office website at www.doegjpo.com.

2.3 Regulatory Regime

In September 1995, NRC issued a license to the Lakeview Site for custody and long-term care of residual radioactive material disposal sites (contained at Title 10 of the *Code of Federal Regulations,* Section 40.27). The purpose of the general license is to ensure that such sites will be cared for in a manner that protects human health and safety and the environment. The general license went into effect when NRC concurred that the site conformed to cleanup standards and formally accepted the site-specific long-term surveillance plan.

Several other requirements govern the long-term stewardship of the Lakeview Site, including the *Uranium Mill Tailings Radiation Control Act of 1978*; the *Atomic Energy Act of 1954,* as amended; Environmental Protection Agency Groundwater Protection Standards, including Subparts A, B, and C of Title 40 of the *Code of Federal Regulations,* Part 192 - *Standards for Cleanup of Land and Buildings Contaminated with Residual Radioactive Materials from Inactive Uranium Processing Sites*; a cooperative agreement between DOE and the State of Oregon; and the *National Environmental Policy Act of 1969,* as amended.

2.4 Assumptions and Uncertainties

Because the site has been monitored for several years, the long-term stewardship activities at the site are well known and are not expected to change dramatically. Sound scope and cost estimates for the long-term stewardship activities at the site have been developed. DOE assumes that monitoring will continue indefinitely, until the disposal cell demonstrates infiltration control. However, there is the potential for a one-time significant "erosion protection activity" for the disposal cell cover.

3.0 Estimated Long-Term Stewardship Costs

Long-term stewardship costs for the Lakeview Site are based on historic costs incurred while conducting actual surveillance and maintenance activities. Cost estimates reflect the current site agreements and monitoring frequencies. Contingency costs, such as cap replacement, have not been incorporated into the cost estimate. Costs from fiscal years (FY) 2000 through 2006 include prorated costs associated with decommissioning unnecessary monitoring wells at similar sites. For purposes of this report, long-term stewardship costs are shown until FY 2070; however, it is anticipated that long-term stewardship activities will be required in perpetuity.

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	***Amount***	***Year(s)***	***Amount***	***Year(s)***	***Amount***
FY 2000	$116,000	**FY 2008**	$32,100	**FY 2036-2040**	$168,000
FY 2001	$126,000	**FY 2009**	$32,000	**FY 2041-2045**	$168,000
FY 2002	$131,000	**FY 2010**	$32,100	**FY 2046-2050**	$168,000
FY 2003	$118,000	**FY 2011-2015**	$153,000	**FY 2051-2055**	$168,000
FY 2004	$130,000	**FY 2016-2020**	$153,000	**FY 2056-2060**	$168,000
FY 2005	$71,000	**FY 2021-2025**	$157,000	**FY 2061-2065**	$168,000
FY 2006	$83,100	**FY 2026-2030**	$166,000	**FY 2066-2070**	$168,000
FY 2007	$32,000	**FY 2031-2035**	$168,000		

4.0 FUTURE USES

Future use of the site will be limited to monitoring and maintaining the disposal cell in perpetuity. Public access to the disposal site will be restricted indefinitely. Land surrounding the site is privately owned and is sparsely populated; the predominant land use is grazing. These uses are expected to continue in the future.

For more information about the Lakeview Site, please contact:

Art Kleinrath, Long-Term Surveillance and Maintenance Program Manager
U.S. Department of Energy, Grand Junction Office
2597 B3/4 Road, Grand Junction, CO 81503
Phone: 970-248-6037
or visit the Internet website at http://www.doegjpo.com

Pennsylvania

Long-Term Stewardship Site Highlights

Burrell Site (page 3)
Major Activities - disposal cell and groundwater monitoring; access restrictions
Site Size - 28 hectares (69 acres)
Start/End Years- 1994/in perpetuity
Estimated Average Annual Cost FY 2000-2006 - $51,600

Canonsburg Site (page 7)
Major Activities - disposal cell monitoring; groundwater and surface water monitoring; access restrictions; inspections
Site Size -14 hectares (34 acres)
Start/End Years- 1996/in perpetuity
Estimated Average Annual Cost FY 2000-2006 - $148,000

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Canonsburg Site 7

BURRELL SITE

1.0 SITE SUMMARY

1.1 Site Description and Mission

The Burrell Site is the location of a disposal cell for uranium mill tailings and other process-related wastes that were transported from the Canonsburg Mill, about 80 kilometers (50 miles) away. The site is located in Burrell Township in southwestern Pennsylvania. The site is one mile east of the Borough of Blairsville in Indiana County. The site, covering approximately 28 hectares (69 acres), is bordered on the south by the Conemaugh River and on the north by the Consolidated Rail Corporation railroad tracks. The disposal cell, located on the western part of the site, occupies about 1.5 hectares (4 acres) of the site.

LONG-TERM STEWARDSHIP HIGHLIGHTS

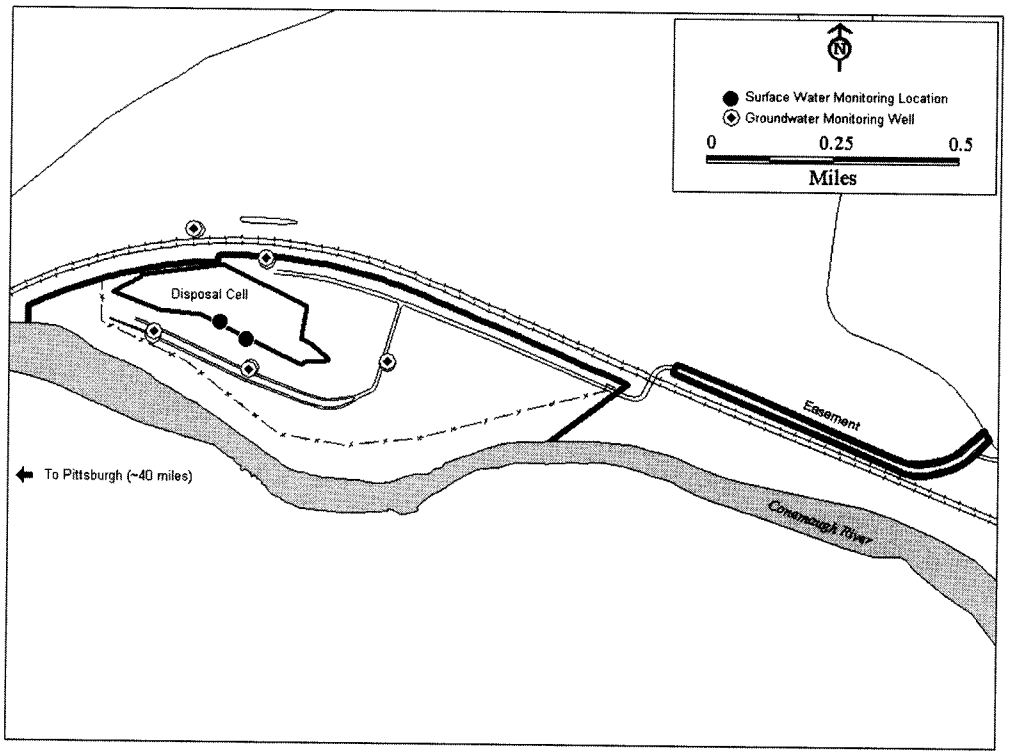
Major Long-Term Stewardship Activities - disposal cell and groundwater monitoring; access restrictions
Total Site Area - 28 hectares (69 acres)
Estimated Volume of Residual Contaminants - disposal cell 55,800 cubic meters (73,000 cubic yards); groundwater unknown
Long-Term Stewardship Start-End Years - 1994-in perpetuity
Average Annual Long-Term Stewardship Cost FY 2000-2006 - $51,600
Landlord - U.S. Department of Energy, Grand Junction Office

In the late 1950s, 11,600 tons of residual radioactive materials were shipped 31 kilometers (50 miles) from the uranium milling site in Canonsburg, Pennsylvania, to the privately owned railroad property in Burrell Township (now known as the Burrell Site) for use as fill material under railroad tracks. In 1986, the U.S. Department of Energy (DOE) acquired the Burrell Site through condemnation proceedings and began consolidating the contaminated material into an onsite disposal cell. The Burrell Site was identified as a "vicinity property" to the Canonsburg processing site. Because of the large volume of waste and the distance to the Canonsburg site, the contaminated material was consolidated at the Burrell Site with the concurrence of the U.S. Nuclear Regulatory Commission (NRC). DOE completed surface remediation of the uranium mill tailings and other contaminated surface radioactive material in 1987.

Remediation is complete and DOE began long-term stewardship activities in 1994. The current mission of the site is long-term monitoring and maintenance of the disposal cell and monitoring of the groundwater. The site is subject to Title I of the *Uranium Mill Tailings Radiation Control Act of 1978* (UMTRCA). As such, DOE is responsible for any remediation and long-term stewardship activities. The Burrell Site did not have a historical DOE mission prior to being acquired for use as a disposal site in 1986.

1.2 Site Cleanup and Accomplishments

Approximately 55,800 cubic meters (73,000 cubic yards) of mill tailings and soils, weighing 86,000 dry tons and contaminated with four curies of radium-226, were consolidated in the disposal cell. Remediation activities were completed at the site in July of 1987. The disposal cell was covered with a radon barrier and a rock erosion protection layer to meet the U.S. Environmental Protection Agency's (EPA) standards for longevity, radon control, and groundwater protection. According to EPA standards, the cover must be designed to remain effective for 200 to 1,000 years. In 1994, the disposal cell was accepted under the NRC general license, and the DOE Grand Junction Office began long-term stewardship activities.



Burrell Site

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

The DOE Grand Junction Office is responsible for long-term stewardship activities at the Burrell Site and manages the site according to a long-term surveillance plan prepared specifically for the site. Site-wide long-term stewardship activities include maintaining and repairing the 1.8 meter (6 foot) high locked security fence that surrounds the entire site, controlling access to the disposal cell. Warning signs, displaying the international trefoil symbol for radioactive materials and indicating that trespassing is forbidden, are located at equal intervals along the security fence. DOE maintains and replaces these signs, as necessary. An inscribed granite marker is located on the site identifying the materials contained in the disposal cell. Drilling and other intrusive activities are restricted across the entire property through the use of institutional controls.

Site records are in permanent storage at the DOE Grand Junction Office in Colorado. The types of records maintained include site characterization data, remedial action design information, the site completion report, long-term monitoring plans, annual inspection reports, and current and historic monitoring data. A report is submitted annually to the NRC to summarize, describe, and evaluate all surveillance and maintenance actions, as required under Title 10 of the *Code of Federal Regulations,* Part 40. Real property records for the site are maintained at the DOE Albuquerque Operations Office in New Mexico.

2.2 Specific Long-Term Stewardship Activities

Engineered Units

The contaminated materials are covered with a low-permeability layer of compacted clay, a bedding layer, and, finally, a protective rock cover. The clay layer prevents the escape of radon gas and the infiltration of precipitation. The free-draining bedding layer overlies the clay layer. Precipitation runs down the sloped cell top through the bedding layer and into surrounding rock drains. The cell design promotes runoff of precipitation to minimize leachate. The surrounding area was graded to promote drainage and was vegetated with native species to minimize erosion. The rock cover protects against erosion. The disposal cell at the Burrell Site is designed and constructed to last for 200 to 1,000 years. However, DOE will be responsible for conducting long-term stewardship activities in perpetuity.

Long-term stewardship activities associated with the disposal cell include annual inspections to evaluate the condition of surface features, cutting grass and clearing vegetation, and performing additional maintenance, as necessary.

STAKEHOLDER INVOLVEMENT

Community interaction has been minimal since the remedial action was completed. Copies of the annual inspection report for Burrell Site and other sites are distributed to the local library and any stakeholder requesting one. The report is also published on the DOE Grand Junction Office website at www.doegjpo.com.

Groundwater

Groundwater near the disposal cell contains limited uranium contamination above background levels but below the maximum concentration limits. Because the uranium levels do not exceed the maximum concentration limits, no groundwater remediation is required. DOE monitors the groundwater at the site to ensure the disposal cell is isolating the encapsulated wastes from the local environment. Groundwater monitoring currently occurs on an annual basis. DOE will be submitting a proposal to NRC to amend the monitoring frequency to once every five years.

2.3 Regulatory Regime

In 1994, the Burrell Site came under a general license issued by NRC for custody and long-term care of residual radioactive materials disposal sites (contained at Title 10 of the *Code of Federal Regulations,* Section 40.27). The purpose of the general license is to ensure that such sites will be cared for in a manner that protects human health and safety and the environment. The general license went into effect when NRC concurred that the site conformed to cleanup standards and formally accepted the site-specific long-term surveillance plan.

Long-term stewardship activities of the Burrell Site are governed by several requirements in the following regulations: UMTRCA; the *Atomic Energy Act of 1954,* as amended; EPA Groundwater Protection Standards; Title 40 of the *Code of Federal Regulations* Part 192; and the *National Environmental Policy Act of 1969,* as amended.

2.4 Assumptions and Uncertainties

Because the Burrell Site has been monitored since 1994, the long-term stewardship activities at the site are well known and are not expected to change dramatically. Cost estimates reflect the current site agreements and monitoring frequencies. If DOE receives approval from NRC to reduce the groundwater monitoring frequency to five-year intervals, the cost for long-term stewardship activities will decrease accordingly.

DOE assumes that the disposal cell cap will not need to be replaced for a minimum of 200 years and disposal cell monitoring will continue indefinitely.

3.0 ESTIMATED LONG-TERM STEWARDSHIP COSTS

Long-term stewardship costs for the Burrell Site are based on historical costs incurred while conducting actual surveillance and maintenance activities. Costs for fiscal years (FY) 2001 through 2006 include prorated costs associated with decommissioning unnecessary monitoring wells at similar sites. This represents a legacy cost inherited from DOE's Uranium Mill Tailings Remedial Action (UMTRA) project. Contingency costs, such as cap replacement, are not reflected in the cost estimates.

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	***Amount***	***Year(s)***	***Amount***	***Year(s)***	***Amount***
FY 2000	$57,252	**FY 2008**	$15,300	**FY 2036-2040**	$80,000
FY 2001	$55,400	**FY 2009**	$15,200	**FY 2041-2045**	$80,000
FY 2002	$58,700	**FY 2010**	$15,300	**FY 2046-2050**	$80,000
FY 2003	$52,300	**FY 2011-2015**	$73,000	**FY 2051-2055**	$80,000
FY 2004	$59,000	**FY 2016-2020**	$72,900	**FY 2056-2060**	$80,000
FY 2005	$38,900	**FY 2021-2025**	$74,800	**FY 2061-2065**	$80,000
FY 2006	$39,600	**FY 2026-2030**	$79,200	**FY 2066-2070**	$80,000
FY 2007	$15,400	**FY 2031-2035**	$80,000		

4.0 FUTURE USES

No future use is expected other than the long-term surveillance and maintenance of the disposal cell.

For more information about the Burrell Site, please contact:

Art Kleinrath, Long-Term Surveillance and Maintenance Program Manager
U.S. Department of Energy, Grand Junction Office
2597 B3/4 Road, Grand Junction, CO 81503
Phone: 970-248-6037
or visit the Internet website at http://www.doegjpo.com

CANONSBURG SITE

1.0 SITE SUMMARY

1.1 Site Description and Mission

The Canonsburg Site is the location of a former radium and uranium processing mill that operated from 1911 to 1957. The site contains a disposal cell for the uranium mill tailings and other contaminated materials that resulted from milling operations. The site is located within the Borough of Canonsburg in southwestern Pennsylvania, approximately 32 kilometers (20 miles) southwest of downtown Pittsburgh. The 14-hectare (34-acre) site lies between Chartiers Creek and the Conrail railroad tracks. The area surrounding the Canonsburg Site is primarily residential and is moderately populated.

LONG-TERM STEWARDSHIP HIGHLIGHTS

Major Long-Term Stewardship Activities - disposal cell monitoring; groundwater and surface water monitoring; access restrictions; inspections
Total Site Area - 14 hectares (34 acres)
Estimated Volume of Residual Contaminants - engineered units 147,000 cubic meters (192,000 cubic yards); groundwater 20,000 cubic meters (26,000 cubic yards)
Long-Term Stewardship Start-End Years - 1996-in perpetuity
Average Annual Long-Term Stewardship Cost FY 2000-2006 - $148,000
Landlord - U.S. Department of Energy, Grand Junction Office

The uranium milling operations at the site resulted in process-related waste and mill tailings. The site generated approximately 286,000 cubic meters (374,000 cubic yards) of contaminated material, some of which was shipped to the Burrell Site approximately 80 kilometers (50 miles) away. The U.S. Department of Energy (DOE) consolidated the remaining materials into a 2.4-hectare (6-acre) onsite disposal cell in 1985.

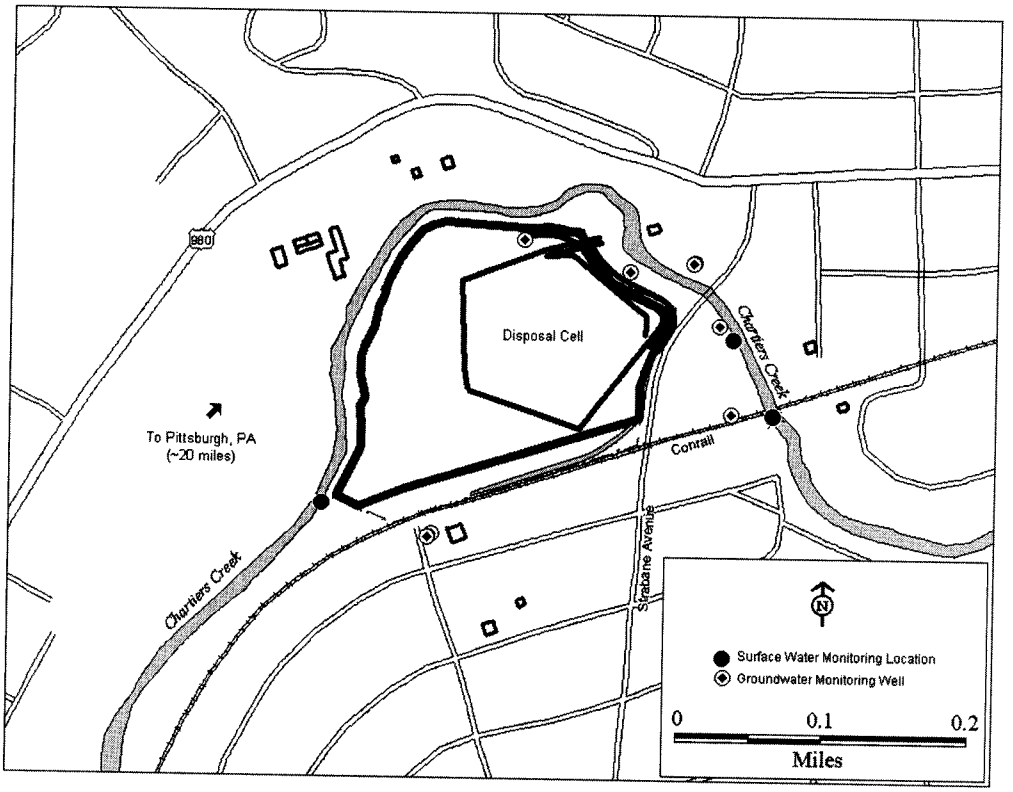
The current mission of the Canonsburg Site is limited to long-term stewardship activities, including monitoring and maintenance of the onsite disposal cell and monitoring of the groundwater. The site is subject to Title I of the *Uranium Mill Tailings Radiation Control Act of 1978* (UMTRCA). As such, DOE is responsible for remediation and long-term stewardship activities. Remediation has been completed and DOE began long-term stewardship activities at the site in 1996.

Historically, the mission of the Canonsburg Site was to provide uranium for the U.S. Government national defense program. Standard Chemical Company originally operated the Canonsburg Site as a radium extraction plant from 1911 to 1922. Later, Vitro Corporation of America acquired the property and processed ore to extract radium and uranium salts. From 1942 until 1957, Vitro was under contract with the Federal Government to recover uranium from ore and scrap. For the next nine years, the site was used only for storage under a U.S. Atomic Energy Commission (the predecessor agency to DOE) contract. In 1967, Canon Development Company purchased the property, and tenant companies leased it for light industrial use.

1.2 Site Cleanup and Accomplishments

Initially, the uranium mill tailings were left on the Canonsburg Site in uncovered piles. Over time, the tailings were dispersed by wind and water erosion or were removed from the site for use as fill material in local and regional construction projects. Remediation of the Canonsburg Site included stabilization of approximately 147,000 cubic meters (192,000 cubic yards) of residual radioactive material remaining on the site and remediation of 163 vicinity properties. Contaminated soils at the site and in the surrounding vicinity properties were remediated to U.S. Environmental Protection Agency (EPA) standards, as codified in Title 40 of the *Code of Federal Regulations*, Part 192. DOE encapsulated the tailings and tailings-contaminated soils in an engineered

disposal cell that was completed in July 1985.



Canonsburg Site

Groundwater in the vicinity of the Canonsburg Site is contaminated with wastes generated during uranium ore processing. Approximately 20,000 cubic meters (26,000 cubic yards) of groundwater, covering approximately 60 hectares (78 acres), are contaminated. The major public water source for the Washington County area is surface water. There are no known uses of the groundwater in the vicinity of the disposal site.

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

The DOE Grand Junction Office has been performing long-term stewardship activities at the Canonsburg Site since 1996. Access to the site is controlled by a two-meter (six-foot) high, locked perimeter fence. DOE performs fence repairs on an as-needed basis. A variety of signs, markers, and permanent monuments exist. Permanent boundary and survey monuments are placed along the site's southern boundaries. Metal signs displaying the international trefoil symbol for radioactive materials are attached to the outside of the fence and replaced, as necessary. No drilling or other intrusive activities are allowed on the property.

Because of the site's proximity to Chartiers Creek, three sets of erosion control markers were installed along the northeast and southwest boundaries to measure movement of the creek. DOE and the U.S. Army Corps of Engineers entered into an interagency agreement establishing that the Corps of Engineers will provide bank protection and erosion control measures if Chartiers Creek threatens the integrity of the Canonsburg Site.

Site records are kept in permanent storage at the DOE Grand Junction Office in Colorado. The types of records maintained include the site characterization data, remedial action design information, the site completion report, long-term monitoring plans, annual inspection reports, and current and historic monitoring data. Real property records for the site are maintained at the DOE Albuquerque Operations Office in New Mexico.

DOE develops and updates the records and reports required in the site-specific long-term surveillance plan for the Canonsburg Site. These reports are submitted annually to the Nuclear Regulatory Commission (NRC) to summarize, describe, and evaluate all surveillance and maintenance actions, as required under Title 10 of the *Code of Federal Regulations*, Part 40.

2.2 Specific Long-Term Stewardship Activities

Engineered Units

The Canonsburg Site disposal cell contains approximately 226,000 dry tons, or 147,000 cubic meters (192,000 cubic yards), of mill tailings, with an estimated total activity of 100 curies of radium-226. The disposal cell has a compacted clay liner to protect the groundwater from contamination. The tailings were placed on top of the liner and covered with one meter (three feet) of a clay-and-soil mixture to prevent the escape of radon gas and the penetration of precipitation into the disposal cell. The radon barrier was covered with layers of rock and soil and seeded with grass. The disposal cell design promotes rapid runoff of precipitation to minimize leachate.

STAKEHOLDER INVOLVEMENT

Community interaction has been minimal since the remedial action was completed. Copies of the annual inspection report for the Canonsburg Site are distributed to the local library and to any stakeholders requesting them. The report is also published on the DOE Grand Junction Office website at www.doegjpo.com.

The long-term stewardship activities associated with the disposal cell include annual inspections to evaluate the condition of surface features, mowing and vegetation control, and periodic maintenance activities. The disposal cell was designed and constructed to last for 200 to 1,000 years in accordance with EPA standards. However, DOE's responsibility for the safety and integrity of the Canonsburg Site will continue in perpetuity.

Groundwater

DOE monitors groundwater and surface water at the site as a "best management practice" to evaluate potential contaminant trends within the unconsolidated materials that underlie the disposal site. Annual groundwater monitoring for uranium is expected to continue in perpetuity. Alternate concentration limits (ACLs), cleanup standards based on site-specific considerations, for uranium have been proposed to the NRC (the site regulator). For the alternate concentrations to be approved, evidence must be provided that ACLs will not adversely impact human health or the environment. The proposed limits are 1.0 milligrams per liter at the point of compliance and 0.1 milligrams per liter at the point of exposure. Groundwater monitoring is currently scheduled to continue annually for uranium in perpetuity and every third year for other constituents until 2023. Surface water monitoring will be conducted annually in perpetuity at three surface locations.

2.3 Regulatory Regime

In 1996, the Canonsburg Site came under a general license issued by NRC for custody and long-term care of residual radioactive disposal sites (contained at Title 10 of the *Code of Federal Regulations,* Section 40.27). The purpose of the general license is to ensure that such sites will be cared for in a manner that protects human health and safety and the environment. The general license went into effect when NRC concurred with DOE that the site conformed to cleanup standards and formally accepted the site's long-term surveillance plan.

Long-term stewardship activities of the Canonsburg Site are governed by several requirements in the following regulations: UMTRCA; the *Atomic Energy Act of 1954,* as amended; EPA Groundwater Protection Standards in Title 40 of the *Code of Federal Regulations* Part 192; and the *National Environmental Policy Act of 1969,* as amended.

2.4 Assumptions and Uncertainties

Because DOE has performed long-term stewardship activities at the Canonsburg Site since 1996, long-term stewardship activities are well known and are not expected to change dramatically.

DOE assumes that groundwater monitoring for uranium will continue annually in perpetuity, and that monitoring of other contaminants will be performed at three-year intervals until 2023.

The disposal cap is not expected to be replaced for a minimum of 200 years. DOE expects to monitor the integrity of the disposal cap in perpetuity.

3.0 Estimated Long-Term Stewardship Costs

Long-term stewardship costs for the Canonsburg Site are based on historical costs incurred while conducting actual monitoring and maintenance activities. Costs expected for fiscal year (FY) 2000 are substantially larger than costs anticipated for later years because of the existence of a one-time expense for stream bank stabilization. FY 2001 through FY 2006 estimates include prorated costs associated with decommissioning unnecessary monitoring wells at similar sites. Remaining costs are associated with groundwater monitoring, institutional controls, and monitoring cell performance. Contingency costs, such as cap replacement, have not been included in the cost estimates.

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	*Amount*	*Year(s)*	*Amount*	*Year(s)*	*Amount*
FY 2000	$577,338	**FY 2008**	$22,900	**FY 2036-2040**	$123,300
FY 2001	$83,100	**FY 2009**	$25,800	**FY 2041-2045**	$123,200
FY 2002	$88,100	**FY 2010**	$22,900	**FY 2046-2050**	$123,300
FY 2003	$78,500	**FY 2011-2015**	$109,500	**FY 2051-2055**	$123,200
FY 2004	$88,500	**FY 2016-2020**	$112,200	**FY 2056-2060**	$123,300
FY 2005	$58,300	**FY 2021-2025**	$115,100	**FY 2061-2065**	$123,200
FY 2006	$62,200	**FY 2026-2030**	$122,000	**FY 2066-2070**	$123,300
FY 2007	$23,000	**FY 2031-2035**	$123,200		

4.0 Future Uses

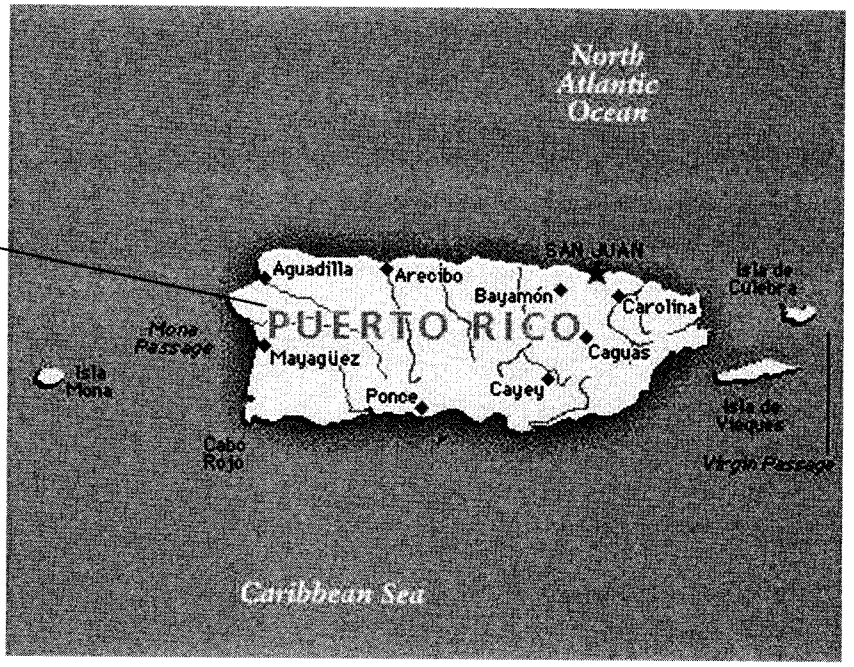
In accordance with UMTRCA provisions, public access to the site will be restricted indefinitely. No future use is expected other than long-term monitoring and maintenance of the disposal cell. The site will be monitored and maintained in accordance with the long-term surveillance plan approved by the NRC.

For more information about the Canonsburg Site, please contact:

Art Kleinrath, Long-Term Surveillance and Maintenance Program Manager
U.S. Department of Energy, Grand Junction Office
2597 B3/4 Road, Grand Junction, CO 81503
Phone: 970-248-6037
or visit the Internet website at http://www.doegjpo.com

Puerto Rico

Center for Energy and Environmental Research



Long-Term Stewardship Site Highlights

Center for Energy and Environmental Research (page 3)
Major Activities - surveillance; inspections
Site Size - 72 hectares (181 acres)
Start/End Years - 1970/in perpetuity
Estimated Average Annual Cost FY 2000-2006 - $25,000

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Center for Energy and Environmental Research 3

CENTER FOR ENERGY AND ENVIRONMENTAL RESEARCH

1.0 SITE SUMMARY

1.1 Site Description and Mission

The Center for Energy and Environmental Research (CEER), located in the Commonwealth of Puerto Rico, was established in 1957 as the Puerto Rico Nuclear Center. It consists of four distinct sites: Mayaguez, El Verde Research Station, and Rio Piedras, operated by the University of Puerto Rico; as well as the Boiling Nuclear Superheat Research Reactor operated by the Puerto Rico Electric Power Authority. These areas were operated under contract to the U.S. Department of Energy (DOE) and its predecessors. The four sites total approximately 72 hectares (181 acres). Each site's specific location and mission is described below:

LONG-TERM STEWARDSHIP HIGHLIGHTS

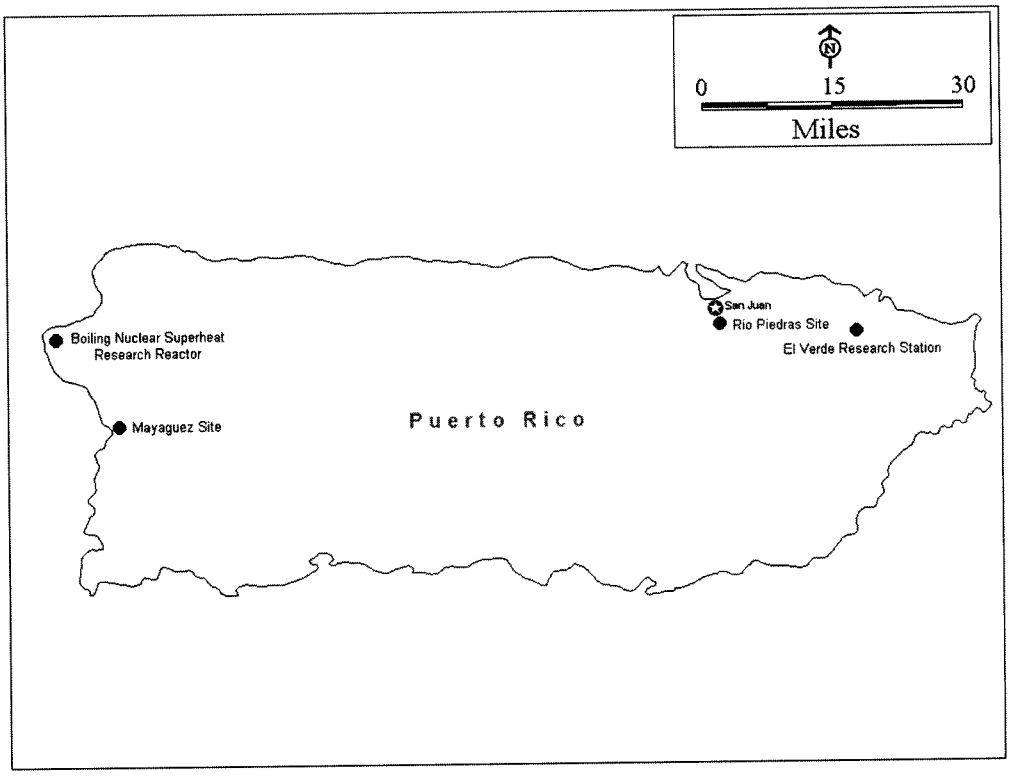
Major Long-Term Stewardship Activities - surveillance; inspections
Total Site Area - 72 hectares (181 acres)
Estimated Volume of Residual Contaminants - facilities unknown
Long-Term Stewardship Start-End Years - 1970-in perpetuity
Average Annual Long-Term Stewardship Cost FY 2000-2006 - $25,000
Landlord - U.S. Department of Energy and Puerto Rico Electric Power Authority

- The Mayaguez Site is located in western Puerto Rico, approximately two kilometers (one mile) east of Mayaguez Bay. This site spans roughly ten hectares (20 acres) and is situated adjacent to the University of Puerto Rico College of Agriculture and Mechanical Arts and the U.S. Department of Agriculture Experiment Station, northeast of the Mayaguez city limits. The Mayaguez Site is a multiple structure facility that housed the marine studies program, the original research reactor, and associated laboratories. In 1976, reactor research activities at the site concluded with the closure of the TRIGA Research Reactor and L-77 Training Reactor. Consequently, the facility mission broadened to include non-nuclear energy research and technology development.

- The El Verde Research Station encompasses approximately 63 hectares (156 acres), and is located in the Luquillo Forest approximately 23 kilometers (14 miles) southeast of San Juan in northeastern Puerto Rico. The El Verde site was an experimental research station that supported a terrestrial ecology program between 1964 and 1976. This site performed radiological tests on the trees and vegetation in a section of rainforest to study mineral cycling and metabolism. The site was transferred to the U.S. Department of Agriculture in 1997. The ongoing mission of the site is non-radiological terrestrial ecology research.

- The Rio Piedras Site is located approximately three kilometers (two miles) south of San Juan and consists of a Biomedical facility. A former underground diesel fuel storage tank was removed in 1994. The primary focus of work at the Rio Piedras Site was nuclear medicine research. In 1982, the site was transferred from DOE to the University of Puerto Rico by means of a Quit Claim Deed.

- The Boiling Nuclear Superheat Research Reactor, which encompasses two hectares (five acres), is located in Rincon, approximately 21 kilometers (13 miles) northwest of Mayaguez. The Boiling Nuclear Superheat Research Reactor operated as a research reactor between 1962 and 1967. The facility was decommissioned by 1970, and the reactor vessel and other components were entombed in place. Puerto Rico Electric Power Authority owns the land; however, DOE is responsible for the facility.



Center for Energy and Environmental Research

1.2 Site Cleanup and Accomplishments

DOE has completed environmental restoration activities at CEER in accordance with local (Puerto Rico Environmental Quality Board) and Federal (*Resource Conservation and Recovery Act*) regulations.

- DOE removed the TRIGA reactor fuel and components at the Mayaguez Site from the Mayaquez site and transferred them to Argonne National Laboratory in Idaho Falls, Idaho, in 1977. In October 1981, the L-77 solution fuel core was removed and shipped to DOE's Y-12 Plant in Oak Ridge, Tennessee. Decommissioning of the reactor, remedial decontamination, and restoration cleanup of the facility was completed prior to 1997. In addition, soils contaminated with polychlorinated biphenyls (PCBs), underground storage tanks containing fuel oil, unknown gas cylinders, hot cells (glass windows), asbestos, and miscellaneous laboratory chemicals were removed. The Mayaguez Site will be transferred to the U.S. Department of Agriculture by 2000.

- DOE has removed contaminated material and has restored the trail in the El Verde Research Station.

- At the Rio Piedras Site, underground storage tanks containing fuel oil were removed and diesel-contaminated soil cleanup was completed. An asbestos survey and sampling of the Biomedical Building at the site have been completed.

- DOE has removed and disposed of non-contaminated materials at the Boiling Nuclear Superheat Research Reactor facility. Radioactive fuel was disposed of in the continental United States. The Boiling Nuclear Superheat Research Reactor has been entombed and all of the underground storage tanks containing fuel oil have been removed from the site. The beta and gamma activity of the entombed material was 53,259 curies, when the measurement was taken in 1968.

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

Both the El Verde Research Station and the Rio Piedras Site have been transferred to the U.S. Department of Agriculture and University of Puerto Rico, respectively, and consequently, DOE does not anticipate any long-term stewardship responsibilities. Assuming the Mayaguez Site is transferred to the U.S. Department of Agriculture, DOE will not be responsible for long-term stewardship activities at the site.

DOE is responsible for long-term stewardship activities at the Boiling Nuclear Superheat Research Reactor. Long-term stewardship activities include surveillance and inspection of the facility. Long-term stewardship activities are expected to continue in perpetuity.

Access to the Boiling Nuclear Superheat Research Reactor is restricted by a locked gate, fence, and security guard. These access restrictions are maintained and repaired, as needed, by the Puerto Rico Electric Power Authority. Institutional controls are also enforced by the Puerto Rico Electric Power Authority. Because of entombed radioactive materials left in place, it is assumed that this area will remain controlled access. DOE will continue to survey and inspect the Boiling Nuclear Superheat Research Reactor facility to ensure protection of human health and the environment.

> ***STAKEHOLDER INVOLVEMENT***
>
> Community interaction regarding the Boiling Nuclear Superheat Research Reactor facility has involved many groups, including La Liga Ecologica Puertorriquena and Frente Unido Ambiental. Copies of annual inspection reports for the site are distributed to the public. In addition, public meetings are held to discuss survey information and future use of the facility.

DOE maintains and updates the specific records and reports required to document long-term stewardship activities at the Boiling Nuclear Superheat Reactor Research site. Site records are kept in permanent storage at the DOE Oak Ridge Office and historic operation records are maintained at the site. The types of records maintained include site characterization data, remedial action design information, the site completion report, long-term monitoring plans, annual inspection reports, and current and historic monitoring data.

Long-term stewardship costs for the Boiling Nuclear Superheat Research Reactor are based on historic costs incurred while conducting annual surveillance and inspection activities. These costs are approximately $25,000 per year.

2.2 Assumptions and Uncertainties

A CERCLA 120(h)(4) report has been requested by the U.S. Department of Agriculture prior to transferring the Mayaguez Site. The site will be transferred directly to the University of Puerto Rico under provision 161(g) of the Atomic Energy Act. The transfer will be completed by the end of December 2000.

The Boiling Nuclear Superheat Reactor Research site is anticipated to be transferred to DOE's Grand Junction

Office for long-term surveillance and maintenance by the end of FY 2001.

3.0 FUTURE USES

Because of entombed radioactive materials left in place, it is assumed that the Boiling Nuclear Superheat Reactor Research area will remain under controlled access. However, the Puerto Rico Electric Power Authority is developing a museum in the reactor building, in which only certain areas will be open to the public.

All future-use decisions regarding Mayaguez, El Verde Research Station, and Rio Piedras sites are the responsibility of the landlord organizations.

For additional information about the Center for Energy and Environmental Research site, please contact:

Mildred S. Lopez-Ferre, Program Manager
Environmental Management Program
U.S. Department of Energy, Oak Ridge Operations Office
P.O. Box 2001
Oak Ridge, TN 37830
Phone: 865-576-8018

South Carolina

Long-Term Stewardship Site Highlights

Savannah River Site (page 3)

Major Activities - institutional controls; surveillance and maintenance; operation/maintenance of treatment systems; and monitoring of engineered units and groundwater

Site Size - 80,127 hectares (198,344 acres)

Estimated Average Annual Cost FY 2000-2006 - $26,474,000

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Savannah River Site 3

SAVANNAH RIVER SITE

1.0 SITE SUMMARY

1.1 Site Description and Mission

The U.S. Department of Energy's Savannah River Site (SRS) produced plutonium and tritium for the nation's defense program from the early 1950s to the late 1980s. SRS now processes, recycles, and stores nuclear materials in support of national defense and nuclear nonproliferation efforts and develops and deploys technologies to improve the environment and treat nuclear and hazardous wastes left over from the Cold War.

LONG-TERM STEWARDSHIP HIGHLIGHTS

Major Long-Term Stewardship Activities - institutional controls; surveillance and maintenance; operation/maintenance of treatment systems; and monitoring of engineered units and groundwater
Total Site Area - 80,127 hectares (198,344 acres)
Estimated Volume of Residual Contaminants - to be determined
Portions Requiring Long-Term Stewardship as of 2006 - 10
Average Annual Long-Term Stewardship Cost FY 2000-2006 - $26,474,000
Landlord - U.S. Department of Energy, Office of Defense Programs

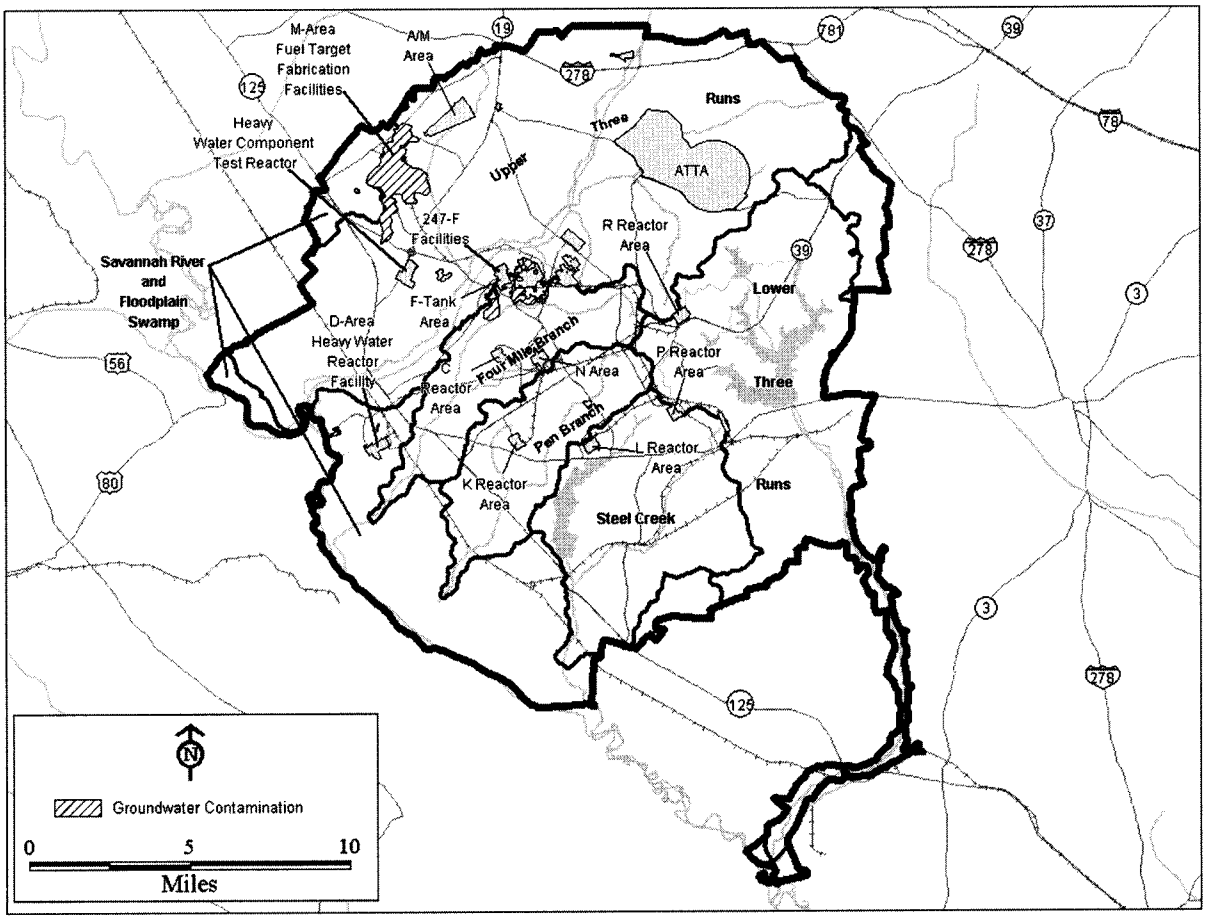
The SRS complex covers 80,127 hectares (198,344 acres), or 803 square kilometers (310 square miles), encompassing parts of Aiken, Barnwell and Allendale counties in South Carolina in a principally rural area. SRS borders the Savannah River and is 40 kilometers (25 miles) southeast of Augusta, Georgia, and 32 kilometers (20 miles) south of Aiken in southwest-central South Carolina. Originally farmland, SRS now encompasses a timber and forestry research center managed by the U.S. Forest Service. Only 10 percent of SRS total area has been developed. SRS is covered by hardwood and pine forests and contains lakes, streams, and Carolina bays and other wetlands. These undeveloped areas provide habitat for a wide variety of plants and animals, including six federally endangered or threatened species and about 70 sensitive species. SRS also houses the Savannah River Ecology Laboratory, an environmental research center operated for DOE by the University of Georgia. The site was designated in 1972 as a National Environmental Research Park.

Historic Mission

The historic mission of SRS, which started in 1950, was to produce strategic isotopes (e.g., plutonium-239 and tritium) for use in the development and production of nuclear weapons. SRS also produced other special isotopes (e.g., californium-252, plutonium-238, and americium-241) to support research in nuclear medicine, space exploration, and commercial applications.

To support the national defense mission, five reactors were built at SRS. Also built were support facilities, including two chemical separations plants, a heavy water extraction plant, a nuclear fuel and target fabrication facility, and waste management facilities. To produce the isotopes, DOE fabricated selected materials into metal targets and irradiated them in SRS's nuclear reactors. The targets were then transferred to the chemical separations facilities (F and H Canyons), where they were dissolved in acid, and where the desired isotopes were chemically separated and converted into a solid form, either an oxide powder or a metal. The oxide or metal was then fabricated into a usable form at SRS or other DOE Sites. In addition, SRS chemically reprocessed spent nuclear fuel to recover uranium-235. From 1953 to 1988, SRS produced about 36 metric tons of plutonium.

After the Cold War, the mission of SRS changed as emphasis shifted from nuclear materials production to environmental management. The fuel and target manufacturing facilities, along with the five production reactors, have been permanently shut down. The processing facilities (F and H Canyons) are currently stabilizing nuclear materials that are considered programmatic or at-risk.



Savannah River Site

Future Missions

Despite the shift in current activities to environmental management, SRS continues to play a major role in Nuclear Material Stewardship and Stockpile Stewardship. Key elements of future missions in these two Stewardship roles are summarized below.

- SRS has been designated to continue as DOE's center for the supply of tritium to the enduring nuclear weapons stockpile and, thus, will perform tritium extraction from fuel rods irradiated in one of the Tennessee Valley Authority's reactors. A new tritium extraction facility is scheduled to go on line in 2006.

- SRS has been selected to "blend down" off-specification highly enriched uranium from retired weapons components and reactor fuel to low-enriched uranium that can be used in commercial nuclear reactors.

- SRS was designated as the lead Site for managing the consolidation of surplus plutonium materials from within the DOE complex and, earlier this year, was selected as the Site for three new plutonium disposition facilities (pit disassembly and conversion, mixed oxide fuel fabrication, and plutonium immobilization).

- SRS is the Site designated for management of aluminum-based spent nuclear fuel, from both domestic research reactors and foreign research reactors, until the spent nuclear fuel can be processed into a suitable form and/or packaged and shipped to a geologic repository for disposal. SRS also continues to prepare high-level wastes (through vitrification at the Defense Waste Processing Facility) for shipment to a geologic repository for disposal.

- SRS continues to provide leadership in environmental and waste management technology development and deployment and continues efforts to clean up the Site (i.e., remediate contaminated facilities, soils, and groundwater) and manage wastes and materials until they are permanently dispositioned.

1.2 Site Cleanup and Accomplishments

1.2.1 Remediation of Contaminated Sites

During SRS's 35-year production mission, contaminants were potentially released at 515 "inactive waste sites" (soil, surface water, and groundwater). This contamination represents:

- About 160 million cubic meters (5,650 million cubic feet) of environmental media contaminated with hazardous substances (e.g., volatile organic compounds (VOCs), heavy metals, and pesticides)

- About 12 million cubic meters (423 million cubic feet) of environmental media contaminated with both radionuclides and hazardous substances

These inactive waste sites, or units, include:

- settling/seepage basins,
- burning/rubble pits and piles,
- groundwater units,
- burial grounds/tanks,
- spill sites, and
- miscellaneous units.

APPROACHES TO REMEDIATION

Soils

- Soil Vapor Extraction
- Bioremediation
- Engineered Landfill Capping
- Solidification and Backfill
- Land Use Controls

Groundwater

- Air Recirculation Systems
- Vapor Extraction
- Baroballs
- Phytoremediation
- Pump and Treat
- Air Sparging
- Bioremediation
- Geosiphon
- Dynamic Underground Stripping

Environmental remediation work has been prioritized to focus on the higher risk sites. A major goal is to remediate, or begin to remediate, all high-risk/priority units by the end of 2006, while maintaining a balanced program for the remaining medium and low-risk units. Since remediation work started a decade ago:

- over 300 of the 500 contaminated acres have completed remediation, or are in the remediation phase, including the high priority Burial Ground Complex;

- over 40% of the 515 inactive waste sites at SRS have completed remediation and over half are in the remediation phase; and

- over four billion gallons of contaminated groundwater have been cleaned to drinking water standards, and major groundwater cleanup systems are operating at nine contaminated groundwater sites.

Remediation options for the inactive waste sites are varied and are determined on a site-specific basis. Most methods combine some aspects of waste stabilization, site capping, waste removal, and grading. Remediation activities also include innovative technologies, such as horizontal wells vapor vacuum extraction and air strippers, and include groundwater monitoring and periodic groundwater quality assessments.

Programmatically, all waste units in the Environmental Restoration program at SRS follow the same protocols for investigation, development of remedial action, and the selection of cleanup levels. Also, units within each watershed at SRS have similar sources of contamination and, thus, similar types of contamination, which would lead to similar cleanup goals and residuals. Programmatically, all the cleanup goals, thus the residual contamination levels, will be similar for each contaminant no matter what unit. For example, levels protective of the industrial worker or Maximum Contaminant Levels (MCLs) for groundwater will be applied to the majority of the operable units within the SRS watersheds and the Environmental Restoration program. Providing specific information for each operable unit within the watershed will not provide more beneficial information than is already discussed at the watershed (or portion) level. It would only serve to provide the same information on each unit (i.e., the same information would be repeated for each unit). For example, both the TNX and D-Area groundwater contamination (discussed in Section 3.11) consists of volatile organic compounds, metal, and radionuclides. The cleanup levels will be similar, as will the residuals.

KEY ACCOMPLISHMENTS IN FY 1999

- Produced 236 canisters of vitrified high-level waste (HLW).
- Received 28 casks of foreign research reactor (FRR) spent nuclear fuel (SNF) and 21 casks of domestic research reactor (DRR) SNF.
- Completed first cross-country shipment of FRR SNF (non-aluminum based) to the Idaho National Engineering and Environmental Laboratory (INEEL), supporting non-proliferation initiatives.
- Completed repackaging of existing SRS plutonium metal in FB-Line Bagless Transfer containers in preparation for mid- to long-term stable storage.
- Completed construction and began operation of new material characterization equipment in FB-Line.
- Shipped 17 casks of SNF material to H Canyon from K Reactor (at-risk materials).
- Completed shipments to F Canyon and stabilization in the FB Line of "failed" Taiwan fuel and "failed" EBR II fuel.
- Completed stabilization of Rocky Flats sand, slag, and crucible plutonium residues in F Canyon.
- Processed 68 million liters (18 million gallons) of wastewater at the Effluent Treatment Facility.
- Reduced legacy hazardous waste inventory by at least 260 cubic meters (9,170 cubic feet).
- 7,300 cubic meters (258,000 cubic feet) of low-level radioactive waste (LLW) added to inventory; treated about 4,900 cubic meters (173,000 cubic feet) and disposed about 8,800 cubic meters (311,000 cubic feet) of LLW.
- Completed retrieval of 2,500 buried transuranic (TRU) waste drums.
- Recycled 6,940 kilograms (15,300 pounds) of radioactively-contaminated lead.
- Completed material castings for the initial examinations of Melt/Dilute concepts.
- Achieved effective steady state operation at F&H Groundwater Treatment Facilities.
- Successfully deployed and saved over $10 million, using innovative technologies for the third consecutive year in environmental management program (i.e., in-situ air sparging, Soil Vapor Extraction (SVE), and in-situ soil stabilization.
- Remediated 13 key waste sites and groundwater units, such as in situ grouting at Old F-Area Seepage Basin, groundwater treatment at C-Area waste unit, and bio-remediation at Nonradioactive Waste Disposal Facility.

KEY PLANNED ACCOMPLISHMENTS IN FY 2000

FY 2000 Commitments

- Produce canisters of vitrified HLW from tanks at an average rate of 200 canisters per year.
- Receive 15 casks of foreign research reactor spent nuclear fuel and 23 casks from domestic reactors.
- Ship 12 casks of spent nuclear fuel material (subject to Defense Nuclear Facilities Safety Board Recommendation 94-1) and 13 casks of SRS spent nuclear fuel materials (pending Record of Decision) to SRS canyon facilities.
- Deinventory 10 casks of spent nuclear fuel in the Receiving Basin for Off-Site Fuels (RBOF) to the L Basin.
- Complete remediation of 10 release sites and assessments of 10 other sites.
- Complete grouting of radioactively contaminated soils at L-Area Oil and Chemical Basin and F-Area Retention Basins.
- Treat 1,320 million liters (350 million gallons) of groundwater and remove 45 thousand kilograms (100 thousand pounds) of volatile organic compounds from the A/M-Area.
- Remove radioactive contaminated soil from four SRL seepage basins near the site boundary.
- Begin operation of the Replacement High-Level Waste Evaporator (RHLWE).
- Complete construction of the H-Tank Farm Storm Water System upgrades.
- Treat approximately 7,570 liters (2,000 gallons) of PUREX solvent in the Consolidated Incinerator Facility (CIF).
- Complete stabilization of SRS depleted uranium/plutonium by conversion to metal.
- Begin stabilization of Mark-42 and non-failed EBR II fuel (pending Record of Decision).
- Receive five Rocky Flats shipments of scrub alloy for stabilization through F-Canyon/FB-Line.

KEY PLANNED ACCOMPLISHMENTS IN FY 2001

FY 2001 Planned Accomplishments

- Produce canisters of vitrified HLW from tanks at an average rate of 200 canisters per year.
- Make four shipments of TRU waste to WIPP.
- Begin receipt of stabilized surplus plutonium from Rocky Flats.
- Commence deactivation of the 313-M Target Slug Manufacturing Facility.
- Complete the experimental basin water strontium/cesium removal technology demonstration.
- Complete Melt and Dilute Pilot construction and startup as an alternative technology to conventional chemical processing of aluminum-based SNF.
- Process 68 million liters (18 million gallons) of wastewater at the Effluent Treatment Facility.
- Demolish the F Area powerhouse.
- Complete Sludge Batch 1B feed to Defense Waste Processing Facility (DWPF), and initiate Sludge Batch 2 feed.
- Complete assessments of eight release sites and remediation of eight release sites.
- Begin final action on the Radioactive Burial Ground and its groundwater unit.
- Operate nine major long-term groundwater cleanup systems.
- Complete stabilization of SRS depleted uranium/plutonium by conversion to metal.
- Initiate stabilization of Rocky Flats scrub alloy through F-Canyon/FB-Line.
- Refresh and consolidate existing inventory of HEU solution pending future initiation of Blend-Down Program.
- Receive 25 casks of foreign research reactor SNF and 16 casks from domestic research reactors.
- Ship 10 casks of SNF material (subject to Defense Nuclear Facilities Safety Board Recommendation 94-1) and 17 casks of SRS spent nuclear fuel materials.
- Deinventory 24 casks of RBOF SNF to the L Basin.

1.2.2 Disposition of Onsite Wastes and Materials

In addition to cleaning up site contamination at SRS, DOE is actively working to disposition the various types of wastes and nuclear materials that are currently stored on the Site.

- About 132 million liters (35 million gallons) of high-level waste are stored in waste tanks at SRS. DOE is working to remove the high-level waste from 49 remaining tanks and stabilize and close the tanks. Two have already been closed. The Defense Waste Processing Facility (DWPF) is converting the liquid high-level waste into a borosilicate glass waste form, a stable storage form, which will ultimately be shipped to a geologic repository for permanent disposal. Low-level waste saltstone, also resulting from this process, will be disposed of at an onsite vault.

- About 2,200 cubic meters (77,000 cubic feet) of mixed low-level waste are currently in inventory, and over 11,000 additional cubic meters (388,000 cubic feet) are expected to be generated over the life cycle of cleanup operations. After a range of treatment activities, 3,600 cubic meters (127,000 cubic feet) are expected to be disposed of at an offsite facility. SRS hosts a mixed low-level waste treatment facility (the Consolidated Incineration Facility), which currently treats only onsite waste.

- About 15,000 cubic meters (529,000 cubic feet) of low-level waste are currently in inventory, and over 213,000 meters (7.5 million cubic feet) are expected to be generated over the life cycle of cleanup operations. After a range of treatment activities, 125,000 cubic meters (4.4 million cubic feet) will be disposed of onsite in either engineered vaults or slit trenches (shallow land burial); 33,000 cubic meters (1.2 million cubic feet) will be sent to an offsite commercial facility; and three million cubic meters (106 million cubic feet) of treated effluent will be discharged through a National Pollutant Discharge Elimination System outfall. Currently, SRS projects to generate and dispose onsite more low-level waste than any other DOE Site. This will require expansion of the onsite low-level waste disposal facilities.

- About 11,000 cubic meters (36,080 cubic feet) of transuranic waste are currently in inventory (primarily stored in drums and black boxes) and 3,800 cubic meters (12,464 cubic feet) are expected to be generated over the life cycle of cleanup operations. After a combination of sorting, segregating, and repackaging, 16,000 cubic meters (52,480 cubic feet) are planned for shipment to the Waste Isolation Pilot Plant (WIPP) for permanent geologic disposal.

- Nonradioactive hazardous waste is being shipped offsite for treatment, incineration, or recovery. More than 2,500 drums have been shipped offsite. About 500 cubic meters (1,640 cubic feet) per year of nonradioactive hazardous waste are shipped offsite for treatment, incineration, or recovery.

- About 20 metric tons of heavy metal (MTHM) of spent nuclear fuel are in inventory and 30 MTHM are expected to be received from offsite. After onsite management, the spent fuel is expected to be placed in an offsite geologic repository for permanent disposal. About 47 metric tons of heavy metal (MTHM) of spent nuclear fuel were in the SRS inventory at the end of 1999. Of these inventories, about 24 MTHM will undergo stabilization processing in the SRS canyon facilities and 20 MTHM will be shipped to the Idaho National Engineering and Environmental Laboratory (INEEL) as part of the *Record of Decision on Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs* (May 1995), which specified consolidation of spent nuclear fuel by fuel type at either Hanford, INEEL or SRS. The remaining three MTHM inventory will be combined with projected receipts of 20 MTHM of aluminum-based foreign and domestic research reactor spent nuclear fuel and stabilized in the SRS Treatment and Storage Facility (melt and dilute) for emplacement and final disposition in the geologic repository.

- 2.1 metric tons of surplus plutonium materials are in inventory at SRS and about 30 metric tons are expected to be received from offsite for either immobilization or fabrication into mixed oxide fuel for use in domestic nuclear power reactors. The vitrified plutonium and spent mixed oxide fuel will ultimately be placed in an offsite geologic repository for permanent disposal.

These waste and materials management activities are not the subject of this report, except for where the facilities or waste units are in remediation or deactivation and will begin long-term stewardship activities by 2006.

DOE assumes, for purposes of long-term stewardship, that these wastes and materials will be removed offsite for permanent disposition (except for the low-level waste, which will be buried in onsite vaults or trenches, in accordance with requirements governing low-level waste disposal facilities). However, in the event of schedule delays, i.e., availability of a geologic repository for high-level waste and spent nuclear fuel, DOE would be managing these materials onsite as part of its long-term stewardship responsibilities.

1.2.3 Deactivation of Facilities

Deactivation of most of the Site's major processing facilities (such as the five reactors, two chemical separation facilities, and Defense Waste Processing Facility) has been deferred beyond 2006. Two of the five reactors are being modified for plutonium storage (K Reactor) and spent nuclear fuel treatment and storage (L Reactor) and will remain active until 2014 and 2036, respectively. Current assumptions are that the chemical separation facilities (F and H Canyons) will continue to support EM missions through 2009. Stabilized plutonium will be packaged and stored in the 235-F vault until final disposition is completed in 2020. The Defense Waste Processing Facility (DWPF) will continue vitrifying high-level waste through 2023. Upon completion of their current EM mission, the facilities will be deinventoried and deactivated. Following deactivation, facilities will be placed in a long-term, low-cost surveillance and maintenance program pending final decommissioning.

As can be seen from the above discussion, SRS is not a near-term "closure site." Detailed planning for facilities disposition and negotiations with Regulators regarding the final disposition of Site facilities is still years away. In addition, future technologies for facilities cleanup will have a dramatic effect on cost. For these reasons, final Site decisions on the ultimate end state of most of the facilities have not been made yet. The SRS planning assumption to deactivate facilities, followed by long-term surveillance and maintenance, ensures the safety of workers, the public, and the environment and does not preclude any ultimate end-state options. The long-term stewardship cost estimate developed for the SRS life-cycle Environmental Management (EM) cost estimate can be applied to a range of facility disposition options, which will be identified as discussions with regulators are initiated, new technologies are evaluated, and detailed disposition plans are developed.

Since decisions on the final end states for most of the Site's facilities will be made after 2006, this report contains cost estimates only for facilities that will have begun long-term stewardship activities by the end of 2006. These include a portion of the high-level waste tanks, the D-Area Heavy Water Facilities, the Heavy Water Component Test Reactor (HWCTR), the Naval Fuel Manufacturing Facility (247-F), and the M-Area Fuel/Target Manufacturing Facilities.

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

Decisions regarding the final disposition of Site facilities will be made during the disposition detailed planning phase (typically initiated three years prior to the completion of scheduled facility operations). The decisions will be consistent with regulatory requirements, input from stakeholders, future use of Site resources, available technology, and cost-effectiveness considerations (see Section 1.2.3 above). The current planning basis is to

monitor and maintain Site facilities indefinitely (for purposes of this report, through 2070) to ensure their structural integrity and protect the health and safety of Site workers, the general population outside the site boundaries, and the environment.

DOE anticipates that DOE/EM Environmental Restoration operating activities at SRS, including well monitoring, maintenance of treatment facilities, maintenance of institutional and engineered controls, and compliance support, will be completed by 2047. Following the operating period, the remediated release sites will be monitored and maintained in perpetuity (estimated, for purposes of this report, through 2070) to ensure the containment of any residual contamination.

Section 3.0 provides a further discussion of those areas of the Site that will require long-term stewardship activities by 2006 (as requested by Congress in the FY 2000 National Defense Authorization Act), referred to as "portions." For purposes of this report, a "portion" is a geographically contiguous and distinct area (which may involve residually contaminated facilities, engineered units, soil, groundwater, and/or surface water/sediment) for which cleanup, disposal, or stabilization will have been completed by 2006 and for which there are long-term stewardship requirements prior to 2006.

General activities involved in long-term stewardship (e.g., institutional and engineered controls, and record-keeping) are discussed below. However, since long-term stewardship activities are dependent on the particular waste site or facility, each portion discussion in Sections 3.1 to 3.11 elaborates, where appropriate, on long-term stewardship activities specific to that portion.

Institutional and Engineered Controls

Long-term surveillance and maintenance will be performed for waste units that have been remediated (or are being remediated through monitored natural attenuation). Activities include required regular maintenance, such as erosion control, placement of signs, fence repair, periodic inspections, and monitoring. Maintenance will be performed on secondary roads, drainage systems, and access roads to monitoring wells. Upon completion of closure activities, periodic inspection of the units will be performed in accordance with approved post-closure inspection procedures.

DOE assumes that the Site will continue to maintain its Industrial Use zoning and, therefore, access will be restricted during long-term stewardship. (See description of SRS land use planning zones in Section 4.0.)

Record-Keeping Activities

The U.S. Environmental Protection Agency, Region IV, requires that all Federal Facilities within the Region commit themselves to implementing a detailed written Land Use Control Assurance Plan for any remedial and/or corrective action involving any reliance on one or more Land Use Controls for the protectiveness of that action. This Plan must be established for all remedial actions under the *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA) and corrective actions under the *Resource Conservation and Recovery Act* (RCRA) that utilize Land Use Controls as all or part of their remedy. A unit-specific Land Use Control Implementation Plan is established for each waste site that implements land use controls as all or part of their remedy. These unit-specific plans are appended to the Land Use Control Assurance Plan.

The *Land Use Control Assurance Plan for the Savannah River Site* (WSRC-RP-98-4125) was established in April 2000. As the unit-specific land use control implementation plans are developed, they will be appended to the Land Use Control Assurance Plan. Anyone desiring to read about the land use controls being implemented at SRS can obtain a copy of the Land Use Control Assurance Plan (see contact information at end of Section 4.0).

The above requirements apply to the Site's Environmental Restoration Program. Record-keeping requirements for dispositioned Site facilities will be developed on a case-by-case basis during the detailed planning phase of the facility disposition effort.

STAKEHOLDER INVOLVEMENT

SRS involves the public in key decisions and planning activities. Public input is considered in strategic planning, comprehensive planning, siting new facilities, decommissioning surplus facilities, environmental research, and remediation decisions. The public has an opportunity to be involved in SRS activities through participation in Citizens Advisory Board meetings and DOE public meetings and by providing comments on draft documents, priorities and budgets. Current information on SRS activities can be found on the SRS website: www.srs.gov.

Stakeholder recommendations concerning future use options for SRS, with few exceptions, have fit several common themes:

- SRS boundaries should remain unchanged, and the land should remain under the ownership of the federal government, consistent with the Site's designation as the first National Environmental Research Park (NERP).
- Residential uses of SRS land should be prohibited.
- All SRS land should be available for multiple use, except for residential use (e.g., industry, ecological research, natural resource management, research and technology demonstration, recreation, and public education) wherever appropriate and non-conflicting.
- Some of the land should continue to be available for nuclear and non-nuclear industrial uses, and commercial industrialization should be pursued.
- Industrial and environmental research and technology development and transfer should be expanded.
- Natural resource management should be pursued wherever possible with biodiversity as the primary goal
- Recreational opportunities should be expanded as appropriate.
- Future use planning should consider the full range of worker, public, and environmental risks, benefits, and costs associated with remediation.

Stakeholders expressed a broad range of concerns related to the level of risk, benefits, and costs that should be evaluated before decisions are made. Concerns addressed both potential onsite and offsite impacts. Most expressed the desire that the health and safety of workers, the public, and the environment be the primary consideration in planning the future of SRS. They also advocated increased consideration of risks, benefits, and costs associated with future Site activities, particularly where future remediation activities were concerned.

2.2 Long-Term Stewardship Technology Development and Deployment

Technology initiatives will include performing programmatic initiatives and process improvements for technical activities, such as technology development, risk assessment initiatives, codes and standards, training, software research, safety documentation, and configuration management. Benefits include varied technologies and process improvements that are deployed to specific waste sites, remediation activities, and regulator interface and cost savings to the Environmental Restoration program. By establishing protocols, performing root cause investigations and developing regulator document templates and procedures for Environmental Restoration work, technology initiatives are essential to the long-term stewardship planning.

2.3 Assumptions and Uncertainties

DOE assumes that the Site will remain under the federal government ownership under its current boundaries in perpetuity. Because SRS will have continued missions for the foreseeable future, DOE assumes that the Site will

remain zoned for industrial, industrial support, and general uses (see Section 4.0). Therefore, long-term stewardship activities will be appropriate.

DOE assumes that the DOE/EM mission at SRS will be complete by 2047; however, the long-term stewardship scope and cost for deactivated facilities and remediated soils and water have been included in the life-cycle cost estimates and are considered as part of the Environmental Management liability beyond that time (for purposes of this report, through 2070).

While much is understood concerning the contaminants at many of the operable units discussed in this report, additional characterization and treatability studies are required in some areas to fully understand the nature and extent of the contamination.

2.4 Regulatory Regime

The environmental cleanup program at SRS is governed by a variety of regulatory requirements, including state and federal laws, interagency agreements, DOE Orders, and various settlement agreements and consent decrees. In 1989, SRS was placed on the National Priority List for response under CERCLA. DOE has performed remedial investigations at inactive waste units at SRS, most of which were included in the 1987 RCRA permit issued by EPA as solid waste management units. In addition, DOE integrated the process at SRS for conducting Remedial Investigations and RCRA Facility Investigations for those waste units covered under both statutes.

As required by Section 120(e) of CERCLA, DOE, EPA, and the South Carolina Department of Health and Environmental Control (SCDHEC) entered into an interagency agreement, the Federal Facility Agreement (FFA), that became effective August 16, 1993. EPA also is a party to the FFA, and the FFA integrates the requirements of RCRA and CERCLA by defining the process for integrated responses and contains an enforceable schedule for current year activities and outyear schedules. An FFA Implementation Plan (FIP) has been developed to aid the three Parties in their task of administering the terms of the FFA.

Additional federal and state statutes and regulations affect responses at SRS cleanup sites on a project-specific basis. These include the National Environmental Policy Act, Clean Water Act, Clean Air Act, Toxic Substances Control Act, South Carolina Pollution Control Act, South Carolina Storm-Water Management and Erosion Control Regulations, and South Carolina Solid Waste Regulations.

The above requirements apply to the Site's Environmental Restoration program. The regulatory regimes for the Site's facility disposition activities will be developed on a case-by-case basis during the detailed planning phase, based on then-current regulatory requirements.

2.5 Estimated Site-Wide Long-Term Stewardship Costs

As stated in Section 1.2.3, decisions on the final end state for most of the Site's facilities are years away, and current estimates for long-term stewardship are based on prudent, but conservative, assumptions (deactivation versus full D&D). This approach was selected to provide Site life-cycle cost estimates that are a good barometer for measuring the total Environmental Management liability rather than just the long-term stewardship component. (This approach is less susceptible to future regulatory decisions and improvements in future technologies as they pertain to long-term stewardship.) Therefore, consistent with the language in the FY 2000 National Defense Authorization Act ("*In those cases where the Department has a reasonably reliable estimate of annual or long-term costs for stewardship activities, such costs shall be provided*"), the table below summarizes the cost for the site portions that will be in long-term stewardship by the end of fiscal year 2006. These estimates include:

- Site Environmental Restoration operating activities (pump and treat) that are in place prior to 2006, which have been identified, for the purpose of this report, as long-term stewardship activities.

- Post-deactivation activities for surveillance and maintenance of deactivated facilities/structures that are in place prior to 2006 to ensure the containment of any residual contamination.

In the years FY 2000 to FY 2006, the costs are dominated by the Environmental Restoration program and reflect the extensive pump and treat systems currently in place to remediate and prevent migration of contaminated groundwater. Costs also reflect the routine institutional and engineered controls involved in long-term stewardship.

In the portion-specific discussions in Section 3, applying to the Environmental Restoration program (e.g., the watershed portions), cost estimates are provided through the anticipated dates for which DOE/EM operations phases of the program are scheduled for completion. Each portion has its own projected end date, consistent with interim regulatory commitments.

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	*Amount*	*Year(s)*	*Amount*	*Year(s)*	*Amount*
FY 2000	$35,001,000	**FY 2008**	$9,523,000	**FY 2036-2040**	$17,255,000
FY 2001	$29,082,000	**FY 2009**	$ 7,380,000	**FY 2041-2045**	$21,967,000
FY 2002	$27,889,000	**FY 2010**	$6,406,000	**FY 2046-2050**	$28,035,000
FY 2003	$22,659,000	**FY 2011-2015**	$20,889,000	**FY 2051-2055**	$35,781,000
FY 2004	$21,390,000	**FY 2016-2020**	$16,137,000	**FY 2056-2060**	$45,667,000
FY 2005	$23,519,000	**FY 2021-2025**	$12,829,000	**FY 2061-2065**	$58,283,000
FY 2006	$25,779,000	**FY 2026-2030**	$11,873,000	**FY 2066-2070**	$74,385,000
FY 2007	$14,010,000	**FY 2031-2035**	$14,134,000		

3.0 PORTION OVERVIEW

The discussion of long-term stewardship is organized according to 11 portions of SRS. Six of those portions are within geographical areas with common topography and hydrology (i.e., watershed areas). The portion itself represents areas of contamination that will have begun long-term stewardship by 2006 (e.g., soil, engineered units, or groundwater). Four portions are facilities that have been or will be deactivated by 2006. One portion includes the F-Tank Area, for which long-term stewardship costs do not begin for the tank area as a whole until FY 2022. However, some of the tanks in the F Area will be emptied of their high-level radioactive waste and "operationally closed" by 2006. The emptied and operationally closed tanks will be under institutional control and monitored as part of the operating tank farm until the final closure is completed in 2022.

The table below identifies the 11 portions and the timeframes for long-term stewardship by DOE. The sections below provide more details on the remediation or deactivation activities taking place at the 11 portions and the anticipated long-term stewardship activities. For ease in presentation of remedial actions, the portions are further broken down by environmental media type, e.g., soil, engineered units, and groundwater. However, long-term stewardship activities are discussed at the portion level.

Long-Term Stewardship Information		
Portion	***Long-Term Stewardship Start Year***	***Long-Term Stewardship End Year***
F-Tank Area (entire tank area)	2022	indefinite
D Area Heavy Water Facilities	2004	indefinite
Heavy Water Component Test Reactor (HWCTR)	2007	indefinite
247-F Naval Fuel Manufacturing Facility	1997	indefinite
M Area Fuel/Target Fabrication Facilities	2007	indefinite
Upper Three Runs	1996	in perpetuity
Lower Three Runs	1997	in perpetuity
Steel Creek	1996	in perpetuity
Pen Branch	2001	in perpetuity
Four Mile Branch	1996	in perpetuity
Savannah River and Floodplain Swamp	1997	in perpetuity

3.1 F-Tank Area

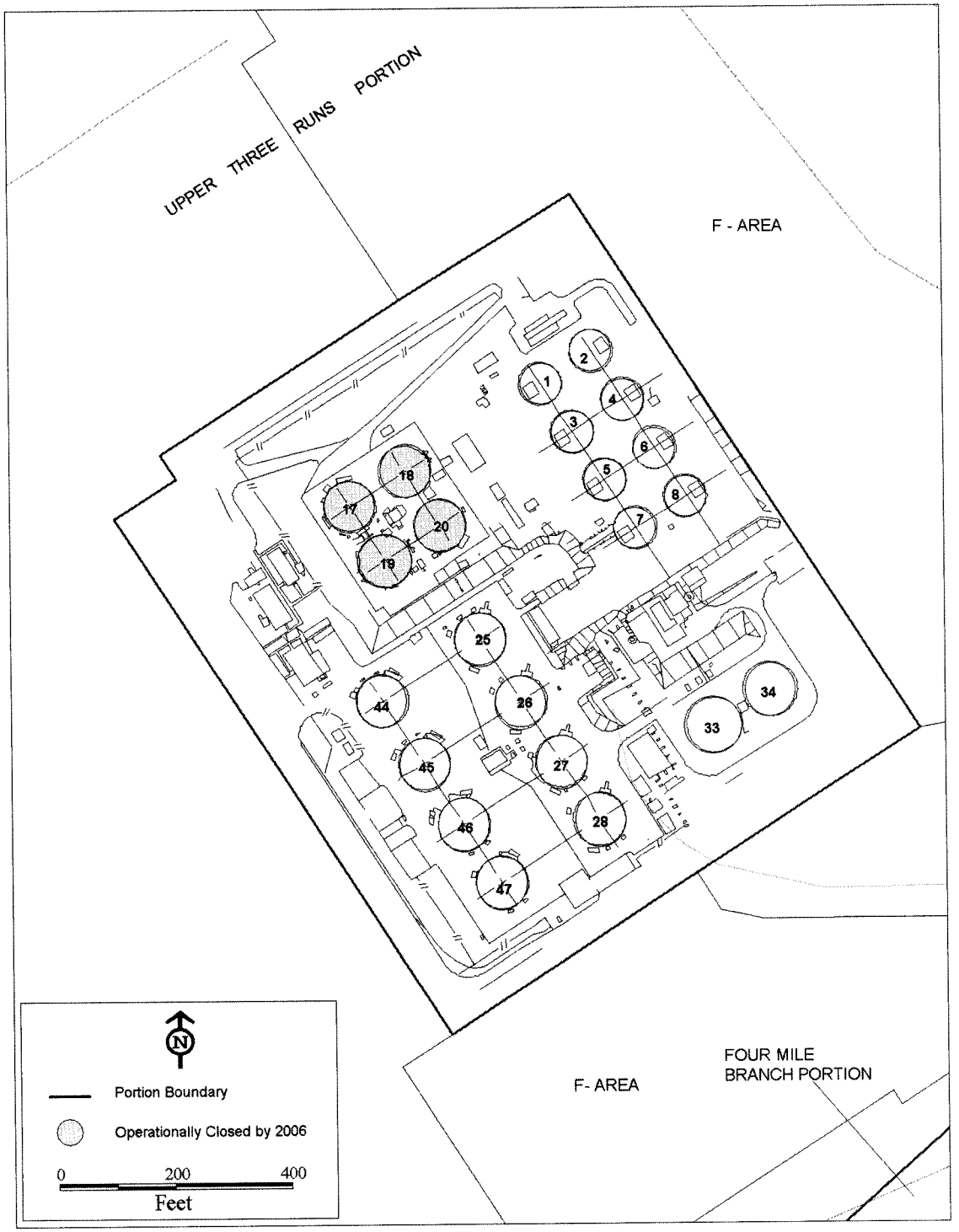
The F-Tank Area is a separately fenced portion of SRS, comprising 7.7 hectares (19 acres) and containing 22 of the 51 high-level waste storage tanks at SRS. (The remaining tanks are located in the H-Tank Area.) The high-level waste contained in the storage tanks are in liquid and sludge forms and resulted from the chemical processing of spent fuel and irradiated targets (to separate plutonium for use in the nuclear weapons program). As part of the Federal Facility Agreement, DOE is required to remove from service and close the non-compliant tanks, in accordance with South Carolina Regulation R.61-82, "Proper Closeout of Wastewater Treatment Facilities," and consistent with other requirements governing high-level waste and hazardous materials.

F-TANK AREA PORTION HIGHLIGHTS

Major Long-Term Stewardship Activities - institutional controls; long-term surveillance and maintenance
Portion Size - 7.7 hectares (19 acres); contains 22 of 51 high-level waste tanks
Estimated Volume of Residual Contaminants - to be determined
Long-Term Stewardship Start-End Years - 2022-indefinitely
Average Annual Long-Term Stewardship Costs FY2000-2006 - n/a

The final end-state for all of the high-level waste tanks (including F- and H-Area Tanks) is scheduled for 2024. Closing the tanks requires first removing the liquid high-level waste and waste heels from the tanks, separating and decontaminating the salt portion of the waste (for disposal as saltstone), vitrifying the highly radioactive liquid and sludge into glass logs for eventual disposal in a geologic repository, and stabilizing and closing the tanks (including capping and sealing all piping). The saltstone disposal vaults will be covered with native soil and a cap will be installed, consisting of layers of clay, gravel, geotextile fabric, and other materials.

Two of the 51 high-level waste storage tanks (Tanks 17 and 20 in the F Area) have already been operationally closed. After removal of the high-level waste and spray washing, the tanks were filled with a specially



F-Tank Area

formulated grout mixture to bind up residual contamination. The remaining 49 tanks in both the F and H Tank Areas have yet to be closed. The separation and decontamination of the salt portion of the waste become

technologically challenging, from a health and safety standpoint, and efforts are now underway to evaluate the most appropriate technology to accomplish this task..

By 2006, DOE anticipates that two additional tanks (old-style tanks that have been emptied of waste) will be operationally closed (Tanks 18 and 19 in the F Area). Therefore, by the end of 2006, a total of four tanks will have been operationally closed. Since all four of the tanks in the tank group 17-20 will have been operationally closed, the common supporting infrastructure for this tank group will also be operationally closed.

3.1.1 Long-Term Stewardship Activities

Long-term stewardship activities will not begin until 2022, when both the F and H Tank Areas, as a whole, will be emptied and closed. For the four tanks operationally closed by 2006, some level of monitoring and institutional controls will be maintained as part of ongoing tank area programs. DOE anticipates that once the tank areas are closed, institutional controls and long-term surveillance and maintenance will be required in perpetuity. The duration for environmental monitoring of the tank areas is undetermined at this time.

3.1.2 Estimated Long-Term Stewardship Costs for the F-Tank Area Portion

The F Tank Farm will be operating through the end of 2021 with final closure in 2022, at which time long-term stewardship activities will begin. Due to current uncertainties in the technology and methodology that will be selected to operationally close the remaining tanks and facilities, current cost estimates contain a high degree of uncertainty and are, therefore, not included in this report.

3.2 D Area Heavy Water Facilities

The 400-D-Area Heavy Water facilities produced heavy water for use in the production reactors. The area originally contained three sets of heavy water extraction towers with the necessary support facilities. The area was operational until 1982. There is no planned reuse for the facilities. In 1995, two sets of extraction towers and most support facilities were removed. The facilities began deactivation in 1999 and are expected to complete deactivation in 2003, at which time they will remain in a long-term monitoring mode until a final decision is made on the disposition of these facilities.

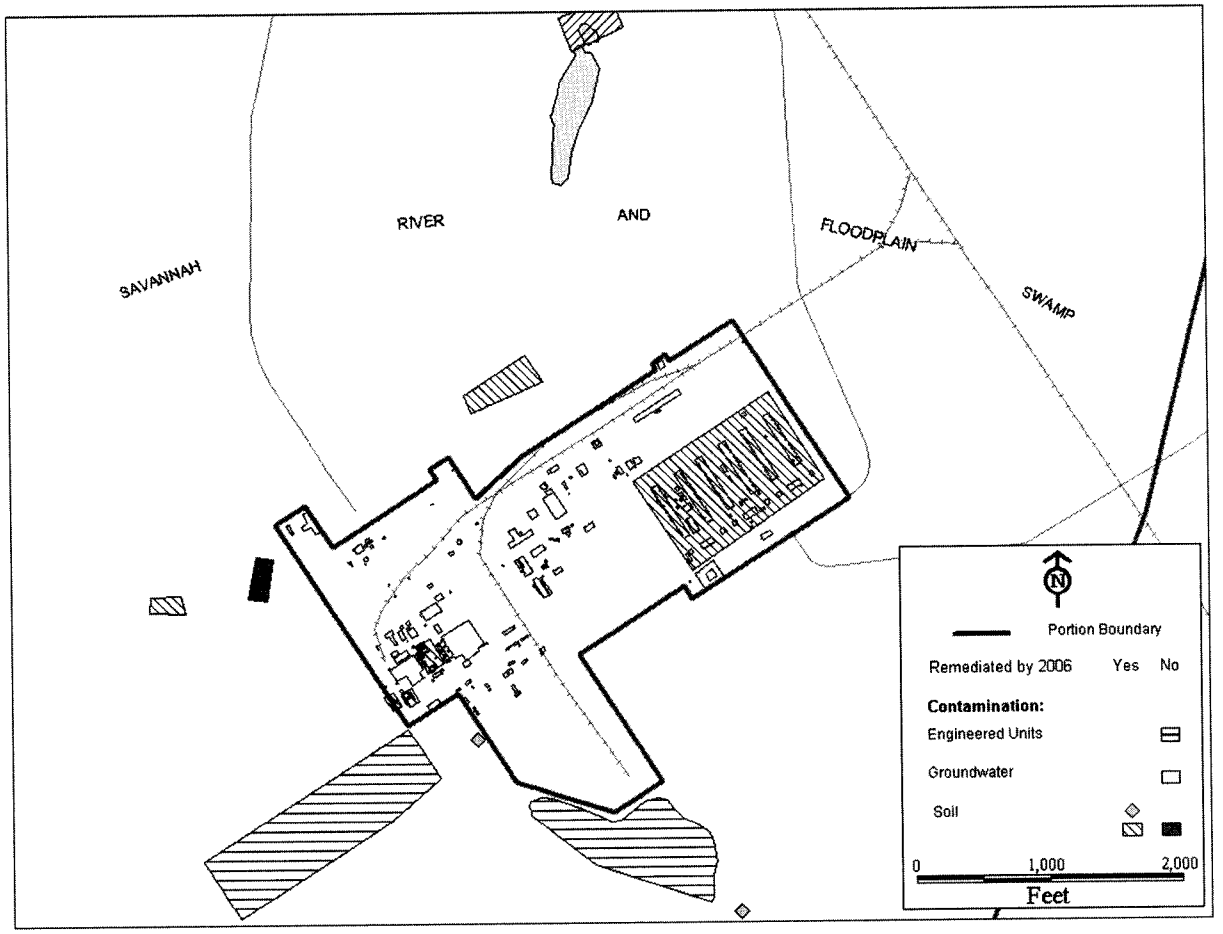
D AREA HEAVY WATER FACILITIES PORTION HIGHLIGHTS

Major Long-Term Stewardship Activities - access restrictions; long-term surveillance and maintenance
Portion Size - 7,714 square meters (83,000 square feet)
Estimated Volume of Residual Contaminants - to be determined
Long-Term Stewardship Start-End Years - 2004-indefinitely
Average Annual Long-Term Stewardship Costs FY2004-2006 - $287,495

There are no current plans for the decommissioning of the facilities. Hazards will be re-evaluated after deactivation and surveillance and monitoring programs are implemented. It is assumed that long-term monitoring will be indefinite. Long-term stewardship is assumed to begin in 2004 and continue indefinitely (for purpose of this report, through 2070).

3.2.1 Facilities

The D-Area Heavy Water Facility consists of 28 buildings and structures, which are of typical "Other Industrial" construction. The majority of the buildings are of metal or wood frame, with corrugated metal and/or transite sheathing. Most of the excess buildings (which, at this time, include the Moderator Processing and Storage



D Area Heavy Water Facilities

Buildings, Administrative Buildings, and a number of abandoned systems and structures) do not contain radiological contamination and are potential candidates for future decommissioning.

3.2.2 Long-Term Stewardship Activities

The facility is located within the fenced boundaries of SRS. Current Site plans include the retention of Site boundaries and access controls. All relevant environmental monitoring programs are assumed to continue. A periodic (annual) surveillance and maintenance program will be instituted to monitor any degradation of the building structure. Surveillance and maintenance requirements are minimal.

The containment of residual contamination is based upon the integrity of the containment structure and the ability to maintain control of water, animal, and/or human intrusion. No other engineering controls are currently planned for this facility.

3.2.3 Estimated Long-Term Stewardship Costs for the D-Area Heavy Water Facilities

The table below provides the estimated long-term stewardship costs for the D-Area Heavy Water Facilities. Costs include institutional controls, long-term surveillance and maintenance, and environmental monitoring of

the facility. Due to the potential for long-term structural degradation, there may be additional costs not currently included in the estimate.

D-Area Heavy Water Facilities							
FY 2000 - FY 2010	***FY 2011 - FY 2020***	***FY 2021 - FY 2030***	***FY 2031 - FY 2040***	***FY 2041 - FY 2050***	***FY 2051 - FY 2060***	***FY 2061 - FY 2070***	***Estimated Total***
$988,000	$333,000	$541,000	$882,000	$1,436,000	$2,340,000	$3,811,000	$10,330,000

3.3 Heavy Water Component Test Reactor (HWCTR)

The Heavy Water Component Test Reactor (HWCTR) terminated operations in December 1964, and all fuel and heavy water were removed from the reactor complex. A decision to retire the reactor was made in 1965, and facility systems were shut down and the facility secured by 1971. During the 1990s, the facility was evaluated and contamination areas were reduced. Demolition of non-radiological contaminated facilities resulted in reduced surveillance and maintenance costs. In early 1997, a decision was made to complete the demolition of the facility as the end-state condition. This was agreed to and supported by the stakeholders. However, budget shortfalls resulted in a decision to defer decommissioning, and activities were initiated to place the facility in a state of long-term passive storage.

HEAVY WATER COMPONENT TEST REACTOR PORTION HIGHLIGHTS

Major Long-Term Stewardship Activities - access restrictions; long-term surveillance and maintenance
Portion Size - 929 square meters (10,000 square feet)
Estimated Volume of Residual Contaminants - to be determined
Long-Term Stewardship Start-End Years - 2007-indefinitely
Average Annual Long-Term Stewardship Costs FY2000-2006 - n/a

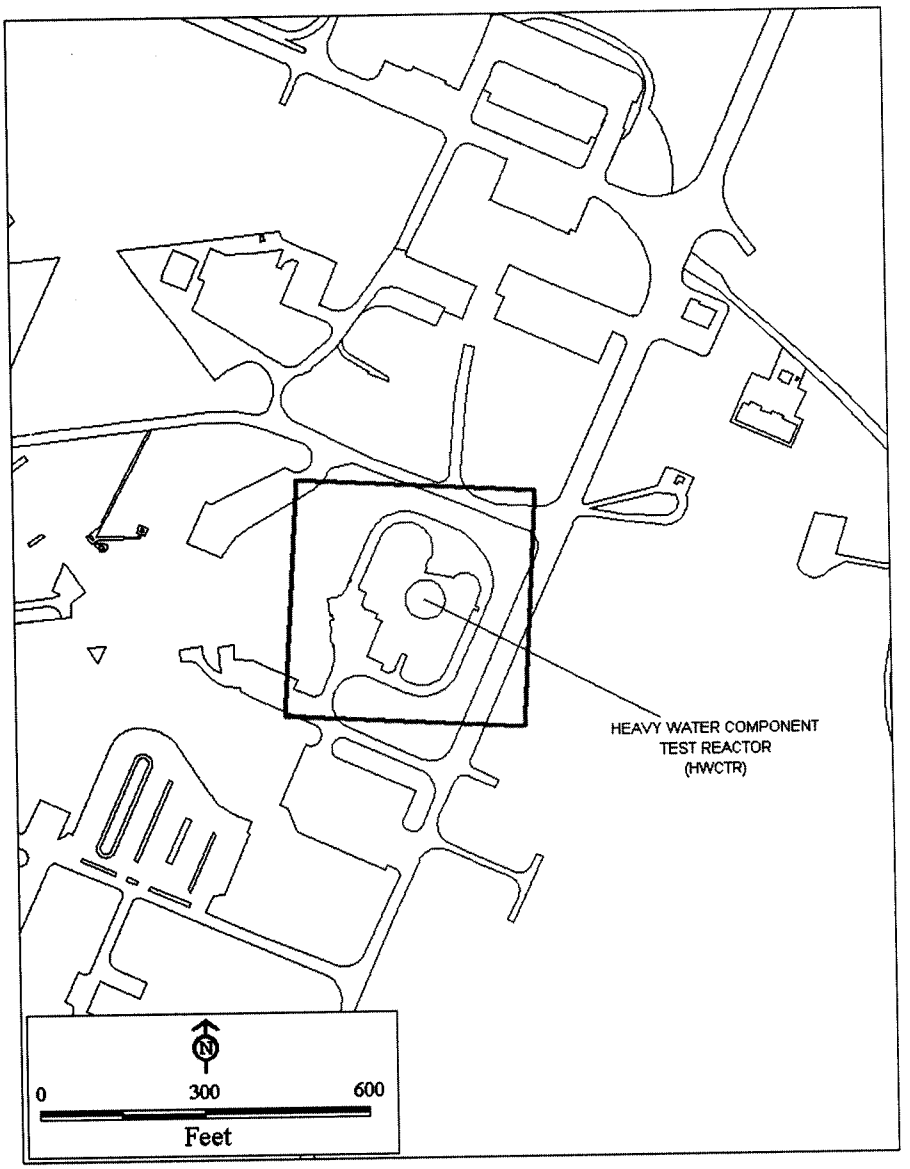
Residual radiological contamination from the operation of the test reactor remains within the reactor containment building. The total radioactive material quantity has been estimated at 2,850 curies, with the major constituents being cobalt-60, strontium-90, and cesium-137. Residual hazards and associated risks were reduced through deactivation of the facility. A low-cost surveillance and maintenance program, consisting of periodic monitoring and radiological surveys, will be conducted until a final disposition decision has been made.

3.3.1 Facilities

There is only one remaining building -- the test reactor containment building. All ancillary facilities have been decommissioned to grade. The reactor facility has been deactivated, although the containment structure has been sealed. The remaining structural envelope for the HWCTR is primarily an above-ground steel structure consisting of a dome and below-ground concrete retaining walls and foundation, comprising 930 square meters (10,000 square feet). Based upon recent evaluations and inspections, the interior concrete walls and foundation and the steel dome are in excellent condition.

3.3.2 Long-Term Stewardship Activities

The facility is located within the fenced boundaries of SRS on two acres. The building is classified as an Other Industrial Facility based upon a recent Hazards Assessment. Current Site plans include the retention of Site boundaries and access controls. All relevant environmental monitoring programs are assumed to continue. A



Heavy Water Component Test Reactor

surveillance and maintenance program will be instituted to monitor any degradation of the building structure. Long-term stewardship activities will continue indefinitely.

The containment of residual contamination is based upon the integrity of the containment structure and the ability to maintain control of water, animal and/or human intrusion. No other engineered controls are currently planned for this facility.

3.3.3 Estimated Long-Term Stewardship Costs for the Heavy Water Component Test Reactor

The table below provides the estimated long-term stewardship costs for the HWCTR. The cost estimate for long-term stewardship is based on an annual surveillance and maintenance program, starting in FY 2000 and continuing indefinitely (for purposes of this report, costs are estimated through FY 2070). Due to the potential for long-term structural degradation, there may be additional costs not currently included in the estimate.

HWCTR Portion Long-Term Stewardship Costs (Constant Year 2000 Dollars)							
FY 2000 - FY 2010	***FY 2011 – FY 2020***	***FY 2021 - FY 2030***	***FY 2031 – FY 2040***	***FY 2041 – FY 2050***	***FY 2051 – FY 2060***	***FY 2061 FY 2070***	***Estimated Total***
$78,000	$208,000	$337,000	$550,000	$896,000	$1,459,00	$2,376,000	$5,904,000

3.4 247-F Naval Fuel Manufacturing Facility

The 247-F Naval Fuel Manufacturing Facility is located within a deactivated security zone in the F Area, which is one of the chemical separations and processing areas at SRS. The manufacturing facility and nearby ancillary facilities were utilized for fabrication of enriched uranium fuel for use in the production of naval reactor fuel elements, until the operation was shut down in 1988. Currently, there is no identified mission for the facility.

247-F NAVAL FUEL MANUFACTURING FACILITY PORTION HIGHLIGHTS

Major Long-Term Stewardship Activities - access restrictions; long-term surveillance and maintenance
Portion Size - 10,827 square meters (116,508 square feet)
Estimated Volume of Residual Contaminants - to be determined
Long-Term Stewardship Start-End Years - 1997-indefinitely
Average Annual Long-Term Stewardship Costs FY2000-2006 - $261,504

After the process was shut down, the 247-F Naval Fuel Manufacturing Facility was de-inventoried of enriched uranium and chemicals, and the process equipment was flushed and isolated; however, portions of the building and equipment are contaminated with corrosive residue, containing a measurable quantity of enriched uranium. The facility was deactivated in the mid-1990s. There are currently no final decisions to the final end state of this facility. Although there is no planned re-use for this facility, there are currently no plans for its decommissioning. The facility is currently in a state of long-term passive storage. Residual hazards and associated risks were reduced through deactivation, and DOE maintains the facilities in a low-cost surveillance and maintenance program until a final disposition decision is made.

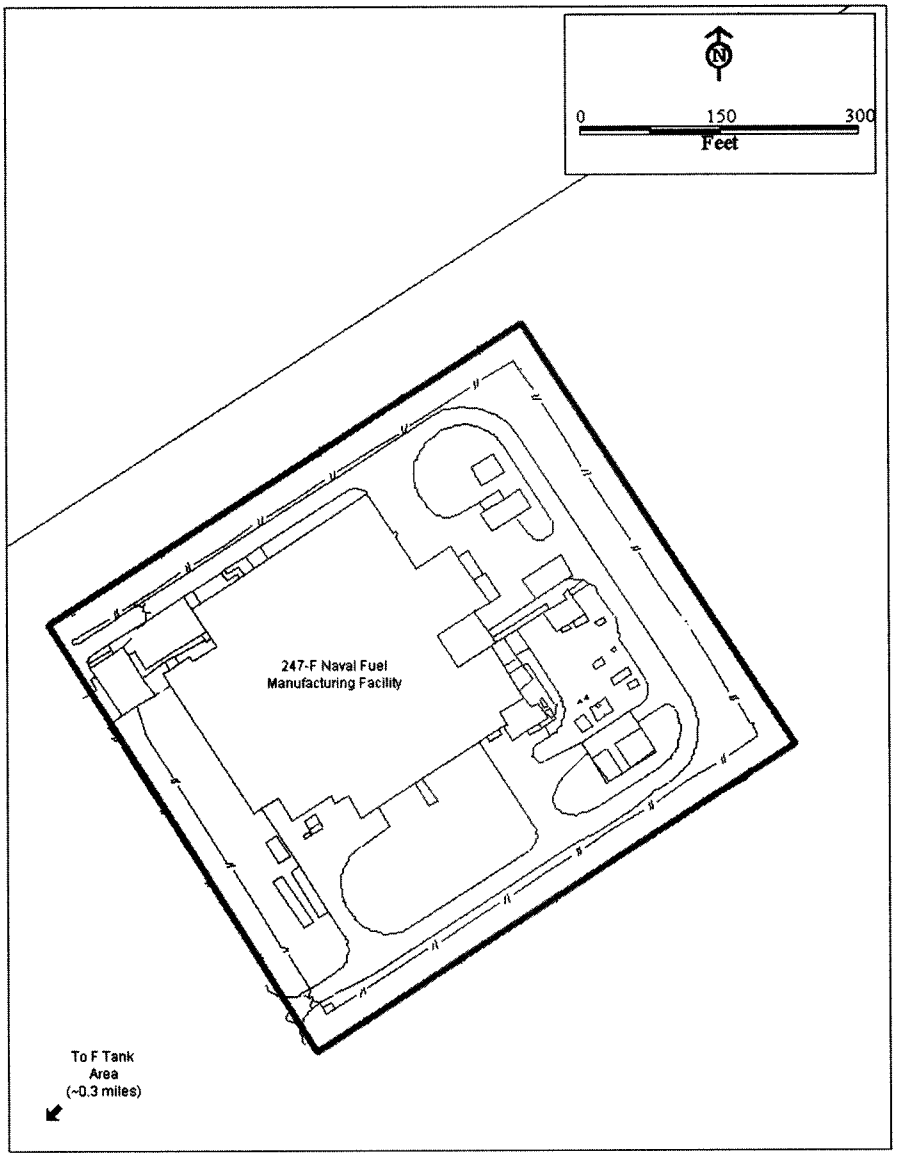
3.4.1 Facilities

The manufacturing building and ancillary structures are made up primarily of steel frame and comprise an area of 10,827 square meters (116,508 square feet). Residual radiological contamination (enriched uranium) from the operation of the manufacturing facility remains within the equipment and systems within the process area.

3.4.2 Long-Term Stewardship Activities

The facility is located within the fenced boundaries of the F Area at SRS. The facility has been reclassified as a Radiological facility based upon a recent Hazards Assessment. A Radiological facility requires continued surveillance and maintenance appropriate to existing hazards and facility condition. Current Site plans include

the retention of F Area and Site boundaries and appropriate access controls. All relevant environmental monitoring programs are assumed to continue.



247-F Naval Fuel Manufacturing Facility

The containment of residual contamination is based upon the integrity of the structure, gloveboxes and other engineered containment. Spread of residual contamination is controlled through the ability to maintain control of water, animal and/or human intrusion. A periodic surveillance and maintenance program is instituted to monitor any degradation of the building structure and or conditions and ensure no impact upon worker, public or environmental safety. No other engineering controls are currently planned for this facility.

Long-term stewardship for this facility began in 1997 and, because no final decision has been made about decommissioning the facility, is anticipated to continue indefinitely (for purposes of this report, costs are estimated through 2070).

3.4.3 Estimated Long-Term Stewardship Costs for the 247-F Naval Fuel Manufacturing Facility

The table below provides the estimated long-term stewardship costs for the 247-F Naval Fuel Manufacturing Facility, starting in FY2000 and continuing through FY2070. Cost estimates are based on a low-cost surveillance and maintenance program. Due to the potential for long-term structural degradation, there may be additional costs not currently included in the estimate.

247-F Naval Fuel Manufacturing Facility Long-Term Stewardship Costs (Constant Year 2000 Dollars)							
FY 2000 - FY 2010	***FY 2011 - FY 2020***	***FY 2021 - FY 2030***	***FY 2031 – FY 2040***	***FY 2041 - FY 2050***	***FY 2051- FY2060***	***FY 2061 - FY 2070***	***Estimated Total***
$2,242,000	$1,465,000	$2,386,000	$3,886,000	$6,331,000	$10,312,000	$16,797,000	$43,419,000

3.5 M Area - Fuel/Target Fabrication Facilities

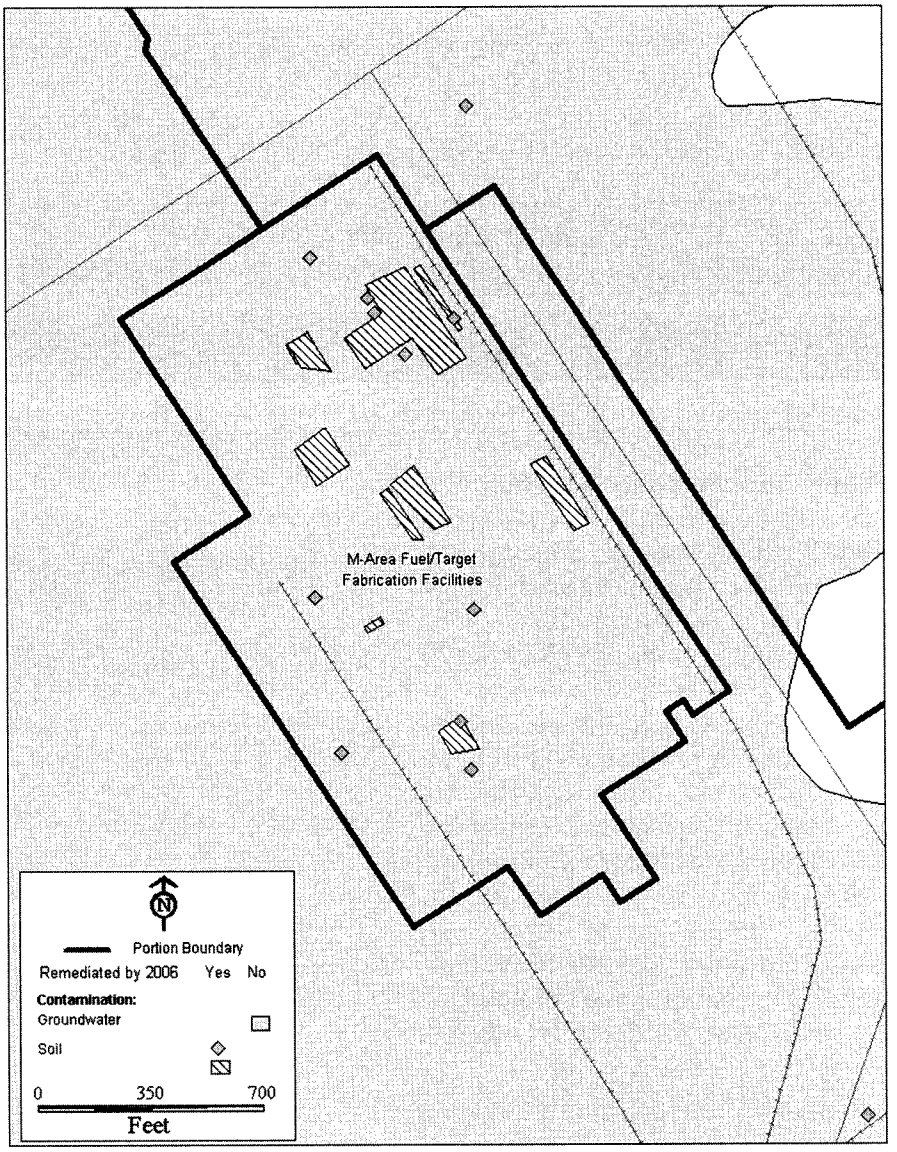
The M Area is located in the northeast portion of SRS, close to the Site border. The fenced area contains the Fuel/Target Manufacturing facilities. These facilities were designed for machine fabrication of special fuel assemblies that contained targets used in the production of special nuclear materials and were also used as safe storage for the assemblies prior to use in the reactor areas. These facilities were used to stabilize existing stockpiles by consolidating (melting) fabricated assemblies into ingots, which have since been stored in another facility until the Oak Ridge Reservation can receive them. No longer required to support a Site mission, the facilities were systematically shut down during the 1990s and are currently being deactivated. There are currently no final decisions as to the final end state of these facilities, and there are no near-term plans to decommission the buildings.

M AREA FUEL/TARGET MANUFACTURING FACILITIES PORTION HIGHLIGHTS

Major Long-Term Stewardship Activities - access restrictions; long-term surveillance and maintenance
Portion Size - 39,151 square meters (421,270 square feet)
Estimated Volume of Residual Contaminants - to be determined
Long-Term Stewardship Start-End Years - 1997-indefinitely
Average Annual Long-Term Stewardship Costs FY2000-2006 - N/A

3.5.1 Facilities

The manufacturing building and ancillary structures are made up primarily of steel frame and comprise an area of 39,151 square meters (421,270 square feet). The several buildings are contaminated with residual uranium and other hazardous material contaminants. The hazard classification of these facilities includes Industrial, Contaminated, and Nuclear, based upon a recent Hazards Assessment. Upon deactivation, these hazard classifications may significantly change. Although there is residual contamination from operation of the facilities, the volume of residual contamination will not be known until deactivation activities are completed, which will be prior to 2006. Once deactivation is completed, the facilities will remain in a long-term passive status until end-state decisions are made.



M Area Fuel/Target Fabrication Facilities

3.5.2 Long-Term Stewardship Activities

The Fuel/Target Fabrication facilities are located within the fenced boundaries of the M Area at SRS. Current Site plans include the retention of M-Area boundaries and appropriate access controls. The containment of residual contamination is based upon the integrity of the structures. Spread of residual contamination is controlled through the ability to maintain control of water, animal, and/or human intrusion. Continuation of periodic surveillance and maintenance will be required to monitor any degradation of the existing building structures and/or conditions and ensure no impact upon workers, the public, and the environment. No other engineering controls are currently planned for these facilities. The surveillance and maintenance program is assumed to begin in 2007 and continue indefinitely (for purposes of this report, costs are estimated through 2070).

3.5.3 Estimated Long-Term Stewardship Costs for the M-Area Fuel/Target Fabrication Facilities

The table below provides the estimated long-term stewardship costs for the M-Area Fuel/Target Fabrication facilities, starting in FY 2007 and continuing through FY 2070. Cost estimates for long-term stewardship are based on a low-cost surveillance and maintenance program. Due to the potential for long-term structural degradation, there may be additional costs not currently included in the estimate.

M-Area Fuel/Target Fabrication Facilities Long-Term Stewardship Costs (Constant Year 2000 Dollars)							
FY 2000 - FY 2010	***FY 2011 - FY 2020***	***FY 2021 - FY 2030***	***FY 2031 - FY 2040***	***FY 2041 - FY 2050***	***FY 2051 - FY 2060***	***FY 2061 - FY 2070***	***Estimated Total***
$2,685,00	$9,565,00	$15,580,00	$25,378,00	$41,339,00	$67,337,00	$109,684,00	$271,569,00

3.6 Upper Three Runs Watershed Portion

The Upper Three Runs watershed contains 818 contaminated hectares (2,023 contaminated acres) that will be in long-term stewardship by 2006. The watershed is in the northernmost area of SRS (about 22 kilometers long by 16 kilometers wide - or about 14 miles long by 10 miles wide) and encompasses several operational areas of SRS -- A/M, F, H, and part of E. This portion contains soil and groundwater contamination as a result of practices used to manage environmental restoration wastes, high-level waste, and facilities deactivation.

UPPER THREE RUNS WATERSHED PORTION HIGHLIGHTS

Major Long-Term Stewardship Activities - well monitoring; operation/maintenance of treatment facilities; maintenance of institutional and engineered controls; and compliance support
Portion Size - 818 hectares (2,023 acres)
Estimated Volume of Residual Contaminants - to be determined
Long-Term Stewardship Start-End Years - 1996-in perpetuity
Average Annual Long-Term Stewardship Costs FY2000-2006 - $10,856,714

The operational areas covered by this report and their respective units (environmental restoration waste, high-level waste, and facilities deactivation) are as follows:

A/M Areas

- SRL Seepage Basins, which contain low-level waste (cesium, strontium);
- A-Area Rubble Pile, which contains soil contaminated with low level PCBs, VOCs and lead;
- A-Area Burning/Rubble Pits, which contain soil contaminated with sanitary waste and groundwater contaminated with low levels of VOC; and
- M-Area Hazardous Waste Management Facility - Vadose Zone, which contains hazardous waste and has groundwater possibly contaminated with chlorinated VOCs

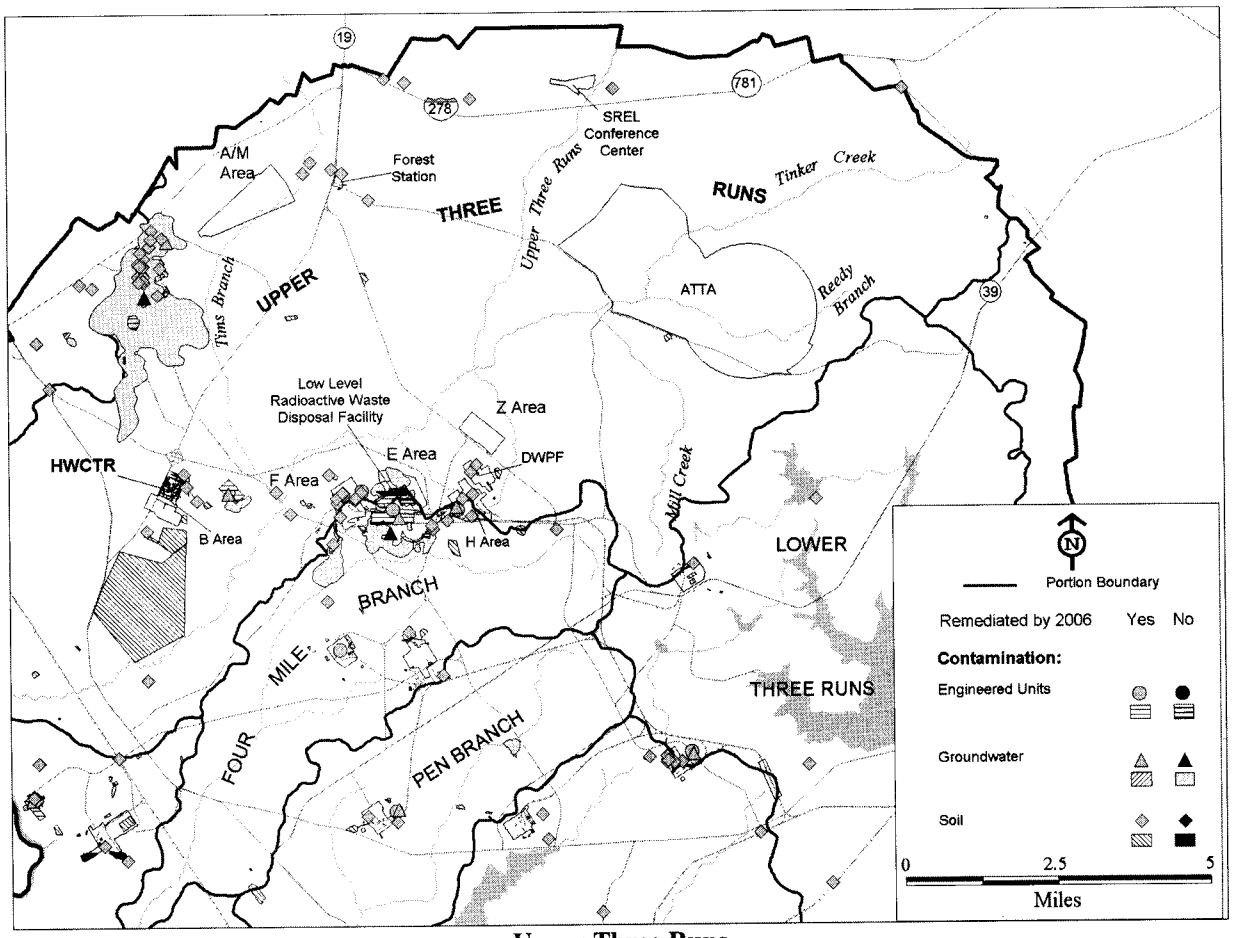
F/H Area

- F-Area Burning/Rubble Pits, which contain contaminated soils
- F-Area Retention Basin, which contains soil contaminated with low-level mixed waste
- Low-Level Radioactive Disposal Facility
- Old F-Area Seepage Basin, which contains soils contaminated with low-level mixed waste
- F&H-Area Hazardous Waste Management Facilities (Groundwater)

Units Not in a Specific Area

- Metallurgical Laboratory Groundwater, which is contaminated with chlorinated VOCs.
- Mixed Waste Management Facility, which contains low-level radioactive waste

Further details on these units are provided in the sections below as they relate to the remediation of the specific contaminated media -- soil, engineered units, and groundwater. A discussion of long-term stewardship for this portion follows the detailed media discussions.



Upper Three Runs

3.6.1 Soil

Soils in the Upper Three Runs are contaminated with VOCs, metals, radionuclides, and semi-volatile compounds. Following the final CERCLA Record of Decision for the Upper Three Runs, it is anticipated that residual VOCs, metals, and radionuclide contamination will exist in the soils in some areas. Some contaminated basins have been previously closed with waste remaining in place. Remedial actions on the source units (soils) will focus on excavation/removal of highly contaminated soils and barrier/containment type technologies that prevent exposure to contamination and that minimize and contain the spread of contamination. The final action for the F-Area Burning/Rubble Pits is institutional controls.

At this time, the volume of residual contamination for the soil cannot be estimated due to the fact that the area is still under investigation, and the extent of contamination is still being defined.

3.6.2 Engineered Units

The engineered units in the Upper Three Runs portion are contained in the F and H Areas. The F-Area Retention Basin contains low-level mixed waste. Proposed methods of remediation include chemical stabilization and grouting. The Old F-Area Seepage Basin is an unlined seepage basin that received low-level radioactive wastewater from F-Area chemical separations until 1969. Soils are contaminated with low-level mixed waste. Stabilization with grouting was completed, and a cover has been installed.

The Low-Level Radioactive Waste Disposal Facility (LLRWDF), a 48-hectare (119-acre) solid waste landfill for radioactively contaminated waste, contains buried contaminated job-control waste and process-equipment waste generated from SRS and offsite operations. The LLRWDF contains two main types of trenches:

- Slit trenches, which are earthen trenches, typically six meters deep by six meters wide (20 feet deep by 20 feet wide) and varying in length. They receive minimally containerized wastes.
- Engineering Low-Level Trenches (ELLTs), which are larger trenches that receive wastes packaged in metal boxes (called B-25 boxes), usually 1.2 meter by 1.2 meter (four feet by four feet). These boxes are stacked four high in a stair-step fashion.

REMEDIATION STRATEGY FOR THE UPPER THREE RUNS WATERSHED PORTION

- Stabilize and remediate sources of contaminants at the waste units.
- Optimize remediation of groundwater plume.
- Install remediation equipment or plan installation during next two years to approach plume control in A/M Areas.
- Drive down costs and remediation time using new technologies.
- Address major issues impacting final closure schedule for A/M Groundwater:
  - Effective technologies needed to locate all Dense Non-Aqueous Phase Liquid (DNAPL) pools for remediation.
  - Negotiation of alternate maximum concentration levels (MCLs) that take credit for natural attenuation
- Aggressively pursue new DNAPL characterization and remediation technologies to greatly reduce remediation time and costs.
- Use multidisciplinary team formed to research natural attenuation basin/benefits/status.

The LLRWDF has been receiving wastes since 1972. In 1990, a RCRA closure of the trenches used between 1972 and March 1986 was completed. This closure involved the covering of the 23 hectares (58 acres) of the facility with a 0.9-meter (three-foot) kaolin clay cap. Another planned closure will close the trenches suspected of receiving RCRA F-listed solvent contaminated rags between March 1986 and January 1990. 5.3 hectares (13 acres) of trenches are required to be closed, but the entire trench closure will be about 9.7 hectares (24 acres) due to the close proximity of trenches used after January 1990. The closure plan has been approved by SCDHEC and stipulates that this closure use a composite cap consisting of a geosynthetic clay liner and a flexible membrane liner.

3.6.3 Groundwater

Contaminated groundwater in the Upper Three Runs portion is located in the A/M Areas, F and H Areas, and in the other smaller general areas. The contaminant is primarily VOCs. Dense non-aqueous phase liquids (DNAPLs) are also present and pose a significant challenge for remediation. DNAPLs are concentrated areas of organic solvent contamination in the vadose zone or in low places in the groundwater aquifer. Technology development efforts have been focused on identifying better ways to find and remediate regions of DNAPL

contamination. Currently, much of the VOC plume is undergoing some remediation. It is anticipated that residual VOCs will remain in the groundwater. Proposed remedial actions include in situ remediation techniques (air sparging, vapor extraction, bioremediation, etc.) and monitored natural attenuation.

At this time, the volume of residual contamination for the groundwater cannot be estimated. This is because the area is still under investigation and the extent of contamination is still being defined. Cleanup goals for groundwater will be set at maximum concentration levels (MCLs). MCLs are the ultimate cleanup goal as set forth by state policy. Cleanup of the groundwater will be achieved through monitored natural attenuation.

3.6.4 Long-Term Stewardship Activities

The A and M Areas are located in the Site's Industrial Support Zone, adjacent to the Restricted Public Use Zone. The E, F, and H Areas are located in the Industrial Zone. Subject to specific site development restrictions, the Industrial Support Zone will allow waste management activities, and the Industrial Zone will allow both waste management and industrial uses. The SRS boundary will restrict public access. Institutional controls will be used to prevent residential use, excavation of buried/stabilized wastes, and inappropriate use of the groundwater.

At this time, the volume of residual contamination for the groundwater and soil cannot be estimated. This is because the area is still under investigation. The extent of contamination is still being defined. Target cleanup levels for groundwater will be set at MCLs. However, groundwater will be allowed to reach MCL levels through monitored natural attenuation. Due to the proximity to the populated Site boundary, some areas may be considered for residential cleanup levels.

DOE anticipates that DOE/EM remediation activities and long-term surveillance and maintenance activities (for the operational phase) of the Upper Three Runs portion will be completed by 2042. Periodic monitoring and institutional controls will be implemented and deed restrictions will be required in the event that the property is transferred to other ownership.

3.6.5 Estimated Long-Term Stewardship Costs for the Upper Three Runs Watershed Portion

The table below provides the estimated cost for the operating phase of long-term stewardship for the Upper Three Runs portion for areas completed by the end of FY 2006. The cost estimate includes costs for well monitoring, operation and maintenance of treatment facilities, and maintenance of institutional and engineered controls, along with compliance support.

The confidence level for the cost estimate is high based on conditions and agreements within the latest approved Federal Facility Agreement and applicable permits, agreements, consent orders, laws, and regulations. However, DOE acknowledges that milestones could change based on future negotiations with regulators as new work scope is identified.

Upper Three Runs Watershed Portion Long-Term Stewardship Costs (Constant Year 2000 Dollars)							
FY 2000 - FY 2010	***FY 2011 - FY 2020***	***FY 2021 – FY 2030***	***FY 2031 – FY 2040***	***FY 2041 - FY 2050***	***FY 2051 - FY 2060***	***FY 2061 – FY 2070***	***Estimated Total***
$89,764,000	$16,042,000	$3,462,000	$0	$0	$0	$0	$109,268,000

3.7 Lower Three Runs Watershed Portion

The Lower Three Runs watershed contains 44 contaminated hectares (110 contaminated acres) that will be in long-term stewardship by 2006. The watershed is in the southeastern area of SRS (about 9.6 kilometers long by 16 kilometers wide - or about six miles long by ten miles wide) and encompasses several operational areas of the Site -- the P and R Areas. Release sites at the reactor areas were used for the disposal of radioactive and chemical wastes. Contamination in this portion consists of low-level radioactive waste, hazardous waste, and toxic metals as the result of practices used to dispose of chemical and radioactive wastes.

LOWER THREE RUNS WATERSHED PORTION HIGHLIGHTS

Major Long-Term Stewardship Activities - well monitoring; operation/maintenance of treatment facilities; maintenance of institutional and engineered controls; and compliance support
Portion Size - 44 hectares (110 acres)
Estimated Volume of Residual Contaminants - to be determined
Long-Term Stewardship Start-End Years - 1997-in perpetuity
Average Annual Long-Term Stewardship Costs FY2000-2006 - $439,857

The specific waste units covered by this section of the report are as follows:

P Area

- P-Area Bingham Pump Outage Pits, which contain low-level radioactive waste

R Area

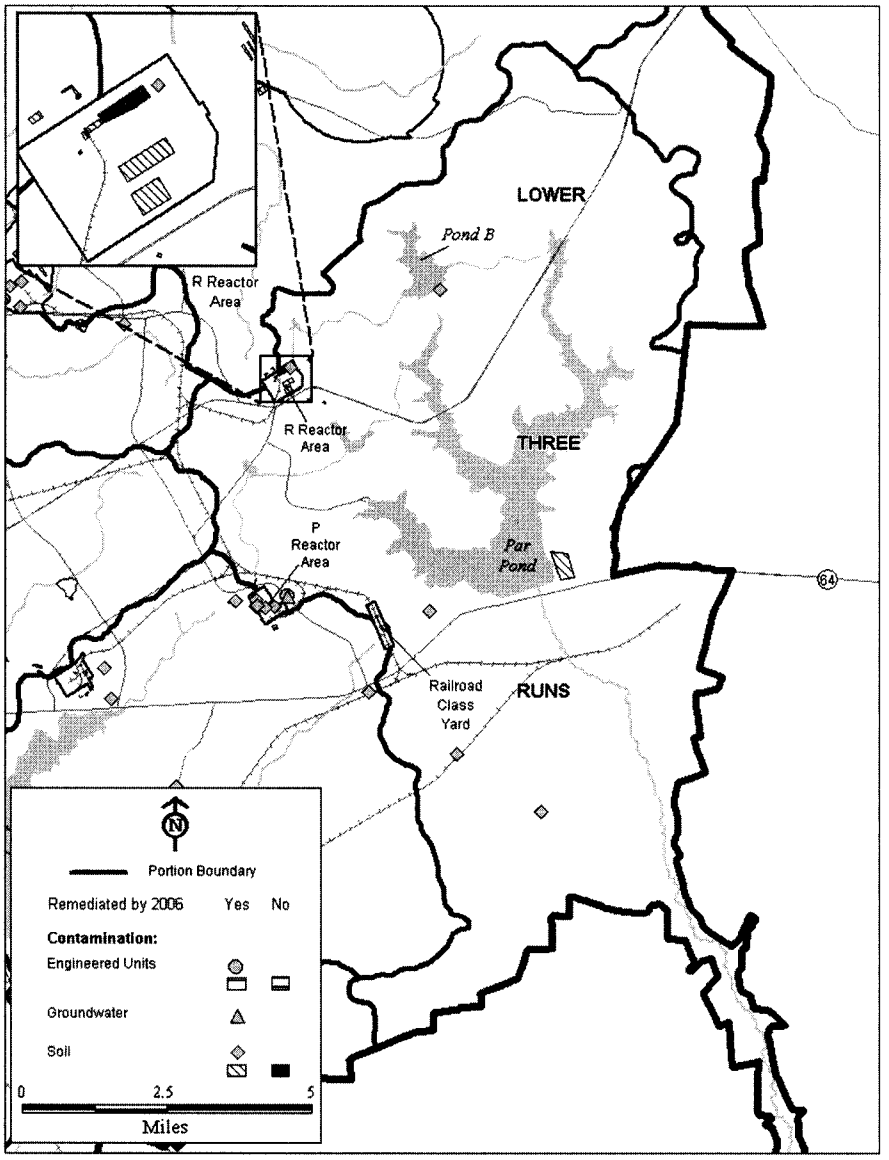
- R-Area Acid/Caustic Basin, which contains toxic metals
- R-Area Burning/Rubble Pit and Rubble Pit, which contains hazardous waste
- R-Area Reactor Seepage Basins

A more detailed discussion of the contamination, by soil and by engineered units, is provided in the sub-sections below. A discussion of long-term stewardship for the Lower Three Runs portion follows.

3.7.1 Soil

Soils in the Lower Three Runs are contaminated with VOCs, metals, tritium, other radionuclides and unknowns. At this time, the volume of residual contamination for soil cannot be estimated. This is because the area is still under investigation and the extent of contamination is still being defined. Cleanup goals for the soils will be set at levels protective of industrial workers and researchers and will be protective of the groundwater to the maximum extent practicable.

Following the final CERCLA Record of Decision for the Lower Three Runs, it is anticipated that residual VOCs, metals, and radionuclide contamination will exist in the soils in some areas. The Lower Three Runs includes radioactive seepage basins, such as the R-Area Reactor Seepage Basins, that received radionuclide materials. These types of waste units will be closed in situ without removing the contamination. Remedial actions on the source units (soils) will focus on barrier/containment type technologies that prevent exposure to contamination and minimize/contain the spread of contamination. In situ soil vapor extraction and air sparging may be used to remove VOC contaminants from the vadose zone. More detail on specific units is provided below.



Lower Three Runs

The R-Area Burning/Rubble Pit, which contains hazardous waste, was closed in 1981. The proposed onsite treatment for the contaminated soils in the R-Area Burning/Rubble Pit is thermal disorption.

The Par Pond Sludge Lagoon received sludge from the Central Shops (N-Area) Sludge Lagoon. The sediment in Par Pond is contaminated with radionuclides and metals. At this time, no active remedial actions are anticipated for the sediments.

For the R-Area Acid/Caustic Basin, capping in place is the proposed remediation. For the P-Bingham Pump Outage, the proposed remediation method is access/institutional controls only.

3.7.2 Engineered Units

The P-Area Bingham Pump Outage Pits contain a series of unlined earthen pits located outside the fences of reactor areas K (one pit), L (two pits), P (one pit), and R (three pits). These pits received low-level radioactive construction debris generated during the 1957 and 1958 repairs to the primary and secondary cooling water systems (known as the "Bingham Pump Outages") in the reactor areas. All pits were backfilled and do not contain pumps. The contaminants of concern are radionuclides and metals. As part of the "Approved Standardized Corrective Action Design" (ASCAD) approach being applied to the Bingham Pump Outage Pits, DOE has determined that the Bingham Pump Outage Pits in the K, L, and P areas are "no action" sites, and institutional controls will be put in place. The R-Area Bingham Pump Outage Pits have been dropped from the ASCAD group due to low level VOC concentrations found in the groundwater and are proceeding on a separate regulatory path and schedule. The R-Area Acid/Caustic Basin is still being assessed (assessment forecasted for completion in 2003).

3.7.3 Long-Term Stewardship Activities

The Lower Three Runs watershed is located within the Site's Industrial and Industrial Support Zones. As appropriate for the specific zone, anticipated end states may allow for nuclear, heavy and light industry, industry support, and research and development. Institutional controls will be implemented to prevent residential use and excavation of buried/stabilized wastes and inappropriate use of the groundwater.

DOE anticipates that DOE/EM remediation activities and long-term surveillance and maintenance activities (for the operational phase) for remediated release sites of the Lower Three Runs portion will be completed by 2038. Periodic monitoring and institutional controls will be implemented and deed restrictions will be required in the event that the property is transferred to other ownership.

3.7.4 Estimated Long-Term Stewardship Costs for Lower Three Runs Watershed Portion

The table below provides the estimated cost for the operating phase of long-term stewardship for the Lower Three Runs portion for areas completed by the end of FY 2006. The cost estimate includes costs for well monitoring, operation and maintenance of treatment facilities, and maintenance of institutional and engineered controls, along with compliance support.

Lower Three Runs Watershed Portion Long-Term Stewardship Costs (Constant Year 2000 Dollars)							
FY 2000 - FY 2010	*FY 2011 – FY 2020*	*FY 2021 - FY 2030*	*FY 2031 - FY 2040*	*FY 2041 - FY 2050*	*FY 2051 - FY 2060*	*FY 2061 - FY 2070*	*Estimated Total*
$7,193,000	$5,918,000	$85,000	$0	$0	$0	$0	$13,196,000

The confidence level for the cost estimate is high based on conditions and agreements within the latest approved Federal Facility Agreement and applicable permits, agreements, consent orders, laws, and regulations. However, DOE acknowledges that milestones could change based on future negotiations with regulators as new work scope is identified.

3.8 Steel Creek Watershed Portion

The Steel Creek watershed contains four contaminated hectares (10 contaminated acres) that will be in long-term stewardship by 2006. The watershed is on the southern boundary SRS (about 9.6 kilometers long by 10

kilometers wide - or about 6 miles long by 6.5 miles wide) and encompasses two operational areas of SRS -- the L and P Areas -- and the L Lake. This portion contains soil and groundwater contamination as a result of practices used to dispose of wastewater and hazardous and radioactive wastes.

STEEL CREEK WATERSHED PORTION HIGHLIGHTS

Major Long-Term Stewardship Activities - well monitoring; operation/maintenance of treatment facilities; maintenance of institutional and engineered controls; and compliance support
Portion Size - 4 hectares (10 acres)
Estimated Volume of Residual Contaminants - to be determined
Long-Term Stewardship Start-End Years - 1996-in perpetuity
Average Annual Long-Term Stewardship Costs FY2005-2006 - $152,000 (no costs identified for FY2000-2004; earlier costs incurred prior to 2000)

The specific waste units covered by this report are as follows:

L Area

- L-Area Oil and Chemical Basin, which has soils containing low-level mixed waste
- L-Area Hot Shop, which has soils containing low-level radioactive and potentially mixed waste
- L-Area Reactor Seepage Basin, which has soils containing low-level radioactive waste

P Area

- P-Reactor Seepage Basin, which has soils containing low-level radioactive waste
- P-Area Burning/Rubble Pit, which has soils containing hazardous waste

A more detailed discussion of the contamination, by soil and by engineered units, is provided in the sub-sections below. A discussion of long-term stewardship for the Steel Creek portion follows.

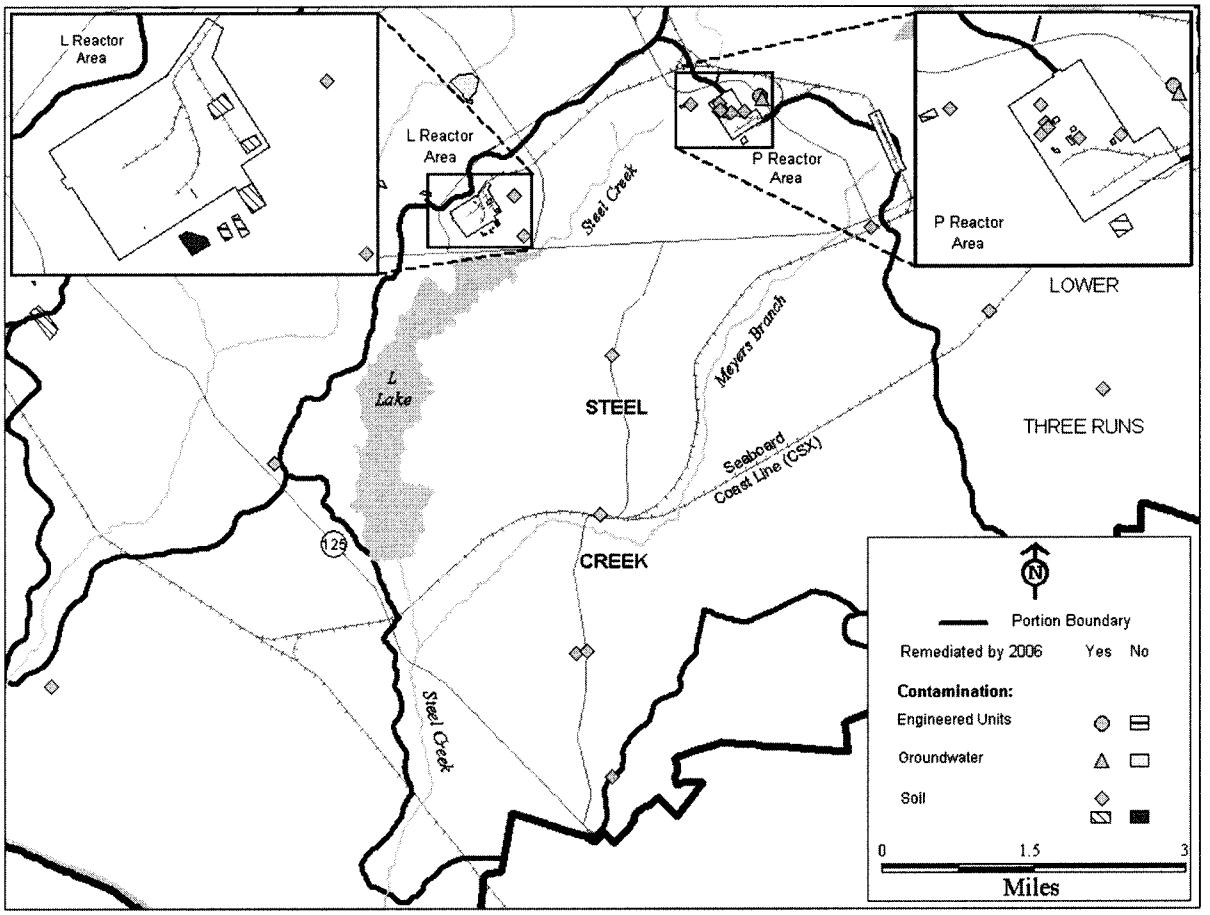
3.8.1 Soil

Soils in the Steel Creek are contaminated with VOCs, metals, tritium, and other radionuclides. Following a final decision for the Steel Creek, it is anticipated that residual VOC, metals, and radionuclide contamination will exist in the soils in some areas. The Steel Creek includes radioactive seepage basins that received organic and radionuclide materials. These types of waste units will be closed in situ without removing the contamination. Remedial actions will focus on barrier/containment type technologies that prevent exposure to contamination and that minimize and contain the spread of contamination. In situ soil vapor extraction and air sparging may be used to remove VOC contaminants from the vadose zone.

REMEDIATION STRATEGY FOR THE LOWER THREE RUNS AND STEEL CREEK WATERSHED PORTIONS

- Pursue Plug-In Record of Decisions for high-risk reactor seepage basins.
- Assess and remediate the area groundwater as an integral operable unit.
- Develop a technology position on tritiated groundwater.
- Assess and remediate surface operable units independent of their groundwater component when a groundwater plume is co-mingled with other plumes.
- Drive down costs and remediation funds using new technologies.

The L-Area Hot Shop consisted of three inter-connected buildings and one storage area, which were used in the maintenance and repair of equipment from the reactor areas. They were last used in 1983, and maintenance work has been minimal. The Hot Shop discharged decontamination wastewater, containing radionuclides, detergents, and spent degreasing solvents, through a pipeline to the L-Area Oil and Chemical Basin pipeline. The soil, rubble, and debris at the L-Area Hot Shop is contaminated with low-level radioactive and potentially mixed waste. The remediation method has not yet been determined.



Steel Creek

In all of the above cases, the volume of residual contamination in the soil cannot be estimated. This is because the area is still under investigation, and the extent of contamination is still being defined.

3.8.2 Engineered Units

The L-Area Oil and Chemical Basin also has soil and pipes contaminated with radionuclides and spent degreasing solvents from operation of the L-Area Hot Shop. Solidification/stabilization is the remediation method.

The P-Area Burning/Rubble Pit was used for the disposal of organic chemicals of unknown use and origin, waste oils, and other wastes. Soils were contaminated with these hazardous wastes from the burning/rubble pits. The proposed remediation method will involve thermal desorption.

3.8.3 Long-Term Stewardship Activities

The L and P Areas are located in the Site's Industrial Zone. Allowed uses in this zone include waste management activities. Institutional controls will be implemented where waste is left in place.

All activities in the Steel Creek watershed are restricted to the uses identified for the Industrial Zone. Anticipated end states may include nuclear, heavy and light industry, industry support, and research and development. Institutional controls will be implemented to prevent residential use and excavation of buried/stabilized wastes and inappropriate use of the groundwater. At this time, the volume of residual contamination for soils and groundwater cannot be estimated. Cleanup goals for the soils will be set at levels protective of industrial workers and researchers and will be protective of the groundwater to the maximum extent practicable. Cleanup goals for groundwater will be set at MCLs. However, groundwater will be allowed to reach MCL levels through monitored natural attenuation.

DOE anticipates that DOE/EM remediation activities and long-term surveillance and maintenance activities (for the operational phase) for remediated release sites of the Steel Creek portion will be completed by 2034. Periodic monitoring and institutional controls will be implemented and deed restrictions will be required in the event that the property is transferred to other ownership.

3.8.4 Estimated Long-Term Stewardship Costs for the Steel Creek Watershed Portion

The table below provides the estimated cost for the operating phase of long-term stewardship for the Steel Creek portion for areas completed by the end of FY 2006. The cost estimate includes costs for well monitoring, operation and maintenance of treatment facilities, and maintenance of institutional and engineered controls, along with compliance support.

Steel Creek Watershed Portion Long-Term Stewardship Costs (Constant Year 2000 Dollars)							
FY 2000 - FY 2010	***FY 2011 - FY 2020***	***FY 2021 - FY 2030***	***FY 2031 – FY 2040***	***FY 2041 - FY 2050***	***FY 2051 - FY 2060***	***FY 2061 - FY 2070***	***Estimated Total***
$834,000	$0	$0	$0	$0	$0	$0	$834,000

The confidence level for the cost estimate is high based on conditions and agreements within the latest approved Federal Facility Agreement and applicable permits, agreements, consent orders, laws, and regulations. However, DOE acknowledges that milestones could change based on future negotiations with regulators as new work scope is identified.

3.9 Pen Branch Watershed Portion

The Pen Branch watershed contains 28 hectares (69 contaminated acres) that will be in long-term stewardship by 2006. The watershed is in the central area of SRS (about 12 kilometers long and 4 kilometers wide - or 7.5 miles long and 2.5 miles wide) and encompasses the L and K Areas. This portion contains soil and groundwater contamination as a result of practices used to dispose of chemicals, metals, pesticides, organic chemicals, and contaminated wastewater. Facilities in this portion are currently being reused for the following activities: moderator storage, highly enriched uranium, and K-Material Storage Project (plutonium).

PEN BRANCH WATERSHED PORTION HIGHLIGHTS

Major Long-Term Stewardship Activities - well monitoring; operation/maintenance of treatment facilities; maintenance of institutional and engineered controls; and compliance support
Portion Size - 28 hectares (69 acres)
Estimated Volume of Residual Contaminants - to be determined
Long-Term Stewardship Start-End Years - 2001-in perpetuity
Average Annual Long-Term Stewardship Costs FY2001-2006 - $340,166

The specific waste units covered by this report are as follows:

L Area

- L-Area Burning/Rubble Pit, Rubble Pile, and Gas Cylinder Disposal Facility, which contains soils contained with hazardous materials
- Chemicals, Metals, and Pesticides Pits, which contain soils contaminated with hazardous materials

K Area

- K-Reactor Seepage Basin (forecast for assessment in 2000), which contains low-level radioactive waste
- K-Area Burning/Rubble Pit and Rubble Pile, which contains soil contaminated with hazardous waste
- Ford Building Seepage Basins, which contain low-level radioactive waste
- Bingham Pump Outage Pits, which contain buried debris contaminated with low-level radioactive waste

A more detailed discussion of the contamination, by soil, groundwater, and engineered units, is provided in the sub-sections below, followed by a discussion on long-term stewardship for this portion.

3.9.1 Soil

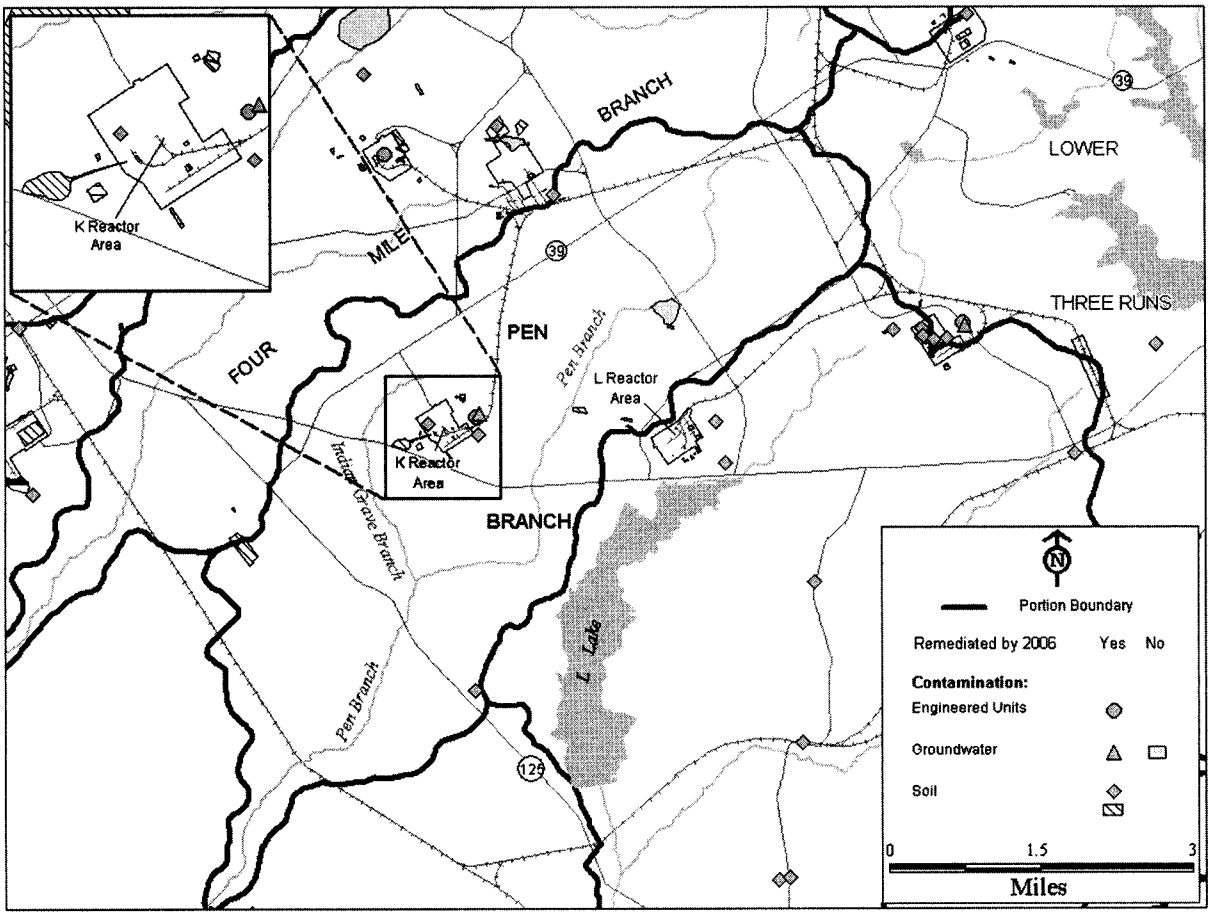
Soils in the Pen Branch are contaminated with VOCs, metals, tritium, other radionuclides, and unknowns. (Characterization of the area is ongoing - all contamination has not been identified.) Following the final decision for the Pen Branch, it is anticipated that residual VOC, metals, and radionuclide contamination will exist in the soils in some areas. The Pen Branch includes radioactive seepage basins, such as the K-Area Reactor Seepage Basin, that received radionuclide materials. These types of waste units will be closed in situ without removing the contamination. Remedial actions will focus on barrier/containment type technologies that prevent exposure to contamination and that minimize and contain the spread of contamination. In situ soil vapor extraction and air sparging may be used to remove VOC contaminants from the vadose zone.

STRATEGY FOR CONTINUED REMEDIATION SUCCESS IN THE PEN BRANCH PORTION

- Pursue Plug-In-Record of Decisions for high-risk seepage basin sites.
- Assess and remediate the groundwater as an integral operable unit.
- Develop a technology position on tritiated groundwater.
- Assess and remediate surface operable units independent of their groundwater component when a groundwater plume is co-mingled with other plumes.
- Drive down costs and remediation funds using new technologies.
- Pursue removal/treatment of PCBs and pesticides at the Chemical, Metals, and Pesticides units.
- Pursue lead and battery removal at the L-Area units.
- Pursue institutional controls at K and L-Area units.
- Pursue removal of soil piles at L-Area units and monitored natural attenuation of groundwater.
- Pursue soil cover at K-Area units and mixing zone/monitored natural attenuation.

The L-Area Burning/Rubble Pit is located about ¼ mile northwest of L Area off Road 7. Burning/Rubble Pits at SRS typically received spent organic solvents, waste oils, paper, plastics, rubber and metals, which were periodically burned. In October 1973, burning of waste was halted, but the pits continued to receive inert rubble until about 1978. They also received a large quantity of zinc-mercury and lead-acid batteries. When the Pit reached its capacity, it was backfilled with soil. The pit location is situated on fairly level terrain near the crest of the same hill occupied by L Area. Local surface drainage is toward the north to an unnamed tributary of Pen Branch.

The Chemicals, Metals, and Pesticides Pits also have soil contamination. A CERCLA investigation is underway to determine the extent of contamination to soils and groundwater. A more detailed discussion of these units is provided below.



Pen Branch

3.9.2 Groundwater

The groundwater in the Pen Branch watershed is contaminated with VOCs, tritium and potentially other contaminants (investigation not complete). Following a final decision for the groundwater, it is anticipated that residual VOCs, inorganics, and tritium will remain in the groundwater. Proposed remedial actions (to reach MCLs) include in situ remediation for VOCs and monitored natural attenuation for VOCs and tritium. The groundwater treatment strategy for this watershed, with the exception of tritium contamination, is a combination of in situ and ex situ treatment. Tritium contamination in these areas is anticipated to be remediated through natural attenuation.

The Chemicals, Metals, and Pesticides Pits were used for the disposal of wastes from 1971 to 1979. They are located about 5,200 feet north of the L-Area perimeter fence and 5,500 feet from the L-Area Burning/Rubble Pit and Rubble Pile. These units consist of seven unlined pits placed into two rows, which formerly occupied the top of a knoll about 310 feet above mean sea level. The units were 10 to 15 feet in width and between 45 and

70 feet in length. Limited records exist concerning the hazardous substances disposed at the units, but VOCs, pesticides, and metals are known to have been disposed there. In 1984, the pits were excavated, backfilled and capped, and a series of groundwater monitoring wells were installed. Thirty active monitoring wells are present in the vicinity of the units for the purpose of monitoring releases of hazardous substances from the units. Groundwater monitoring data indicate the presence of VOCs and metals in the groundwater at various wells. A soil gas survey was performed in the vicinity of the pits in 1991. Characterization of the area indicated that the soils and groundwater beneath the units contain VOCs, and surface soils adjacent to the units contain PCBs and pesticides. Remediation of the units is underway, with the installation of a system for air sparging and soil vapor extraction to treat the VOCs in the vadose zone and groundwater.

3.9.3 Engineered Units

The Ford Building Seepage Basins soils contain low-level waste. In situ remediation (capping in place) is proposed for this area.

3.9.4 Long-Term Stewardship Activities

All activities in the Pen Branch watershed are restricted to uses identified for the Site's Industrial Zone. Anticipated end states may include nuclear, heavy and light industry, industry support, and research and development. Institutional controls will be implemented to prevent residential use and excavation of buried/stabilized wastes and inappropriate use of the groundwater. At this time, the volume of residual contamination for the groundwater and soil cannot be estimated. This is because the area is still under investigation. The extent of contamination is still being defined. Cleanup goals for the soils will be set at levels protective of industrial workers and researchers and will be protective of the groundwater to the maximum extent practicable. Cleanup goals for groundwater will be set at MCLs. However, groundwater will be allowed to reach MCL levels through monitored natural attenuation.

DOE anticipates that DOE/EM remediation activities and long-term surveillance and maintenance activities (for the operational phase) for remediated release sites of the Pen Branch portion will be completed by 2032. Periodic monitoring and institutional controls will be implemented and deed restrictions will be required in the event that the property is transferred to other ownership.

3.9.5 Estimated Long-Term Stewardship Costs for the Pen Branch Watershed Portion

The table below provides the estimated cost for the operating phase of long-term stewardship for the Pen Branch portion for areas completed by the end of FY 2006. The cost estimate includes costs for well monitoring, operation and maintenance of treatment facilities, and maintenance of institutional and engineered controls, along with compliance support.

Pen Branch Watershed Portion Long-Term Stewardship Costs (Constant Year 2000 Dollars)							
FY 2000 - FY 2010	***FY 2011 - FY 2020***	***FY 2021 - FY 2030***	***FY 2031 - FY 2040***	***FY 2041 - FY 2050***	***FY 2051 - FY 2060***	***FY 2061 - FY 2070***	***Estimated Total***
3,309,000	$635,000	$300,000	$0	$0	$0	$0	$4,244,000

The confidence level for the cost estimate is high based on conditions and agreements within the latest approved Federal Facility Agreement and applicable requirements. However, DOE acknowledges that milestones could change based on future negotiations with regulators as new work scope is identified.

3.10 Four Mile Branch Watershed Portion

The Four Mile Branch watershed contains 204 contaminated hectares (504 contaminated acres) that will be in long-term stewardship by 2006. The watershed is in the northern central area of SRS (about 12.8 kilometers long by 6.5 kilometers long, or eight miles long by four miles wide) and encompasses several operational areas of the Site -- the C, and N Areas and parts of the F and H Areas. This portion contains soil and groundwater contamination as a result of practices used to dispose of hazardous and radioactive wastes. Contaminants include VOCs, metals, inorganic compounds, and radionuclides.

FOUR MILE BRANCH WATERSHED PORTION HIGHLIGHTS

Major Long-Term Stewardship Activities - well monitoring; operation/maintenance of treatment facilities; maintenance of institutional and engineered controls; and compliance support
Portion Size - 204 hectares (504 acres)
Estimated Volume of Residual Contaminants - to be determined
Long-Term Stewardship Start-End Years - 1996-in perpetuity
Average Annual Long-Term Stewardship Costs FY2001-2006 - $14,198,857

The specific waste units covered by this report are as follows:

C Area
- Coal Pile Runoff Basins, which contain contaminated soils
- C-Area Burning/Rubble Pits, which contain soils and groundwater contaminated with hazardous waste
- C-Area Reactor Seepage Basins, which are contaminated with low-level radioactive waste

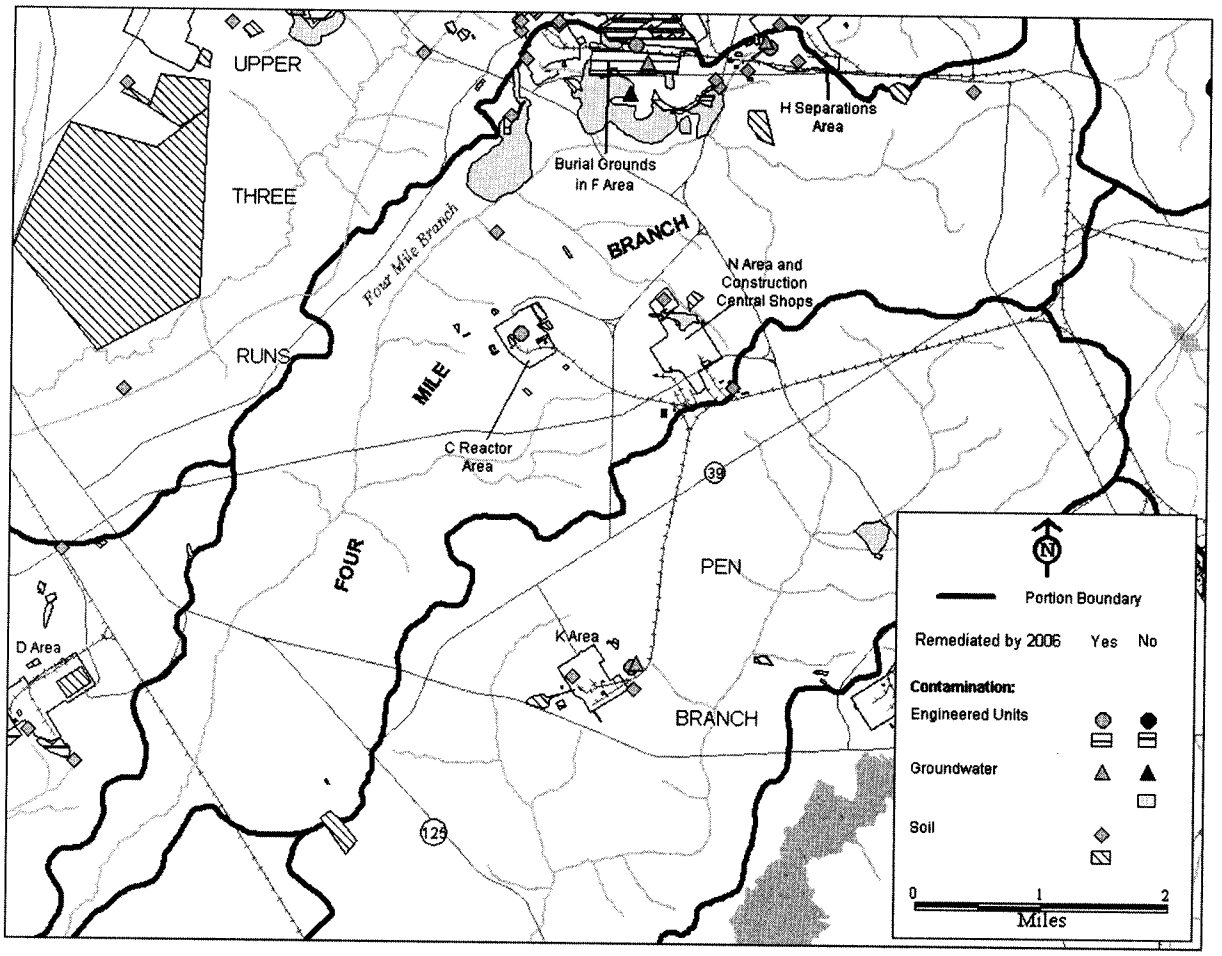
F and H Areas
- F- and H-Area Inactive Process Sewer Lines, which are contaminated with low-level radioactive waste
- H-Area Retention Basin, which contains low-level mixed waste
- Burial Ground Complex (Old Radioactive Waste Burial Ground and Low-Level Radioactive Waste Disposal Facility)
- N Area
- Soils at Central Shops Burning/Rubble Pits, which contain contaminated soils
- Soils at Central Shops Sludge Lagoon, which contains hazardous waste

A more detailed discussion of the contamination, by engineered units, soil, and groundwater, is provided below, followed by a discussion of long-term stewardship activities for this portion.

3.10.1 Engineered Units

The Burial Ground Complex is divided into a southern area and a northern area. The southern area comprises the Old Radioactive Waste Burial Ground (ORWBG). The ORWBG was the first part of the Burial Ground Complex to receive waste and was filled to capacity. Covered with a low-permeability interim cap, the engineered native soil cover reduces water infiltration by 70%. Studies will determine if this interim action proves sufficient as a final action. The northern area comprises the Low-Level Radioactive Waste Disposal Facility (LLRWDF). This area of the complex received low-level waste, which was disposed of in engineered vaults. The 58-acre Mixed Waste Management Facility (MWMF), which comprises three separate areas, closed in 1991 in accordance with RCRA regulations (i.e., covered with a conventional clay cap). However, the remaining 25 acres of the LLRWDF have been remediated using geosynthetic-capping materials.

The F- and H-Area Inactive Process Sewer Line contains contaminated soils and piping to the F- and H-Area Basin. Possible remediation includes soils mixing, grouting, and capping in place. The H-Area Retention Basin has retention basin soil with approximately 50,000 gallons of water in the basin. Chemical stabilization is the



Four Mile Branch

proposed remediation method. The remediation method has not yet been determined for the Central Shops Burning/Rubble Pits engineered unit.

3.10.2 Soil

Soils in the Four Mile Branch are contaminated with VOCs, metals, inorganic compounds, and radionuclides. Following the final decision for the Four Mile Branch, it is anticipated that residual VOC, metals, inorganic compounds and radionuclide contamination will exist in the soils. The Four Mile Branch includes the radioactive and mixed waste burial grounds and seepage basins that received inorganic, organic and radionuclide materials. Some of these source units have already been closed under RCRA and CERCLA, with waste left in place. In some cases, substantial amounts of contamination will remain in place (DOE will not dig up the burial grounds).

Remedial actions on the source units will focus on barrier/containment type technologies that prevent exposure to contamination and that minimize and contain the spread of contamination.

Possible remediation methods for the soils at the C-Area Coal Pile Runoff Basins and Burning/Rubble Pits include bioremediation/air sparging and thermal desorption. No remediation method has been chosen yet for the soils at the Central Shops Lagoon. Institutional controls will also be implemented.

3.10.3 Groundwater

The groundwater in the Four Mile Branch is contaminated with VOCs, inorganic compounds, tritium, and other radionuclides. Following the decision for the groundwater, it is anticipated that residual VOCs, inorganic compounds, and tritium will remain in the groundwater. Proposed tritium remediation includes hydraulic control and phytoremediation. Proposed remedial actions for the VOCs include in situ hot spot remediation and monitored natural attenuation (to achieve MCLs).

Possible remediation methods for the C-Area Burning/Rubble Pits groundwater [which is contaminated with trichloroethylene (TCE) and tetrachloroethylene (PCE)] include thermal desorption.

3.10.4 Long-Term Stewardship Activities

The portions discussed in this watershed are located in the Site's Industrial and Industrial Support Zones. The Burial Ground Complex has been used as disposal sites for hazardous and radioactive wastes. As such, areas have been identified that could be developed for future waste management or industrial use (to support future missions involving mixed oxide fuel and production and purification of tritium). Periodic monitoring and institutional controls will be implemented and deed restrictions will be required in the event that the property is transferred to other ownership.

At this time, the volume of residual contamination for soils and groundwater cannot be estimated. This is because the area is still under investigation, and the extent of contamination is still being defined. Cleanup goals for the soils will be set at levels protective of industrial workers and researchers and will be protective of the groundwater to the maximum extent practicable. Cleanup goals for groundwater will be set at MCLs. However, groundwater will be allowed to reach MCL levels through monitored natural attenuation. Institutional controls will prevent unacceptable uses of the groundwater.

DOE anticipates that DOE/EM remediation and long-term surveillance and maintenance activities (for the operational phase) for remediated release sites of the Four Mile Branch portion will be completed by 2036. Periodic monitoring and institutional controls will be implemented and deed restrictions will be required in the event that the property is transferred to other ownership.

3.10.5 Estimated Long-Term Stewardship Costs for the Four Mile Branch Watershed Portion

The table below provides the estimated cost for the operating phase of long-term stewardship for the Four Mile Branch portion for areas completed by the end of FY 2006. The cost estimate includes costs for well monitoring, operation and maintenance of treatment facilities, and maintenance of institutional and engineered controls, along with compliance support.

Four Mile Branch Portion Long-Term Stewardship Costs (Constant Year 2000 Dollars)							
FY 2000 - FY 2010	***FY 2011 - FY 2020***	***FY 2021 - FY 2030***	***FY 2031 – FY 2040***	***FY 2041 – FY 2050***	***FY 2051 - FY 2060***	***FY 2061 - FY 2070***	***Estimated Total***
$113,474,000	$2,393,000	$1,582,000	$695,000	$0	$0	$0	$118,144,000

The confidence level for the cost estimate is high based on conditions and agreements within the latest approved Federal Facility Agreement and applicable requirements. However, DOE acknowledges that milestones could change based on future negotiations with regulators as new work scope is identified.

3.11 Savannah River and Floodplain Swamp Watershed Portion

The Savannah River and Floodplain Swamp watershed contains 50 contaminated hectares (123 contaminated acres) that will be in long-term stewardship by 2006. The watershed is on the western boundary of SRS, about 31 kilometers (19 miles) long and eight kilometers (five miles) wide, and encompasses two major operational areas of the Site (the TNX and D Areas), as well as a few small waste sites on the fringe of M Area in the Upper Three Runs watershed and throughout the portion. The TNX Area, M Area, and parts of the D Area were used for the disposal of debris, oil, and chemicals (in seepage basins, buried rubble pits, a burial ground, and an ash basin). The TNX Area was also used to conduct nuclear pilot plant research projects. These activities resulted in soil and groundwater contamination by metals, VOCs, and radionuclides.

SAVANNAH RIVER AND FLOODPLAIN SWAMP WATERSHED PORTION HIGHLIGHTS

Major Long-Term Stewardship Activities - well monitoring; operation/maintenance of treatment facilities; maintenance of institutional and engineered controls; and compliance support
Portion Size - 50 hectares (123 acres)
Estimated Volume of Residual Contaminants - to be determined
Long-Term Stewardship Start-End Years - 1997-in perpetuity
Average Annual Long-Term Stewardship Costs FY2000-2003 - $454,250 (no portion-specific costs allocated for 2004-2006)

The specific waste units covered by this report are as follows:

TNX Area

- TNX Outfall Delta, Lower Discharge Gully, which contains low-level radioactive waste
- TNX Operable Unit (including the following operable units: TNX Groundwater, New TNX Seepage Basin, Old TNX Seepage Basin, and TNX Burying Ground), which is still being characterized

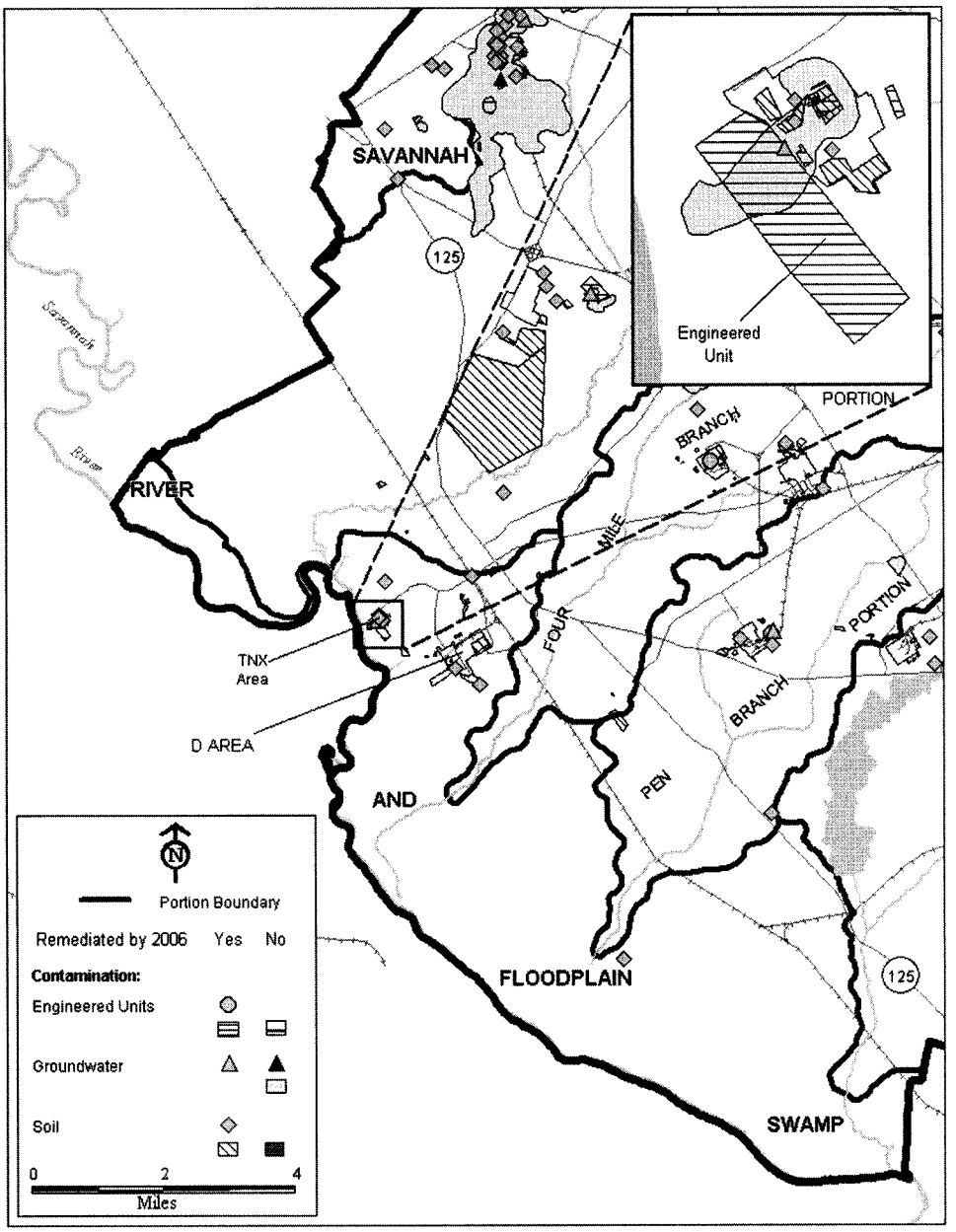
D Area

- D-Area Expanded Operable Unit, which includes the D-Area Powerhouse (containing ash and runoff from the coal pile) and D-Area Waste Oil Facility, which has groundwater contaminated with TCE, tritium and low-pH heavy metals
- D-Area Burning/Rubble Pits, which consist of sanitary (non-hazardous/non-radioactive) buried rubble and debris

A more detailed discussion of the contamination, by soil, groundwater, and engineered units, is provided below, followed by a discussion of long-term stewardship activities for this portion.

3.11.1 Soil

Soils in the Savannah River and Floodplain Swamp are contaminated with VOCs, metals, and radionuclides. Following the final decision for the Savannah River and Floodplain Swamp, it is anticipated that residual VOCs, metals, and radionuclide contamination will exist. The levels of contamination remaining will meet human health and environmental remedial goals for an industrial area. Proposed remedial actions for the soils in the Savannah



Savannah River and Floodplain Swamp

River and Floodplain Swamp portion include: leave waste in place and install a cover; excavate soils and place cover system over residual waste; stabilization of soils; and institutional controls.

The D-Area Burning/Rubble Pits operated from 1951 to 1973. During this time, spent organic solvents, waste oils, paper, plastics, wood, telephone poles, and rubber were disposed and periodically burned (typically monthly). In 1973, burning of the waste was discontinued, and a layer of soil was placed over the pit debris. The pits were then filled to capacity with rubble only. Allowable rubble waste included concrete, bricks, tile, all burning/rubble, asphalt, plastics, wallboard, rubber, and non-returnable empty drums. When the pits were filled to capacity, a layer of soil was placed over the pit, and all burning/rubble pits were closed in 1981. The two pits

are 60-plus meters (200-plus feet) long, 11-15 meters (35-50 feet) wide, and 3 meters (10 feet) deep. Iron, lead, and manganese have exceeded EPA maximum concentration levels at least once in the groundwater monitoring wells. Low concentrations of arsenic, barium, chromium, copper, lead, mercury, nickel, and selenium were detected in soil samples from the pits. Low-to-moderate concentrations of semi-volatile organic compounds (components of waste oil, pesticides/herbicides, and wood preservatives) and very low levels of radionuclide indicators have also been detected). The quantities of contaminants are unknown at this time.

The D-Area Waste Oil Facility, which is part of the D-Area Expanded Operable Unit, contains contaminated soil beneath the facility that will be remediated by soil vapor extraction.

3.11.2 Groundwater

The groundwater under the Savannah River and Floodplain Swamp is contaminated with volatile organic compounds and tritium. Following the final decision for the groundwater, it is anticipated that residual VOCs and tritium will remain in the groundwater. Tritium will eventually decay to below MCLs. Proposed remedial actions for the VOCs include: soil vapor extraction and air sparging, Geosiphon, permeable barriers, and monitored natural attenuation. Proposed remedial actions for tritium include monitored natural attenuation.

The VOC contamination plume at TNX outcrops 201 meters (660 feet) from the river, and the groundwater contaminants include VOCs, nitrates, and uranium and daughter products. Currently, there are no offsite risks from the groundwater contamination. The interim remedial action includes an Air Stripper, with four collection wells that begin remediation at the leading edge of the plume. Since startup, 132 million liters (35 million gallons) of groundwater have been remediated. In addition to aggressive air stripping technology, an innovative passive technology called Geosiphon has also been deployed at TNX. Contaminated water is drawn through an underground cell containing iron filings. As the TCE-contaminated groundwater is flushed from the Geosiphon cell to the surface, the TCE is remediated. The Geosiphon cell utilizes a gravity feed design to discharge the clean water toward the Savannah River without mechanical pumping.

Characterization of the D-Area Expanded Operable Unit began in 1998 and has identified extensive groundwater contamination and large volumes of source material. Groundwater in the lower D Area is contaminated with TCE, tritium, and heavy metals. The presence of heavy metals is primarily due to low pH coal leachate. The commingled plume is about 202 hectares (500) acres. The TCE portion of this plume is about 121 hectares (300 acres), while the tritium plume is about 36 hectares (90 acres), and the heavy metal (low pH) plume is about 81 hectares (200 acres). The estimated volume of contaminated groundwater is over 5.7 billion liters (1.5 billion gallons) and extends as close as 150 meters (500 feet) from the Savannah River. Since this project is in the early stages of investigation, no definitive remediation strategy has been approved. Characterization and evaluation of data will be completed in 2002, with a risk evaluation and remedial options to be completed in 2003.

STRATEGY FOR CONTINUED REMEDIATION SUCCESS IN THE FLOOD PLAIN SWAMP PORTION

- Asphalt-cover Hg sources at the Old TNX Seepage Basin.
- Reduce VOC sources in the vadose zone using Soil Vapor Extraction to levels that will not impact groundwater.
- Maintain existing Interim Action (pump and treat system) to prevent continued migration of high concentration VOC plume into Swamp.
- Use monitored natural attenuation strategy to allow low concentrations of VOCs in the distal groundwater plumes to attenuate.
- Pursue excavation/phytostabilization of the Ash Basin
- Pursue excavation/neutralization of the coal pile runoff basin.
- Pursue possible phytoremediation alternatives for additional source areas

The D-Area Powerhouse (part of the D-Area Expanded Operable Unit) is currently operating and generating ash and runoff from the coal pile into the coal pile runoff basin. A remediation strategy is excavation/ phytostabilization.

3.11.3 Engineered Units

The Old TNX Seepage Basin unit, the New TNX Seepage Basin unit, and TNX Burying Ground are included in the TNX Operable Unit. During its operation, the Old TNX Seepage Basin would periodically overflow, and the liquids would flow down the hill to the west and discharge into the Savannah River floodplain. This periodic overflowing, and the breaching of the western wall of the basin in 1981, resulted in the creation of a deep incised gully (the Lower Discharge Gully) and the TNX Outfall Delta in the TNX swamp. The swamp is heavily wooded lowland, located between the TNX facility and the Savannah River. Additional characterization of the TNX Outfall Delta is required. This additional data will provide a better understanding of the nature and extent of contamination at the TNX Outfall Delta unit.

The TNX Outfall Delta, Lower Discharge Gully, is a seepage overflow basin that consists of low-level radioactive waste. A commercial vendor is being used to collect and dispose of this waste. The Old TNX Seepage Basin, which is included in the TNX Operable Unit, contains both low-level mixed waste and low-level radioactive soils and sediments. The New TNX Seepage Basin, which is also part of the TNX Operable Unit, received process wastes. Chemical stabilization, soil mixing, and grouting are proposed remediation methods.

3.11.4 Long-Term Stewardship Activities

The Savannah River and Floodplain Swamp watershed has an anticipated end state that is limited to activities specified in the Site's Industrial Support Zone. These activities include industry support activities and research and development. Institutional controls will be implemented to prevent residential use and excavation of buried/stabilized wastes and inappropriate use of the groundwater. At this time, the volume of residual contamination for the groundwater and soil cannot be estimated. This is because the area is currently undergoing remedial investigation. Once the remedial investigation has been completed and final remedial goals have been established, a volume estimate can be calculated.

Cleanup goals for the soils will be set at levels protective of industrial workers and researchers and will be protective of the groundwater to the maximum extent practicable. Cleanup goals for groundwater will be set at MCLs. However, groundwater will be allowed to reach MCL levels through monitored natural attenuation. Institutional controls will prevent unacceptable uses of the groundwater

DOE anticipates that DOE/EM remediation activities and long-term surveillance and maintenance activities (for the operational phase) for remediated release sites of the Savannah River and Floodplain Swamp portion will be completed by 2047. Periodic monitoring and institutional controls will be implemented and deed restrictions will be required in the event that the property is transferred to other ownership.

3.11.5 Estimated Long-Term Stewardship Costs for the Savannah River and Floodplain Swamp Watershed Portion

The table below provides the estimated cost for the operating phase of long-term stewardship for the Savannah River and Floodplain Swamp portion for areas completed by the end of FY 2006. The cost estimate includes costs for well monitoring, operation and maintenance of treatment facilities, and maintenance of institutional and engineered controls, along with compliance support.

Savannah River and Floodplain Swamp Watershed Portion Long-Term Stewardship Costs (Constant Year 2000 Dollars)							
FY 2000 - FY 2010	***FY 2011 - FY 2020***	***FY 2021 - FY 2030***	***FY 2031 – FY 2040***	***FY 2041 - FY 2050***	***FY 2051 - FY 2060***	***FY 2061 - FY 2070***	***Estimated Total***
$2,069,000	$465,000	$431,000	$0	$0	$0	$0	$2,965,000

The confidence level for the cost estimate is high based on conditions and agreements within the latest approved Federal Facility Agreement and applicable permits, agreements, consent orders, laws, and regulations. However, DOE acknowledges that milestones could change based on future negotiations with regulators as new work scope is identified.

4.0 FUTURE USES

According to the March 1998 Future Use Plan, SRS will remain under federal government ownership under its current boundaries in perpetuity. DOE will be the SRS landlord until 2028, after which Site landlord responsibilities is expected to be transferred to another federal government entity. The future uses of SRS are not expected to change significantly from their current uses. The SRS Future Use Plan anticipates that the SRS will operate as a controlled access facility under its current boundaries and will require institutional controls in perpetuity. All areas with institutional controls will require federal oversight until the property is transferred with appropriate deed restrictions.

SRS is divided into three principal land use planning zones, as depicted in the table below. The most intensive future industrial and waste management uses of SRS will occur in the Site's Industrial Zone, close to the center of the Site, with less intensive research and development, technology development, and other uses in the Site's Industrial Support Zone, and limited controlled access for recreational activities in the General Support Use Zone. Residential land use will not be allowed in any of the SRS land use zones at any time in the future. Site infrastructure, security, and other institutional controls will be maintained in all zones in perpetuity.

SRS Land Use Planning Zones		
Site Industrial Zone	***Site Industrial Support Zone***	***Site General Support Use Zone***
Located close to Site's center to minimize effect on surrounding communities	Accommodates uses of decreasing intensity from Site Industrial Zone	More open and accessible than the other two Site zones
Surrounded by safety and security buffer; controlled site access	Administrative areas serve as buffer and transitional zones between intensely developed and less developed areas; controlled site access	Zone still required as part of safety and security buffer; some uses may include temporary and restricted access by public
Most intensive (highest impact) uses occur in this zone	Activities have much less impact than those in Site Industrial Zone	Includes ecological research and natural resource management activities

SRS Land Use Planning Zones		
Site Industrial Zone	***Site Industrial Support Zone***	***Site General Support Use Zone***
Primary activities grouped according to following uses: - Heavy Industrial Non-Nuclear - Heavy Industrial Nuclear - Light Industrial - Waste Operations	Primary allowable activities grouped according to following uses: - Administrative (office parks, laboratories) - Research and Technology Dev. - Resource Extraction - Storage and Warehousing - Natural Resources Management	Other primary allowable uses include: - Controlled Recreation - Public Education

For additional information about the Savannah River Site, please contact:

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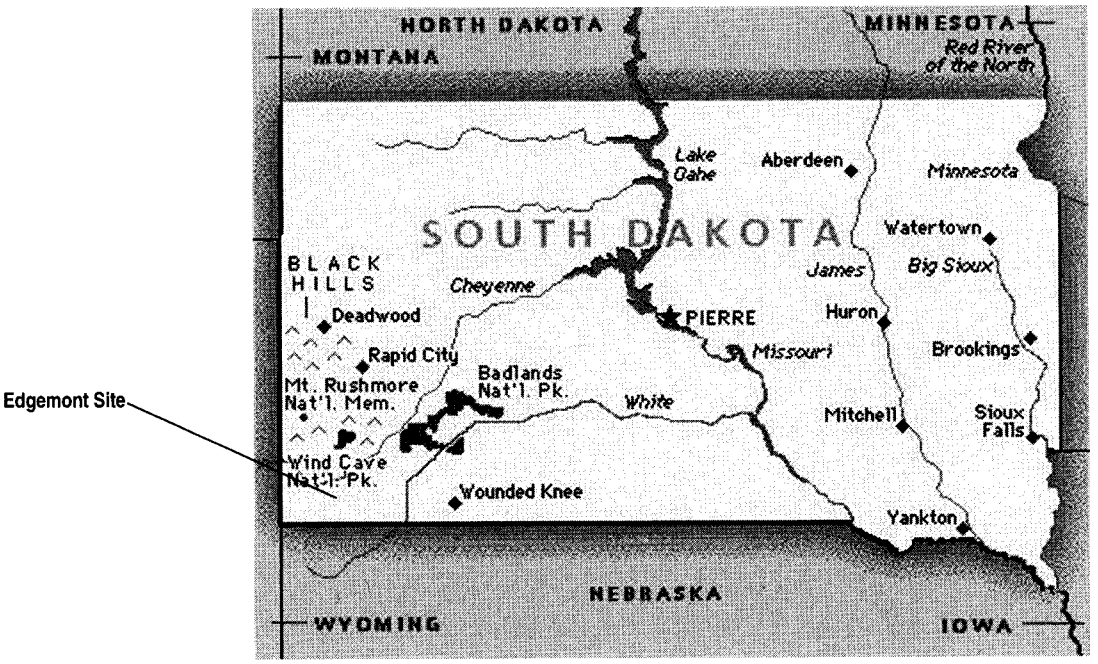
Email: terry.vought@srs.gov
or visit the Savannah River Site Internet website at http://www.srs.gov

South Dakota



Long-Term Stewardship Site Highlights

Edgemont Site (page 3)

Major Activities - disposal cell monitoring; access restrictions; inspections; maintenance
Site Size -145 hectares (360 acres)
Start/End Years - 1996/in perpetuity
Estimated Average Annual Cost FY 2000-2006 - $7,800

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Edgemont Site 3

EDGEMONT SITE

1.0 SITE SUMMARY

1.1 Site Description and Mission

The Edgemont Site (also known as Edgemont Vicinity Properties) is the location of a disposal cell built by the Tennessee Valley Authority (TVA) to encapsulate uranium mill tailings and other contaminated materials from the former Edgemont Mill, located 3.2 kilometers (two miles) away. The 145-hectare (360-acre) site is located in the southwest corner of the State of South Dakota, approximately five kilometers (three miles) south of the town of Edgemont. The site's disposal cell occupies 40 hectares (100 acres) of the site.

LONG-TERM STEWARDSHIP HIGHLIGHTS

Major Long-Term Stewardship Activities - disposal cell monitoring; access restrictions; inspections; maintenance
Total Site Area -145 hectares (360 acres)
Estimated Volume of Residual Contaminants - engineered unit 2.3 million cubic meters (3.0 million cubic yards)
Long-Term Stewardship Start-End Years - 1996-in perpetuity
Average Annual Long-Term Stewardship Cost FY 2000-2006 - $7,800
Landlord - U.S. Department of Energy, Grand Junction Office

Uranium ore processing operations at the nearby former mill created uranium mill tailings and other process-related wastes. TVA built the disposal cell at the Edgemont Site as part of the Edgemont Mill's remediation strategy. TVA encapsulated the tailings and other contaminated wastes from the former Edgemont Mill materials in the cell in 1989.

The current mission for the site is the long-term monitoring and maintenance of the disposal cell. The disposal site is subject to Title II of the *Uranium Mill Tailings Radiation Control Act of 1978* (UMTRCA). As such, the DOE Grand Junction Office is responsible for long-term stewardship activities at the site. DOE began long-term stewardship activities in 1996.

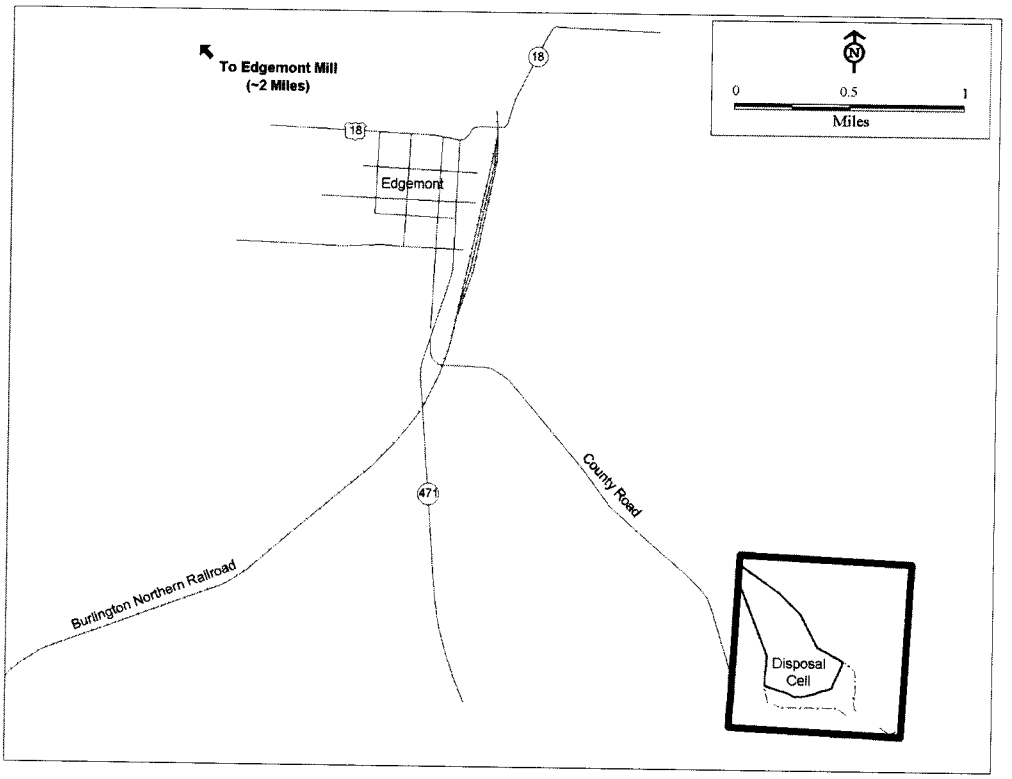
The Edgemont Site had no historic mission, other than to be the final repository for the contaminated mill tailings and soils remediated from the former Edgemont Mill. The historic mission of the Edgemont Mill was to process and provide uranium to support the U.S. Government national defense program. Mines Development, Inc. built the Edgemont Mill in 1956 to process uranium ore and operated it until 1974. Almost all the ore processed at the Edgemont Mill was mined in the Black Hills area of southwestern South Dakota and northeastern Wyoming. TVA acquired the mill facility in 1974, but decided against processing uranium ore at the mill based on engineering, economic, and environmental studies. Therefore, TVA never operated the mill.

1.2 Site Cleanup and Accomplishments

In 1986, the U.S. Nuclear Regulatory Commission (NRC) approved the reclamation alternative to relocate the tailings to an engineered disposal site located 3.2 kilometers (two miles) from the former Edgemont Mill. Decommissioning activities began at the mill site in 1986, and reclamation was completed by 1989. Remediation of the Edgemont Mill consisted of demolishing site structures, excavating onsite contamination, and relocating mill tailings and contaminated structural materials into the Edgemont Site disposal cell. Concurrently, contaminated materials from vicinity properties in and around the town of Edgemont were removed and disposed of in the Edgemont Site's disposal cell. The disposal cell contains 4,000,000 tons of contaminated material, with an estimated total activity of 527 curies of radium-226.

The base of the disposal cell lies on shale of the Belle Fourche Formation, which has a thickness of 56.4 meters (185 feet) immediately off the site. Underlying the Belle Fourche Formation are more than 91 meters (300 feet)

of generally impermeable strata that isolate the uppermost confined aquifer from the surface. Consequently, no groundwater remediation or monitoring is needed at this site.



Edgemont Site

TVA conducted all remediation at the site under its NRC license. Once reclamation was complete, the site was eligible for transfer to DOE for custody and long-term care. To enable the site's transfer to DOE, TVA provided a one-time payment to the U.S. Treasury to cover monitoring and maintenance costs. The Edgemont Site was transferred to DOE in June 1996 for long-term stewardship activities.

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

The DOE Grand Junction Office is responsible for performing long-term stewardship activities of the Edgemont Site. Access to the site is controlled by a locked stock fence around the perimeter of the site. DOE permits limited grazing on the land to maintain the health of the vegetation. Signs and markers notify potential intruders of the final site conditions. A metal sign displaying the international trefoil symbol for radioactive materials is placed at the site entrance and replaced as necessary. DOE performs sign and fence repairs on an as-needed basis. No drilling or other intrusive activities are allowed within the property boundary.

Site records are in permanent storage at the DOE Grand Junction Office in Colorado. The types of records maintained include site characterization data, remedial action design information, the site completion report, long-term monitoring plans, annual inspection reports, and current and historic monitoring data. DOE develops

and updates records and reports required in the site long-term surveillance plan. These reports are submitted annually to the NRC to summarize, describe, and evaluate all surveillance and maintenance actions, as required under Title 10 of the *Code of Federal Regulations,* Part 40.

2.2 Specific Long-Term Stewardship Activities

Engineered Units

The Edgemont Site disposal cell is approximately 426 meters (466 yards) wide and 944 meters (1,033 yards) long and occupies 40 hectares (100 acres) of the 145-hectare (360-acre) site. The cell contains approximately 2.3 million cubic meters (3.0 million cubic yards) of uranium mill tailings, soils, and construction debris contaminated with radium and thorium.

STAKEHOLDER INTERACTION

Community interaction has been minimal since the remedial action was completed. Copies of the annual inspection report for the Edgemont Disposal Site are distributed to the State of South Dakota and to any stakeholders requesting them. The report is also published on the DOE Grand Junction Office website at www.doe.gjpo.com.

The 2.7-meter (three-yard) thick cover over the tailings consists of a 0.91-meter (one-yard) thick compacted clay radon barrier, a 1.52-meter (1.7-yard) thick compacted fill frost protection layer, and a 0.3-meter (0.3-yard) thick layer of topsoil material. The Edgemont Site disposal cell was designed and constructed to last for 200 to 1,000 years, in accordance with EPA standards. The cell design promotes rapid runoff of precipitation to minimize leachate. The site location and design were selected to minimize the potential for erosion from onsite runoff or storm water flow. All surrounding disturbed areas were regraded and reseeded to prevent wind and water erosion. An existing gully northwest of the cell and the containment dam face were armored with riprap for erosion protection. Additional riprap and grass-protected diversion ditches were installed to channel runoff water away from the disposal cell.

Long-term stewardship activities at the site include annual inspections of the disposal cell and maintenance, as needed. Grazing is allowed to enhance the success of the revegetation efforts.

Groundwater

Because of the more than 91 meters (300 feet) of generally impermeable strata that isolate the uppermost confined aquifer from the surface, no groundwater monitoring or remediation is needed.

2.3 Regulatory Regime

In 1996, the Edgemont Site came under a general license issued by NRC for custody and long-term care of residual radioactive disposal sites (contained at Title 10 of the *Code of Federal Regulations,* Section 40.28). The purpose of the general license is to ensure that such sites will be cared for in a manner that protects human health and safety and the environment. The general license went into effect when NRC agreed that the site conformed to cleanup standards and formally accepted the site-specific long-term surveillance plan.

Long-term stewardship activities at the Edgemont Site are governed by several requirements in the following acts: the *Uranium Mill Tailings Radiation Control Act of 1978*; the *Atomic Energy Act of 1954,* as amended, and the *National Environmental Policy Act of 1969,* as amended.

2.4 Assumptions and Uncertainties

Because DOE Grand Junction Office has been performing long-term stewardship activities at the site since 1996,

long-term stewardship activities are well known and are not expected to dramatically change.

The cap over the disposal site is not expected to be replaced for a minimum of 200 years. In addition, groundwater monitoring is not anticipated since there exists immediately off the site an impermeable strata which isolates the uppermost confined aquifer from the surface.

3.0 ESTIMATED LONG-TERM STEWARDSHIP COSTS

TVA made a one-time payment of $581,610 to the U.S. Treasury in June 1996, as required under UMTRCA, to cover the costs associated with long-term stewardship activities of the site.

The cost estimates, identified below, are based on the costs of ongoing long-term stewardship activities at the site. Contingency costs, such as cap replacement, have not been incorporated in the cost estimates.

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	***Amount***	***Year(s)***	***Amount***	***Year(s)***	***Amount***
FY 2000	$10,800	**FY 2008**	$7,000	**FY 2036-2040**	$34,100
FY 2001	$8,300	**FY 2009**	$7,000	**FY 2041-2045**	$34,100
FY 2002	$7,200	**FY 2010**	$6,900	**FY 2046-2050**	$34,100
FY 2003	$7,000	**FY 2011-2015**	$32,700	**FY 2051-2055**	$34,100
FY 2004	$7,100	**FY 2016-2020**	$31,800	**FY 2056-2060**	$34,100
FY 2005	$7,100	**FY 2021-2025**	$31,900	**FY 2061-2065**	$34,100
FY 2006	$7,000	**FY 2026-2030**	$33,700	**FY 2066-2070**	$34,100
FY 2007	$7,100	**FY 2031-2035**	$34,100		

4.0 FUTURE USES

The primary future use of the site will be the long-term surveillance and maintenance of the onsite disposal cell. DOE permits some limited grazing on the land to ensure the health of the vegetation.

For more information about the Edgemont Site, please contact:

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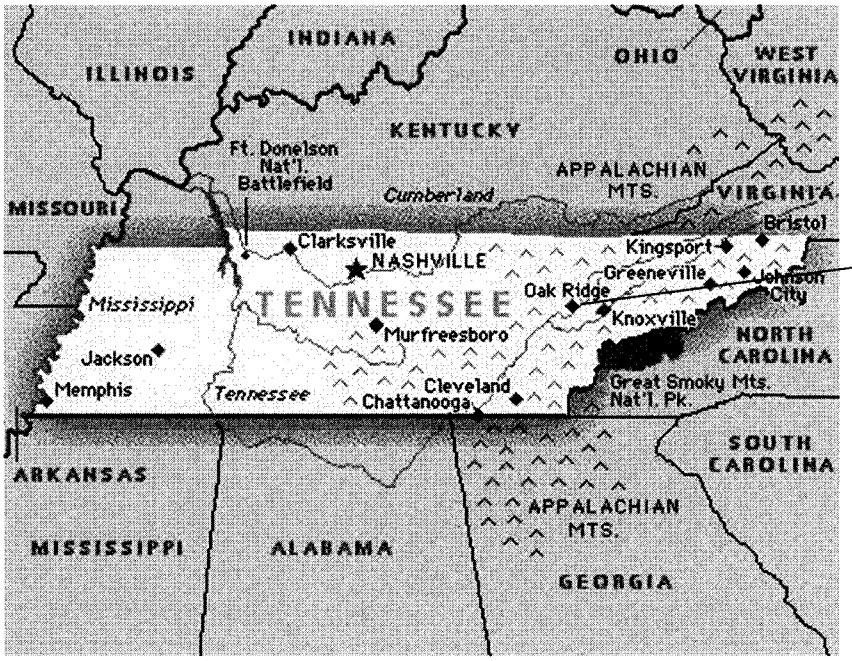
Tennessee



Oak Ridge Reservation

Long-Term Stewardship Site Highlights

Oak Ridge Reservation (page 3)

Major Activities - maintaining engineered barriers; monitoring ground and surface water; enforcing institutional controls

Site Size -14,000 hectares (35,000 acres)

Estimated Average Annual Cost FY 2000-2006 - $6,733,000

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Oak Ridge Reservation 3

OAK RIDGE RESERVATION

1.0 SITE SUMMARY

1.1 Site Description and Mission

The Oak Ridge Reservation (ORR), which occupies approximately 14,000 hectares (35,000 acres), is located almost entirely within the city limits of Oak Ridge in eastern Tennessee, approximately 40 kilometers (25 miles) west of Knoxville. The Reservation was established in the early 1940s by the Manhattan District of the U.S. Army Corps of Engineers. Soon after the war, the U.S. Atomic Energy Commission was formed to transfer the nuclear enterprise to civilian control. Some 20 years later, other energy programs were merged with the nuclear program to ultimately become the U.S. Department of Energy (DOE). The Reservation is composed of three primary areas: the Oak Ridge National Laboratory, the East Tennessee Technology Park, and the Y-12 Plant. Work performed in each area contributed to the Reservation's major role in the enrichment of uranium or the production of plutonium for the first nuclear weapons.

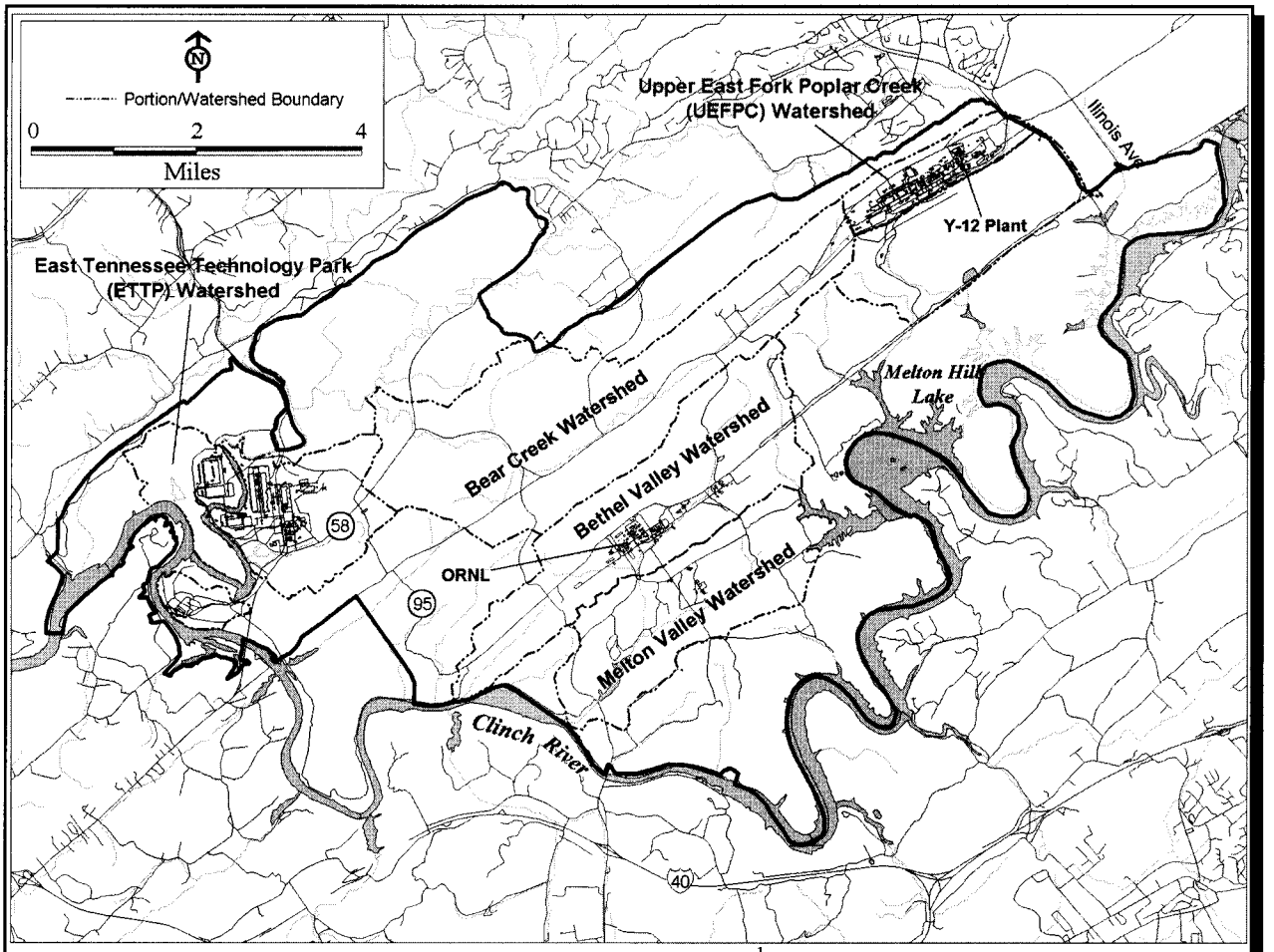
LONG-TERM STEWARDSHIP HIGHLIGHTS

Major Long-Term Stewardship Activities -maintaining engineered barriers; monitoring ground and surface water; enforcing institutional controls
Total Site Area - 14,000 hectares (35,000 acres)
**Estimated Volume of Residual Contaminants* - soil 1.1 million cubic meters (1.5 million cubic yards); groundwater unknown; surface water/sediments 166,300 cubic meters (217,500 cubic yards); engineered units 4.2 million cubic meters (5.5 million cubic yards); facilities 1,500 cubic meters (2,000 cubic yards)
Portions Requiring Long-Term Stewardship as of 2006 - 6
Average Annual Long-Term Stewardship Cost FY 2000-2006 - $6,733,000
Landlord - U.S. Department of Energy
*The estimated volume indicates only the known amounts of residual contaminants. For certain portions discussed for this site, exact volume is not known at this point. For specific discussions, please see Section 3.0.

- Oak Ridge National Laboratory occupies approximately 1,350 hectares (3,300 acres) within the Oak Ridge Reservation in Melton and Bethel Valleys. The Laboratory's original mission was to produce and chemically separate the first gram quantities of plutonium to support the production of the atomic bomb. Now, Oak Ridge National Laboratory is a multiprogram science, technology, and energy laboratory with distinctive capabilities in materials science and engineering, neutron science and technology, energy production and end-use technologies, mammalian genetics, and ecological research. In support of the missions of DOE, Oak Ridge National Laboratory conducts basic and applied research and development to create scientific knowledge and technological solutions that strengthen the nation's leadership in key areas of science; increase the availability of clean, abundant energy; restore and protect the environment; and contribute to national security.

- East Tennessee Technology Park (formerly called K-25) occupies 405 hectares (1,000 acres) within the Oak Ridge Reservation adjacent to the Clinch River. The K-25 facility was used to enrich uranium through the gaseous diffusion process. In 1987, the facility was shut down due to a decrease in demand for enriched uranium. The facility is now involved in reindustrialization, environmental restoration, and waste management activities.

- Y-12 Plant occupies approximately 300 hectares (800 acres) within the Bear Creek Valley. The original mission of the Y-12 Plant was uranium enrichment and nuclear weapons production. Currently, the Y-12 Plant is refocusing its technical capabilities and expertise to serve DOE and DOE-approved customers. The Y-12 Plant continues to serve as a key manufacturing technology center for the development and demonstration of unique materials, components, and services of importance to DOE and the nation.



Oak Ridge Reservation[1]

Specific focus areas for the Y-12 Plant in coming years include: (1) weapons dismantlement and storage;

(2) enriched uranium materials warehousing and management; (3) nuclear weapons process technology and development support; (4) Y-12 Plant management/landlord activities, including taking standby or shutdown facilities into a safe, legally compliant condition; (5) identifying and managing the decontamination and decommissioning of facilities; (6) providing unique capabilities and technologies not found in the private sector on DOE-approved tasks; (7) transferring technology developed at DOE facilities to enhance our industrial competitive edge in worldwide markets; and (8) maintaining and supporting the National Security Office for DOE.

The Reservation has approximately 400 hectares (1,100 acres) of unlined radioactive and mixed-waste burial grounds, inactive tanks, surplus facilities, and unlined ponds. As a result of past operations, approximately 1,500 hectares (4,000 acres) of land in parts of the three primary areas and in other areas of the Reservation have been or have the potential to be contaminated. Contamination is found in the soil, groundwater, surface water, and two major rivers, the Clinch River bordering the Oak Ridge Reservation and the Tennessee River further downstream. However, approximately 12,500 hectares (31,000 acres) of land on the Reservation are

[1] All maps shown for ORR reflect the current, as of year 2000, contamination at the site.

uncontaminated. DOE has begun remediation of the Reservation. The first phase of remediation involves stabilizing the plants in support of their existing missions and will not be completed until after 2010. Additional remediation may be needed as the missions change.

The current mission of the Oak Ridge Reservation is to continue research at the Oak Ridge National Laboratory, continue national defense related activities at the Y-12 Plant, and remediate the East Tennessee Technology Park to allow for reindustrialization. Concurrently, environmental remediation will continue, in addition to required long-term stewardship activities. The long-term stewardship activities consist of maintaining barriers to the spread of contamination (engineered barriers), monitoring ground and surface water, operation and maintenance of the wastewater treatment units, and enforcing institutional controls.

1.2 Site Cleanup and Accomplishments

Remediation at the Oak Ridge Reservation is based on five watersheds: Melton Valley and Bethel Valley at Oak Ridge National Laboratory, East Tennessee Technology Park, and Bear Creek and Upper East Fork Poplar Creek at the Y-12 Plant and is conducted in accordance with the *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA). All remedial decisions to leave waste in place are considered interim because the State of Tennessee is opposed to leaving waste in place in perpetuity without a set-aside long-term stewardship funding mechanism; however, DOE cannot commit to this funding mechanism. Remediation levels for the Oak Ridge Reservation are expected to support the following uses: approximately five percent restricted access, five percent controlled industrial (defined as industrial use on the surface), 15 percent unrestricted industrial (defined as industrial use to three meters (10 feet) in depth), and 75 percent unrestricted. In 2006, most of the remediation activities identified below will be partially completed; however, very few will be fully completed. The following remediation discussion represents current DOE assumptions since most of the Record of Decisions (RODs) have not yet been signed.

Oak Ridge National Laboratory

A CERCLA ROD for Melton Valley is nearing signature, rendering most of the Melton Valley discussion less likely to change than other portions in this document. Under this ROD the large burial grounds in Melton Valley will be hydraulically isolated through caps and upgradient and downgradient collection trenches for shallow groundwater. Some transuranic waste will be excavated and disposed at the Waste Isolation Pilot Project (WIPP). The liquid low-level waste seepage pits and trenches will be grouted or vitrified in situ and capped. The most contaminated areas of onsite sediment will be dredged and disposed at the Environmental Management Waste Management Facility (EMWMF), which will be constructed in Bear Creek Valley.

Signature of the CERCLA ROD for Bethel Valley is a year or two away; however, the proposed plan is currently undergoing public review. In the main plant area of Oak Ridge National Laboratory (Central Bethel

OAK RIDGE NATIONAL LABORATORY ACCOMPLISHMENTS

- Removed sludge and liquid (nearly 1,900 cubic meters (2,500 cubic yards)) from aging gunite low-level waste tanks
- Removed sludge and liquid from several low-level waste steel tanks and surface impoundments. Grouted steel tanks
- Demolished the Waste Evaporation Facility
- Collected contaminated shallow groundwater in several places, and established plans for future monitoring

BY 2006 OAK RIDGE NATIONAL LABORATORY WILL HAVE:

- Demolished approximately 36 buildings
- Filled pipelines and gunite tanks with grout
- Collected deep groundwater
- Capped several of the large burial grounds in Melton Valley
- Removed contaminated sediment from the Intermediate Holding Pond
- Completed decontamination and decommissioning of the molten salt reactor experiment

Valley), contaminated soil will most likely be excavated to a depth of 0.6 meters (two feet) and disposed of in the EMWMF. Contaminated sediments are assumed to also be excavated and disposed of in the EMWMF in Bear Creek Valley. Small disposal areas of solid low-level waste will most likely remain in place with clean soil or caps placed on top. Surface features of contaminated buildings will be demolished and the material disposed either in the EMWMF or at offsite disposal sites. Subsurface features are expected to be partially decontaminated and backfilled. Pipelines and tanks may be grouted in place after removal of sludge. Migration of groundwater most likely will be controlled through interceptor trenches, sumps, and groundwater extraction wells. For the industrial areas outside the main plant area (East Bethel Valley), contaminated soils, pipelines, tanks, and subsurface features of buildings are expected to be removed to a depth of three meters (ten feet), if required. Contamination remaining at the Oak Ridge National Laboratory will include all present burial grounds, subsurface soil and groundwater, subsurface tanks, piping, and substructures, and some contaminated sediments in Melton Valley.

East Tennessee Technology Park

Except for the decision to demolish buildings, most remedial decisions at East Tennessee Technology Park are in the early planning stages; therefore, the information provided in this report concerning East Tennessee Technology Park has greater uncertainty than the information provided on the Oak Ridge National Laboratory and the Y-12 Plant. To bring East Tennessee Technology Park to assumed unrestricted industrial remediation levels, the contaminated soil would be removed to a depth of three meters (ten feet), if needed. The contaminated surface and subsurface features of buildings and facilities, including inactive infrastructure, may be removed when no longer useable. Contaminated scrap will be removed. Contaminated waste, such as that in the burial grounds, may be removed, treated (if necessary), and disposed at the EMWMF. Remaining contamination is assumed to include that in deep soils (greater than three meters (ten feet)) and in the groundwater.

EAST TENNESSEE TECHNOLOGY PARK ACCOMPLISHMENTS

- Demolished seven buildings under CERCLA; long-term monitoring required
- Removed sludges from two ponds; future monitoring required
- Collected and treated shallow groundwater; long-term monitoring required

BY 2006 EAST TENNESSEE TECHNOLOGY PARK WILL HAVE:

- Demolished approximately 80 buildings
- Excavated all contaminated soil, scrap, and debris outside of the main fence
- Completed excavation of the Old Contaminated Burial Ground
- Completed decommissioning of K-31/33 buildings

Y-12 Plant

The first significant remedial decision for Upper East Fork Poplar Creek is one to two years away. A proposed plan is currently being generated. Plans presented in this report could change. In the main plant area (referred to as Upper East Fork Poplar Creek), soil and sediment contributing to exceedances of surface water standards, or future worker risk, are expected to be removed, treated, and disposed in the EMWMF . Some soil may be treated in place to remove mercury. Scrap will be removed from the site. Contaminated groundwater will be intercepted at the edge of the plant prior to offsite migration; however, institutional controls are in place and will remain in place for contaminated groundwater that has already moved offsite in Union Valley. A large process building, Alpha-4, may be decontaminated for future use as a warehouse.

A remedial decision for part of Bear Creek Valley (the adjacent waste disposal area for Y-12) has just been signed. However, remaining remedial decisions on the burial grounds are years away. Therefore, parts of the discussion are still uncertain and subject to change. In Bear Creek Valley, contaminated soil leaching uranium

to groundwater and ultimately surface water will be excavated from the Boneyard/Burnyard and disposed in the EMWMF. Shallow groundwater near the S-3 Ponds and the burial grounds will be treated through in-situ reactive trenches. The burial grounds (future decision) are assumed to be hydraulically isolated through capping and in-situ treatment. The groundwater that has migrated past the burial grounds is expected to naturally attenuate. Contamination remaining at Y-12 is expected to include burial grounds, subsurface soil and groundwater, and subsurface features, such as pipelines. The EMWMF will be constructed in Bear Creek Valley. By 2002, this facility will provide a permanent disposal location for the low-level waste and mixed wastes generated by CERCLA actions. The 28-hectare (68-acre) cell will be constructed above grade with leachate collection and monitoring systems.

Y-12 PLANT ACCOMPLISHMENTS

- Removed surface debris from the White Wing Scrapyard and Kerr Hollow Quarry
- Remediated shallow groundwater at S-3 ponds via in-situ passive treatment; long-term monitoring required
- Removed contaminated soil from the firing range
- Treated and capped S-3 ponds, improving the quality of Bear Creek
- Capped large areas of burial grounds under RCRA
- Received regulatory approval to construct an onsite waste disposal facility
- Reduced effluent mercury levels to historically low levels

BY 2006 THE Y-12 PLANT WILL HAVE:

- Completed excavation of hot spots and residual capping at the Boneyard/Burnyard
- Completed remediation of offsite properties
- Removed or treated mercury soil/sediment sites in the plant

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

DOE or a successor is expected to maintain ownership of most of the contaminated areas of the Reservation once remediation is complete and, therefore, will be responsible for long-term stewardship. To ensure that unacceptable exposures to residual contamination do not occur, DOE and the other Federal Facility Agreement parties (i.e., U.S. Environmental Protection Agency (EPA) and Tennessee Department of Environment and Conservation (TDEC)) are committed to maintaining the needed institutional controls for as long as they are necessary. This commitment is documented in each ROD where wastes are left in place.

Land use controls include: (1) proprietary controls, which rely on property law; (2) governmental controls, which rely on regulatory authorities; and (3) physical controls. The proprietary controls for the Reservation consist of restrictions and notices on added deeds or the original acquisition records. Governmental controls use the regulatory authority of a governmental unit to impose restrictions on citizens or sites under its jurisdiction. DOE maintains a permit program that controls excavation and penetration activities on the Reservation, including groundwater use. To provide easy access to this information, notices will be filed on the original acquisition records and with the City of Oak Ridge and the county or counties wherein the property is located (Anderson and/or Roane) on the residual contamination locations and associated risk levels. Physical controls will include limited, passive engineering measures, as well as measures to prevent human intervention, for restricting access. For the Reservation, this includes access controls (i.e., fences/gates), signs, and personnel training. These land use controls are not mutually exclusive and will be "layered" to enhance the overall reliability and the health and safety of the public and the environment.

Access to contamination off the Reservation (Poplar Creek and Clinch River) is currently controlled through deed restrictions or use advisories and signs that are enforced under an interagency agreement between DOE, EPA, TDEC, Tennessee Valley Authority, and the U.S. Army Corps of Engineers. The approved ROD for Union Valley groundwater resulted in license agreements with property owners requiring them to notify DOE of any changes in surface water or groundwater use.

DOE and the State of Tennessee developed a unique approach to funding long-term stewardship of the EMWMF. DOE signed a Consent Order with the State of Tennessee and agreed to deposit $14 million (in $1 million annual installments) into a pooled investment fund established by Tennessee state law (T.C.A. Section 9-4-603). After payment of the final installment, interest for the fund will be used to pay for surveillance and maintenance of the facility. The fund will terminate upon written agreement that surveillance and maintenance for the facility are no longer required. Upon termination, the balance of the fund will be returned.

Engineered controls include caps on burial grounds in Melton Valley (part of Oak Ridge National Laboratory), West Bethel Valley, and Bear Creek Valley. These caps will be maintained, patrolled, and replaced, as needed. Other engineered controls include the collection and treatment of radioactive groundwater in Melton Valley and in Bethel Valley. The wastewater treatment plants will be operated and maintained and their equipment will be replaced periodically, as needed. Ongoing monitoring activities include surface water, groundwater, and ecological monitoring (bio-survey).

CERCLA five-year reviews will be conducted for all remediated sites where the decision is to leave waste in place. These reviews evaluate the implementation and effectiveness of the remedial action (including institutional controls). The five-year reviews will be conducted consistent with the EPA Comprehensive Five-Year Review Guidance (EPA 540R-98-050).

Record-keeping activities will mostly follow current procedures. DOE, in accordance with the Federal Facility Agreement with EPA and TDEC, requires that information used in decision-making be maintained in the administrative record. These documents include remedial investigations, feasibility studies, proposed plans, and RODs. Associated correspondence, data, and some post-ROD information are also included. Most post-ROD information, including design reports, monitoring plans, monitoring results, and action completion reports, are kept in a separate system. These information collection systems will be reviewed to determine a way to capture information relevant to long-term stewardship and to store the information in retrievable form for the long term.

2.2 Long-Term Stewardship Technology Development and Deployment

The role of technology development in long-term stewardship is to develop, demonstrate, and improve technologies that will ensure the post-closure long-term protection of the environment and the public. Technologies are needed to enhance the reliability and reduce the cost of planned engineered controls and to decrease the time for long-term management of residual wastes. The long-term stewardship life-cycle baseline scope for the Oak Ridge Reservation Environmental Management program was reviewed to identify key (mission critical) engineered systems, recurring actions, and high-cost activities. It was determined that key engineered systems for long-term stewardship include hydraulic isolation of buried wastes and reactive barriers for treatment of contaminated surface and groundwater. Major hydraulic isolation components include caps and stormwater diversion trenches. Major reactive barrier components include reactive media and collection and treatment trenches. Long-term reliable operation and maintenance of these systems, coupled with periodic replacement, as needed, is a key component of the long-term stewardship strategy. Assessments to predict the long term performance of these systems is needed to support the remedy selection process, design effective monitoring systems, and plan for periodic system replacement. Monitoring of surface water, groundwater, sediments and biota is a recurring long-term stewardship activity. The projected cost of monitoring is excessive if DOE assumes that existing technology will be used in the future.

A workshop was held to further examine technology development needs because of the humid eastern environment (precipitation and hydrology). Principle cap failure modes were identified as bio-intrusion, subsidence, and erosion. Mechanisms for trench failure (plugging and clogging) were identified as erosion, siltation, microbial interferences, and chemical reactions. Technology development to extend the life of

hydraulic isolation by addressing these potential failure modes is needed. The use of remote monitoring techniques, possibly incorporating satellite technology, was also identified as a technology development need.

The failure of reactive barriers is related to both treatment and hydraulic considerations. Hydraulic-related factors reduce the permeability in the capture zone and include plugging, bio-fouling, and gas buildup. Treatment-related factors include media fouling, media life, and remobilization of contaminants. Limited information is available in these areas, and technology development is needed to sustain reactive barrier performance over the long-term periods required by stewardship.

Systems need to be developed to reduce long-term stewardship costs. Reliable, remote-time, automated monitoring systems are available, but technology development of contaminant-specific (radionuclides, organic chemical and metals) sensors is needed. Technology for in-situ biological monitoring is needed to supplement and eventually replace traditional analytical monitoring. Innovative groundwater well design and replacement technology is needed to minimize costs and enhance worker safety.

Technologies are also needed to shorten the period that long-term stewardship is required. This may include technologies that enhance the natural attenuation processes to accelerate remediation of contaminated soil and water or technologies that limit the need for hydraulic isolation of buried residual wastes by irreversibly treating the waste to nontoxic forms. Cost-effective development of in-situ treatment or excavation and ex-situ treatment of contaminated soils, buried wastes, and contaminated water requiring treatment should also be considered.

2.3 Assumptions and Uncertainties

No final remedial decisions and few interim remedial decisions have been made for the Oak Ridge Reservation. Only partial remedial decisions in Bear Creek and Melton Valley are anticipated to be made in fiscal year (FY) 2000. Other decisions for most of the Y-12 Plant, all of East Tennessee Technology Park (except building demolition), and much of Oak Ridge National Laboratory are one to five years away. The ultimate strategies selected may be different than the assumptions used to perform this analysis.

2.4 Estimated Site-Wide Long-Term Stewardship Costs

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	***Amount***	***Year(s)***	***Amount***	***Year(s)***	***Amount***
FY 2000	$6,394,000	**FY 2008**	$9,620,000	**FY 2036-2040**	$40,724,000
FY 2001	$6,394,000	**FY 2009**	$9,807,000	**FY 2041-2045**	$50,600,000
FY 2002	$6,394,000	**FY 2010**	$9,805,000	**FY 2046-2050**	$79,936,000
FY 2003	$6,356,000	**FY 2011-2015**	$49,296,000	**FY 2051-2055**	$85,546,000
FY 2004	$6,470,000	**FY 2016-2020**	$47,924,000	**FY 2056-2060**	$40,724,000
FY 2005	$7,618,000	**FY 2021-2025**	$44,312,000	**FY 2061-2065**	$44,867,000
FY 2006	$7,508,000	**FY 2026-2030**	$43,526,000	**FY 2066-2070**	$40,757,000
FY 2007	$7,596,000	**FY 2031-2035**	$44,264,000		

Long-term stewardship costs include maintaining engineered barriers and monitoring and treating ground and surface water. DOE assumes, for planning purposes, that each cap will be replaced every 50 years, which results in a peak in long-term stewardship costs in various years depending on when the caps were installed. Other engineered controls, such as pumps, piping, trenches, and wells, are replaced at different frequencies. Residual contamination will be monitored, as necessary, to identify changing conditions and reported at least every five years during the CERCLA five-year review process. However, monitoring efforts and their associated costs will decrease over time. Although costs are only estimated to FY 2070, DOE anticipates that long-term stewardship activities will continue in perpetuity at most areas.

3.0 PORTION OVERVIEW

The Oak Ridge Reservation consists of six "portions" that will require some long-term stewardship activities as of 2006. For purposes of this report, a "portion" is defined as a geographically contiguous and distinct area (which may involve residually contaminated facilities, engineered units, soil, groundwater, and/or surface water/sediment) for which cleanup, disposal, or stabilization will have been completed and long-term stewardship will be required as of 2006.

Each portion is listed in the table below, with further explanations in Sections 3.1 through 3.6. Each portion, except for the offsite portion, corresponds to a watershed. The offsite portion includes contaminated surface water bodies that have left the Reservation (Poplar Creek, Clinch River). Offsite sources of contamination (Atomic City Auto Parts in Oak Ridge and the David Witherspoon sites in Knoxville) are planned to be completely restored with no long-term stewardship requirements. For the Oak Ridge Reservation, remedial decisions are made at the watershed scale. The overall strategy is to group contaminated units by watershed because: (1) surface water drainage basins result in shared contaminant plumes, and (2) watershed areas have relatively homogeneous present or potential future land use. The five watersheds include the following:

- Bear Creek Valley - includes the Y-12 Plant waste disposal area
- Bethel Valley - is the main plant area of the Oak Ridge National Laboratory
- Upper East Fork Poplar Creek - primarily includes the Y-12 Plant and Chestnut Ridge to the south
- East Tennessee Technology Park - incorporates the entire East Tennessee Technology Park plant site
- Melton Valley - includes most of the burial grounds at the Oak Ridge National Laboratory

Long-Term Stewardship Information		
Portion	***Long-Term Stewardship Start Year***	***Long-Term Stewardship End Year***
Bear Creek Watershed	2000	In Perpetuity
Bethel Valley Watershed	2000	In Perpetuity
Upper East Fork Poplar Creek Watershed	2000	In Perpetuity
East Tennessee Technology Park Watershed	2000	In Perpetuity
Melton Valley Watershed	2000	In Perpetuity
Offsite	1997	In Perpetuity

3.1 Bear Creek Watershed Portion

BEAR CREEK WATERSHED PORTION HIGHLIGHTS

Major Long-Term Stewardship Activities - monitoring and maintaining engineered units; monitoring groundwater; enforcing institutional controls
Portion Size - 1,942 hectares (4,800 acres)
Estimated Volume of Residual Contaminants - soil 15,000 cubic meters (19,000 cubic yards); groundwater unknown; engineered units 2,440,000 cubic meters (3,191,000 cubic yards)
Long-Term Stewardship Start-End Years - 2000-in perpetuity
Average Annual Long-Term Stewardship Costs FY 2000-2006 - $2,002,000

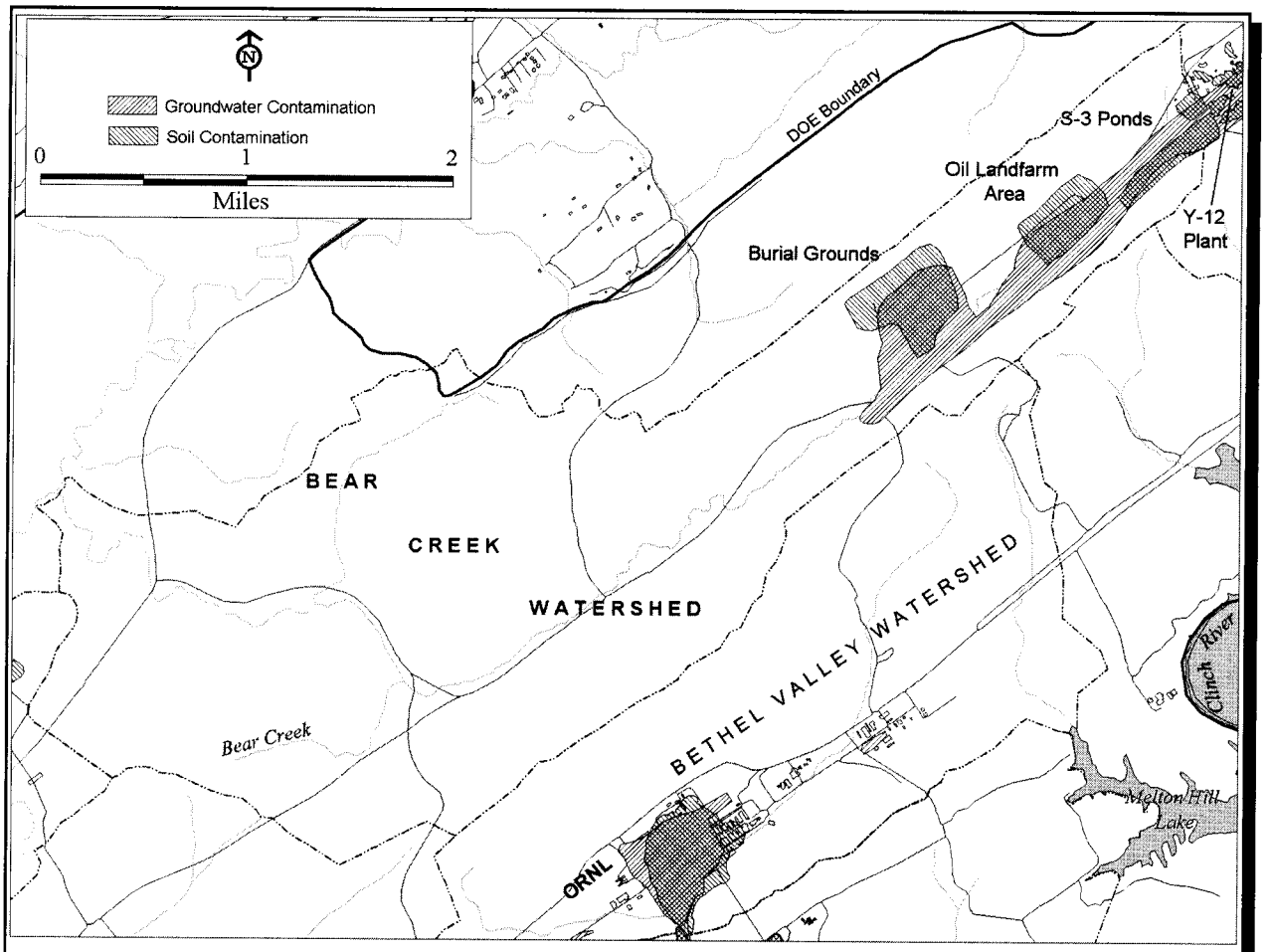
The Bear Creek Watershed Portion is several miles long within the Bear Creek Valley and extends from the western end of the Y-12 Plant to the boundary of groundwater contamination on the west. The Y-12 Plant began operations in 1943 to enrich uranium for nuclear weapons as part of the Manhattan Project. Now, the Y-12 Plant is a major manufacturing, development engineering, and technology center supporting DOE and other government programs. The auxiliary facilities at the Y-12 Plant, including many of the former waste disposal areas, are in the Bear Creek watershed. They contain radiologically contaminated and nonradiologically contaminated wastes generated primarily by Y-12 Plant operations. This region is considered one portion because the multiple disposal areas within Bear Creek Valley are releasing contaminants into common ground and surface water migration pathways.

None of the disposal areas are currently active and most (burial grounds, hazardous chemical disposal area and S-3 ponds) have been capped with either a soil cover or engineered multilayer cap under a *Resource Conservation Recovery Act* (RCRA) closure program. Two leachate collection systems were installed during capping operations to collect leachate at potentially contaminated caps. The former waste disposal areas contain large volumes, greater than 400,000 cubic meters (500,000 cubic yards), of contaminated soil and buried solid waste, primarily uranium and other metals. Several contaminants have been identified in soil, groundwater, surface water, and sediment in the Bear Creek watershed. Contaminants include radionuclides and metals in soil and uranium, nitrates and volatile organic compounds (VOCs) in ground and surface water. Much of the contamination, particularly in soil and somewhat less so in groundwater, is contained within or near the boundaries of the waste disposal areas. The highest concentration of contaminants in groundwater occurs at the former waste disposal areas for the plant, but concentrations causing unacceptable risk have been detected up to a mile west of the area.

The Bear Creek Valley watershed is divided into three functional areas which will be remediated in accordance with CERCLA: the Oil Landfarm Area, Burial Grounds, and the S-3 Ponds. The contaminated media for this portion (soil, groundwater, and engineered units) are discussed in the following paragraphs. Surface water and sediment will be restored to recreational use, the highest use possible given the size of the stream. Long-term stewardship activities will not be required for Bear Creek Valley surface water and sediment; therefore, these media are not discussed. In addition, the EMWMF will be built in Bear Creek Valley. Access to eastern Bear Creek Valley, which contains the waste disposal areas and the EMWMF, will be restricted and will require long-term stewardship.

3.1.1 Soil

Due to past disposal operations, contaminated soils are associated with three functional areas: the S-3 Ponds, the Burial Grounds, and the Oil Landfarm Area. The S-3 Ponds were four unlined ponds used for industrial waste treatment and contain contaminated soils underneath the closed ponds. The Burial Grounds consist of trenches used for disposal of liquid and solid wastes and contain contaminated soils between the trenches. The contaminated soils under the S-3 Ponds and between the trenches in the Burial Grounds will be discussed in Section 3.1.3 on engineered units.



Bear Creek Watershed

The Oil Landfarm Area includes the Oil Landfarm and the Boneyard/Burnyard. The Oil Landfarm is a former land-farming plot used for biological degradation of approximately 4,000 cubic meters (5,000 cubic yards) of industrial waste oil and machine coolants between 1973 and 1982. The Boneyard/Burnyard consists of three areas: Boneyard (used for contaminated, noncombustible material disposal), Burnyard (used for contaminated, combustible material disposal), and the Hazardous Chemical Disposal Area.

Soils in the Oil Landfarm Area are contaminated with uranium, polychlorinated biphenyls (PCBs), metals, and other radionuclides. Highly contaminated soil (i.e., hot spots) will be excavated from the Boneyard/Burnyard and disposed in the EMWMF. Residual materials that pose lower long-term risk will be contained onsite through appropriate hydraulic isolation measures, including soil covers or caps. These are primarily uranium and organic chemical contaminated soils. Approximately 20 hectares (40 acres) of contaminated soil will remain. The contaminated soil could be as deep as six meters (20 feet) or as shallow as two meters (six feet). At an average of four meters (12 feet), the volume is estimated to be 15,000 cubic meters (19,000 cubic yards). By 2006, soil remediation will be completed in the Oil Landfarm Area.

Soil Long-Term Stewardship Activities

To ensure that unacceptable exposures to residual contamination in Bear Creek Valley do not occur, DOE will maintain necessary land use restrictions and governmental controls. The contaminated area of Bear Creek Valley will be designated for controlled industrial use (restrictions below two feet), with areas of restricted waste disposal use, including the residual soil contamination in all three functional areas. Requirements for institutional controls in Bear Creek were documented in the first ROD, and more details will be provided in a future land use control implementation plan. As other RODs are signed, additional institutional controls may be added. Institutional controls, such as restricting access and prohibiting soil excavation, have been in place since the waste has been in place but will begin in 2000 under CERCLA now that a significant ROD has been signed. These controls will be implemented through a permit program maintained by DOE. In addition, residual contamination will be monitored as often as necessary to identify changing conditions and reported at least every five years in accordance with the CERCLA five-year review process. Monitoring efforts will decrease over time as site conditions stabilize and less frequent monitoring is required, resulting in long-term stewardship cost decreases over time. However, the cap planned for the soil in the Boneyard/Burnyard is assumed to be replaced every 50 years, as needed.

3.1.2 Groundwater

The groundwater in Bear Creek Valley is contaminated with uranium, nitrates, PCBs, and volatile organic compounds (i.e., trichloroethene and degradation products) released from historic waste disposal operations. A relatively continuous zone of groundwater contamination exists throughout the three functional areas: the Burial Grounds, Oil Landfarm, and S-3 Ponds areas. The contaminated groundwater plume is approximately 40 hectares (100 acres) and extends from all waste disposal units down the valley to the west. The plume is not expected to reach beyond the west end of the Burial Grounds.

The groundwater flow is governed by the valley's geology. The rock formations are extensively fractured (karstified), which substantially increases the permeability. The fracture width generally decreases with depth, restricting the depth of active groundwater circulation. However, the shallow interval (top 30 meters (100 feet)) is well connected and, therefore, rapidly transports water to Bear Creek. Most groundwater flow occurs in this interval during and immediately following precipitation.

The final groundwater remediation strategy has been deferred from all negotiations. There has been significant disagreement on the strategy, so the Federal Facility Agreement parties agreed to implement actions to prevent source contaminant releases and monitor the effects on groundwater before negotiating a final groundwater strategy. The groundwater contamination conditions are complex since the geology is karstic and contaminant flow paths are difficult to track. The sources of groundwater contamination are well identified, but contamination is deep, and secondary sources (free product) have been found hundreds of feet deep. For cost estimating purposes, DOE is assuming that remediation will be by natural attenuation with no active restoration and installing of hydraulic barriers to isolate contaminant sources (i.e., the Burial Grounds).

Groundwater Long-Term Stewardship Activities

Based on the assumed remedial strategy, DOE will monitor the groundwater to ensure that the remedy is effective and contaminants are being attenuated as expected. DOE assumes, for costing purposes, that any necessary groundwater interception/treatment trenches and wells will be replaced at 50-year intervals. To ensure that unacceptable exposures to residual contamination do not occur, DOE would need to maintain necessary land use restrictions under this strategy, such as prohibiting any use of onsite groundwater. Long-term stewardship activities will be described in a future decision, which is expected well after 2006 (assumed to be no earlier than

2010). Such a strategy allows for evaluation of the impact of previous actions on the groundwater quality.

3.1.3 Engineered Units

This portion contains three engineered units: the Bear Creek Burial Grounds, S-3 Ponds, and the EMWMF, which, together, occupy a 56-hectare (138-acre) area. The Bear Creek Burial Grounds and S-3 Ponds were used for historical disposal of Y-12 Plant waste. The EMWMF will be used for disposal of Oak Ridge Reservation CERCLA wastes.

The Bear Creek Burial Grounds are approximately three kilometers (two miles) west of the Y-12 Plant and were primarily used to dispose of uranium turnings and industrial wastes contaminated with uranium from nuclear weapons production. The burial grounds, which operated from approximately 1955 to 1993, consist of several principal waste disposal units, each with a series of trenches. Since 1989, several waste disposal units have been closed with a RCRA-approved cap. The remaining burial grounds are assumed to be contained in place. The material eventually capped in place would include uranium chips in solvents, trash and debris contaminated with radioactivity, waste oils, beryllium metals, and unstable materials, such as picric acid. The volume of soil and debris remaining in place is estimated at 917,000 cubic meters (1.2 million cubic yards).

The S-3 Ponds were four unlined ponds located adjacent to the west end of the Y-12 Plant. Constructed in 1951, these impoundments covered approximately 122 by 122 meters (400 by 400 feet). The ponds were approximately five meters (17 feet) deep and, while in operation, each pond had a storage capacity of 9,464 cubic meters (12,378 cubic yards). The ponds were used to dispose of liquid wastes and sludge, including nitric acid and uranium, from Y-12 Plant operations. In-situ treatment of wastewater in the S-3 Ponds consisted of neutralization and biodenitrification processes that began in 1983 and continued until September 1984. After biodenitrification, the ponds' contents were allowed to settle and form a sludge layer ranging from 0.6-to-1.5 meters (two-to-five feet) thick. The volume of neutralized sediment and underlying contaminated soil above the water table is estimated at 23,000 cubic meters (30,000 cubic yards). In 1988, the S-3 Ponds were closed, in accordance with RCRA, by placing a multilayer cap over the area and covering it with asphalt to create a parking lot. While the source has been contained, remediation efforts are underway to control the migration of contaminated groundwater from past pond releases. These efforts will be completed before 2006. Institutional controls are already in place to maintain the cap and prevent access to residual contamination.

The EMWMF is being constructed for disposal of mixed (hazardous and low-level) wastes generated during CERCLA remediation of the Oak Ridge Reservation. The EMWMF, with two additional expansions, is anticipated to contain 1,500,000 cubic meters (2,000,000 cubic yards) of waste when filled and closed. A wide variety of materials is expected to be placed in the cell, including radioactively contaminated demolition debris; radioactively contaminated soil; soils after treatment for mercury removal; lightly contaminated trash; personal protective equipment; and materials from East Tennessee Technology Park burial grounds, which would include uranium, thorium, beryllium, other metals, and organic contaminated soil and debris. A Waste Acceptance Criteria Attainment Plan is under development that would control the types of contamination that can be disposed. For instance, RCRA material must be treated first; and highly mobile contaminants, such as Technetium-99, are limited. The EMWMF, estimated to cover 28 hectares (68 acres), will contain a bottom barrier, a leachate collection system, and an intruder barrier final cap. The EMWMF will be accepting waste by 2002 and is not anticipated to be closed until around 2015. TDEC is planning on administering the long-term surveillance and monitoring program through a trust fund that has been set up.

Engineered Units Long-Term Stewardship Activities

Long-term stewardship activities, such as monitoring, maintenance, replacement, and surveillance, will be

required to ensure that the engineered controls remain protective of human health and the environment. Regular monitoring will occur in accordance with agreements reached during closure. Effectiveness of the remedial actions and these long-term stewardship activities will be validated and verified through the CERCLA five-year review process. The engineered caps and other items are expected to be replaced as needed. Institutional controls, such as a permit program requiring DOE approval before any penetration in the area, have been in place since the waste has been in place, but CERCLA will also require these controls once a ROD is signed. The EMWMF will be fenced with access controls.

DOE is committed to maintaining necessary land use controls to ensure that unacceptable exposures to residual contamination do not occur. Specific land use control requirements for Bear Creek were incorporated in the first ROD, and the details will be described in a land use control implementation plan. Future Bear Creek Valley RODs may augment the land use controls. The areas of Bear Creek Valley that are contaminated will be designated for controlled industrial (restrictions below 0.6 meter (two feet)), with areas of restricted waste disposal use for the Burial Grounds and the EMWMF.

3.1.4 Estimated Long-Term Stewardship Costs for Bear Creek Watershed

Long-term stewardship activities for the Bear Creek Watershed Portion are anticipated to include monitoring and maintaining engineered units, monitoring groundwater, and enforcing institutional controls. For cost estimating purposes, DOE is assuming that groundwater remediation will be by natural attenuation with no active restoration and installing of hydraulic barriers to isolate contaminant sources (i.e., the Burial Grounds). Also, for cost estimating purposes, DOE assumes that engineered caps, trenches, and groundwater wells will be replaced at 50-year intervals, resulting in peaks in long-term stewardship costs around the years 2040-2050 for existing caps and 2060 for new caps. Regular monitoring will occur in accordance with agreements reached during closure. Effectiveness of the remedial actions and long-term stewardship activities will be validated and verified through the CERCLA five-year review process. However, monitoring efforts are expected to decrease over time as environmental conditions stabilize, resulting in decreasing cost over time. Although costs are reported until FY 2070, long-term stewardship is anticipated to be required beyond FY 2070.

Currently, the environmental remediation project costs for the Reservation are not estimated by portion (watersheds), but rather, by three major areas (Oak Ridge National Laboratory, Y-12 Plant, and East Tennessee Technology Park). The estimated long-term stewardship costs for the Bear Creek Watershed Portion are a percentage of the Y-12 Plant's long-term stewardship costs.

Long-Term Stewardship Costs (Constant Year Dollars)							
FY 2000 - FY 2010	***FY 2011 - FY 2020***	***FY 2021 - FY 2030***	***FY 2031 - FY 2040***	***FY 2041 - FY 2050***	***FY 2051 - FY 2060***	***FY 2061 - FY 2070***	***Estimated Total***
$22,006,000	$18,101,000	$12,469,000	$10,728,000	$29,050,000	$8,198,000	$11,359,000	$111,911,000

3.2 Bethel Valley Watershed Portion

This portion encompasses a 702-hectare (1,734-acre) area of Bethel Valley in the southwest region of the Oak Ridge Reservation and contains the main plant area for the Oak Ridge National Laboratory. The Bethel Valley portion is a contiguous area of contamination that lies within the valley. Within Bethel Valley, there are three areas: East Bethel Valley, Central Bethel Valley, and West Bethel Valley.

- East Bethel Valley is the Laboratory maintenance area, which contains a single facility and a volatile organic compound (VOC) contaminated groundwater plume. There are no contaminated soil, surface

water, sediment, or engineered units.

- Central Bethel Valley includes the Laboratory area, which contains active and inactive buildings, former burial grounds, underground liquid low level waste tanks, underground pipelines, and associated underground and above-ground utilities. Contaminated soil, surface water, sediment, and groundwater have resulted from Laboratory activities. The most significant release offsite results from subsurface spills of strontium in the Laboratory area, which have contaminated groundwater and surface water. Strontium contamination resulting from Bethel Valley flows offsite through Melton Valley and can be detected in the Clinch River.

BETHEL VALLEY WATERSHED PORTION HIGHLIGHTS

Major Long-Term Stewardship Activities - monitoring and maintaining engineered units; monitoring groundwater; enforcing institutional controls
Portion Size - 702 hectares (1,734 acres)
**Estimated Volume of Residual Contaminants* - soil 765,000 cubic meters (1 million cubic yards); groundwater unknown; engineered units 115,000 cubic meters (150,000 cubic yards); facilities unknown
Long-Term Stewardship Start-End Years - 2000-in perpetuity
Average Annual Long-Term Stewardship Costs FY 2000-2006 - $1,124,000
*The estimated volume indicates only the known amounts of residual contaminants.

- West Bethel Valley contains a burial ground area. Groundwater and soil are contaminated as a result of disposal activities in this area of the valley.

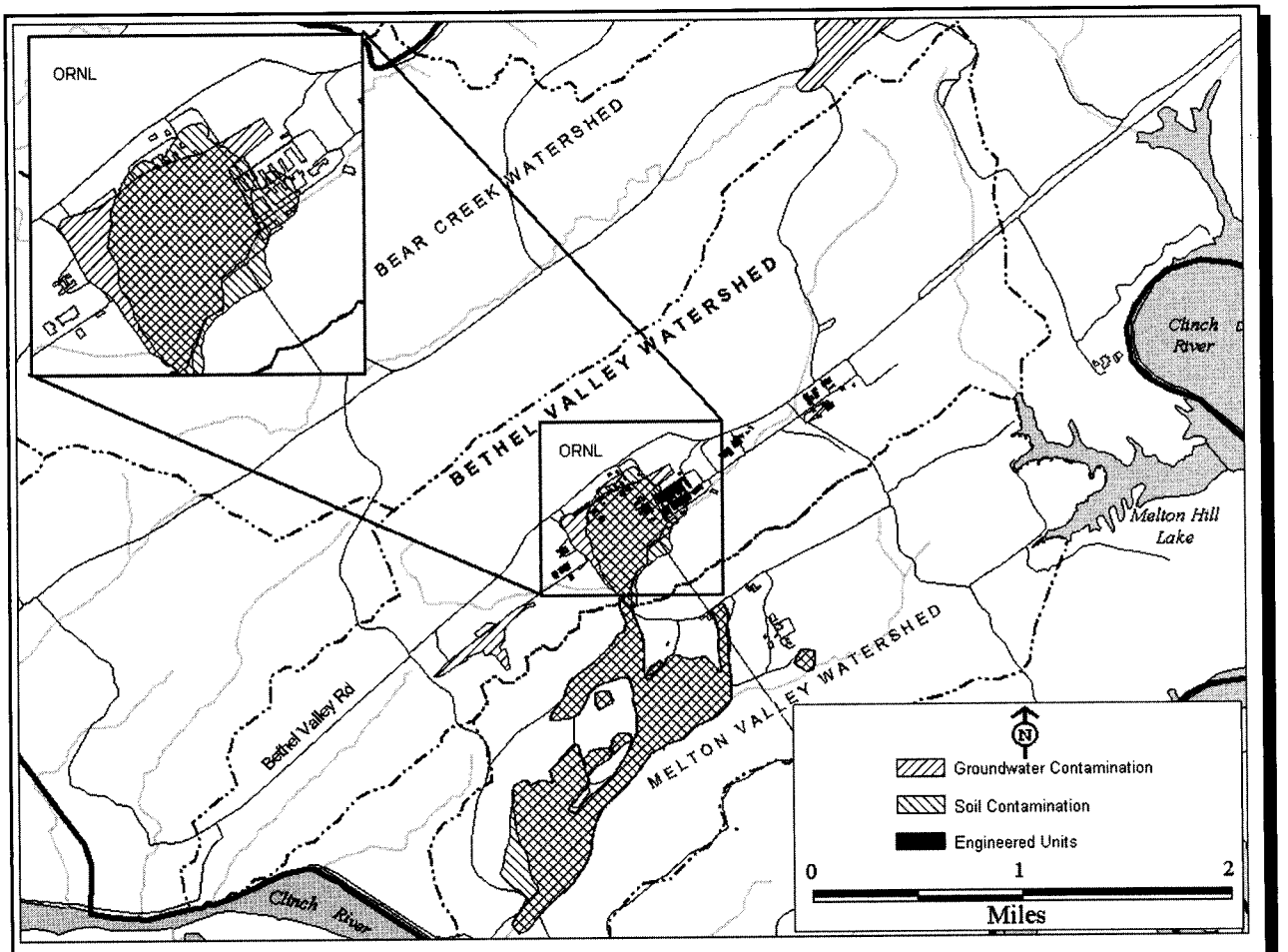
These areas will be remediated and will be subject to long-term stewardship in accordance with CERCLA. The assumptions below are from a proposed plan and could be modified when decisions are made in the next year. The contaminated media for this portion (soil, groundwater, engineered units, facilities) are discussed in the following paragraphs. Surface water and sediments would be restored to recreational use, the highest use possible given the size of the streams. Contaminated sediments would be excavated and disposed in the EMWMF. No institutional controls or other long-term stewardship activities would be required in Bethel Valley surface water and sediment once established goals have been met.

3.2.1 Soil

Contaminated soil through Central Bethel Valley releases contaminants into common ground and surface water paths. Bethel Valley is underlain by bedrock which has innumerable small-scale folds, faults, and fractures that play a major role in groundwater flow. The bedrock is covered with a mantle of soils that tend to retain the fractures and bedding planes of the parent bedrock but have a higher porosity and permeability than the parent rock. The primary contaminants of concern in the soil are cesium-137, strontium-90, and cobalt-60.

- East Bethel Valley has no soils that are known to be significantly contaminated.

- Central Bethel Valley has soil that is primarily contaminated with radionuclides (e.g., cesium-137), although there is also some mercury contamination. The surface soil is contaminated as a result of spills, fallout, and runoff. Contamination leaked out of Oak Ridge National Laboratory buildings as a result of pipeline leaks and breaks, tank leaks, migration of surface contamination through the soil, and movement of contaminated groundwater through pipelines and natural channels. An extensive amount, approximately 765,000 cubic meters (one million cubic yards), of contaminated soil will remain in Central Bethel Valley because remediation efforts will focus only on the top 0.6 meters (two feet). Although considerable sampling has occurred, there is still a high degree of uncertainty on the extent and depth of contamination.



Bethel Valley Watershed

- West Bethel Valley soils are associated with the burial ground and will be addressed as part of the engineered unit.

The proposed remediation strategy is to generally remove (down to 0.6 meters (two feet)) contamination in the surface soil and dispose of the soil in the EMWMF in Bear Creek Valley. Contamination in subsurface soil, such as in secondarily contaminated areas along seepage discharge routes from source units, will remain in place unless significantly contributing to groundwater contamination, in which case it will be removed. In general, high levels of cesium-137 contamination will remain, although strontium-90 levels will be reduced. However, the soil remediation levels are dependent on the final land use identified for the area. The Oak Ridge National Laboratory main plant area (Central Bethel Valley) is assumed to be remediated to a controlled industrial land use (clean to a depth of 0.6 meters (two feet)). The remainder of the developed area outside the main plant area (East Bethel Valley) is assumed to be remediated to unrestricted industrial land use (clean to a depth of three meters (ten feet)). The burial grounds/landfill in West Bethel Valley are assumed to be a waste management area (although some limited surface use may be appropriate). The remainder of the watershed (which has only small isolated areas of contamination and no current industrial use) will be remediated to unrestricted land use in West Bethel Valley. By 2006, soil remediation is anticipated to be only partially complete.

Soil Long-Term Stewardship Activities

In Central Bethel Valley, 0.6 meters (two feet) of clean surface soil would prevent access to contamination. DOE will maintain a permit program to control unauthorized penetration into residual contamination. Likewise, three meters (ten feet) of clean soil in East Bethel Valley and a cap on the burial ground in West Bethel Valley with the same permit program will control access in those areas. DOE is committed to maintaining the necessary land use controls, including institutional controls, for as long as they are necessary to ensure that unacceptable exposures to residual contamination do not occur. Specific requirements for institutional controls in Bethel Valley will be documented in the ROD; additional detail will be provided in a future land use control implementation plan to be developed after the watershed ROD is signed. The land use controls will include a DOE-administered permit program that will require the appropriate safeguards and precautions whenever disturbance of the remediated area is needed. The controls will also include fences and signs, primarily in Central Bethel Valley. Regular monitoring will occur in accordance with agreements reached during closure. Effectiveness of the remedial actions and long-term stewardship activities will be validated and verified through the CERCLA five-year review process.

If selected, the engineered controls, such as multilayer caps or soil covers, will require periodic surveillance and maintenance. DOE assumes, for planning purposes, that each cap will be replaced every 50 years.

3.2.2 Groundwater

The groundwater in Bethel Valley is contaminated with numerous radionuclides and volatile organic compounds. A relatively continuous zone of groundwater contamination, 17 hectares (42 acres), exists through the plant area in Central Bethel Valley. Contaminated groundwater originates from source areas and typically follows shallow pathways to nearby surface water bodies and basement sumps. The groundwater contamination migrates through the subsurface along natural channels, as well as via pipelines and their bedding material. Groundwater is not expected to migrate along deep pathways outside the current zone of groundwater contamination. Some early actions to control one of the most contaminated areas have resulted in decreased contamination of nearby surface water bodies. Collected groundwater from early actions is currently treated at a wastewater process treatment plant onsite. The proposed remedial action would continue these activities and would add deep groundwater extraction in Central Bethel Valley.

- East Bethel Valley contains a plume of volatile organic compounds thought to be due to a spill in the maintenance area. To date, neither the extent of contamination nor the spill source have been identified. The proposed action is enhanced in-situ biodegradation.

- Central Bethel Valley groundwater is contaminated primarily from subsurface pipeline leaks. Additional contamination has resulted from the migration of contaminants from tank, building, and impoundment leaks, as well as contaminated soil. The contamination is primarily radionuclides (strontium-90 and tritium) volatile organic compounds, and some metals. However, the groundwater system is not clearly understood. There are multiple sources and complex flow paths. Multiple groundwater collection activities are proposed for this contamination.

- West Bethel Valley groundwater is contaminated primarily with strontium-90 as a result of materials in the burial ground. Groundwater contamination is reasonably well understood because there is only a single, well identified source (burial ground) and a fairly old and stable plume of strontium contamination. Monitoring is all that is proposed for this plume.

As mentioned above, the contaminated groundwater conditions are complex. Consequently, the final

groundwater remediation strategy has been deferred by the Federal Facility Agreement parties. For cost-estimating purposes, DOE assumes that the actions mentioned above are implemented through interim decisions, but no active restoration will occur. The completed source control actions (i.e., tank sludge removal, pond sludge removal) and those proposed in the next remedy (deep soil removal, pipeline grouting) are expected to reduce contamination concentrations and flux in the groundwater but not restore the groundwater to drinking water standards. In-situ biodegradation in East Bethel Valley and deep groundwater extraction in Central Bethel Valley will also reduce contaminant levels. The final remedial decision on groundwater will not be made until source control actions are complete and their effectiveness monitored. A more informed decision for final groundwater remediation can be made sometime after 2006.

Groundwater Long-Term Stewardship Activities

DOE will monitor groundwater in accordance with interim decisions. Effectiveness of the remedial actions and long-term stewardship activities will be validated and verified through the CERCLA five-year review process. DOE assumes, for costing purposes, that any necessary groundwater interception/treatment trenches and wells will be replaced at 50-year intervals. To ensure that unacceptable exposures to residual contamination do not occur, DOE will maintain land use restrictions, including institutional controls, for as long as they are necessary. Specific requirements for institutional controls in Bethel Valley will be documented in the ROD, with the details to be presented in a future land use control implementation plan to be developed after the watershed ROD is signed. The land use controls will include a DOE-administered permit program that will require the appropriate safeguards and precautions to prevent inappropriate use of the groundwater.

The engineered controls for groundwater contamination include pump and treat and shallow collection in existing sumps for groundwater contaminated with radionuclides. Groundwater collected will be treated at one or more water treatment plants prior to release. Each of the engineered controls will receive periodic surveillance and maintenance.

3.2.3 Engineered Units

The West and Central areas of Bethel Valley have 61 multiple and low-level waste engineered units (five burial grounds/landfills, 13 gunite tanks, and 43 steel tanks), which occupy three hectares (eight acres). All of these units have released, or have the potential to release, contaminants into the environment. Depending on their location, these units contribute to commingled groundwater contamination. East Bethel Valley does not contain any engineered units. The burial grounds in West Bethel Valley and Central Bethel Valley contain a total of 109,000 cubic meters (142,000 cubic yards) of residual contamination.

- West Bethel Valley has a burial ground area that contains demolition debris contaminated with radionuclides, fly ash, contaminated soil, and alpha waste. Procedures were to bury waste in unlined trenches and cover with soil. Considerable radioactive (alpha) contaminants from other sites were buried in West Bethel Valley. Most of this material was covered with concrete. As discussed previously, releases of strontium to the groundwater have occurred. The proposed remediation strategy is to cap the material in place. Remediation of the burial grounds is not anticipated until around 2006.

- Central Bethel Valley contains a minor burial ground and some landfills, gunite and steel underground tanks, and pipelines.

  - The burial ground consists of unlined trenches covered by soil, and covered landfills. These are some of the older burial areas at the Oak Ridge National Laboratory and, therefore, portions have been removed. There is slight contamination from minor quantities of radioactive waste

(low-level waste) under the burial area, but it is not impacting nearby surface water. The estimated volume of contamination in Central Bethel Valley burial ground/landfills is 17,200 cubic meters (22,450 cubic yards). The proposed remedial action is to cover and cap the burial sites in place; however, the State of Tennessee prefers that the waste eventually be removed. Regardless, the burial areas will not be remediated until after 2006.

- Thirteen gunite tanks (gunite is a concrete, sand, and water mixture that was sprayed over a wire mesh and steel reinforcing frame) and 43 steel tanks (totaling 5,800 cubic meters (7,600 cubic yards) capacity) were used in Bethel Valley to store wastewater and provide settling and storage capacity for low-level waste. These tanks have been sources of groundwater contamination, typically as a result of line leaks outside of the tanks. Groundwater underneath the tanks is contaminated with strontium and uranium. Removal of 99 percent of the sludge and liquid waste and 95 percent of the contamination remaining in the tanks was completed in November 2000. The sludge and liquids were transferred to new stainless steel tanks. By 2006, the shells (and residual sludge in the tanks) will be filled with grout. Slight radioactive contamination of the shells will exist. Eventually, the waste will be treated onsite and shipped to the Waste Isolation Pilot Plant in New Mexico for disposal.

- Roughly 17,000 meters (56,000 feet) of inactive pipelines exist in Central Bethel Valley. These pipelines were used to transport process wastes from buildings to waste treatment facilities. Transported waste included radionuclides, organics, and transuranic waste. As these pipelines aged, numerous leaks occurred. The proposed remedial action is to flush out the materials in the pipelines and then fill them with grout in place. Residual contamination is expected to be minimal, although residuals from historic releases will exist in the surrounding soils.

Engineered Units Long-Term Stewardship Activities

The required long-term stewardship activities will include monitoring and maintaining engineered barriers and enforcing institutional controls. Each of the engineered controls (i.e., multilayer caps) will require periodic surveillance and maintenance. DOE assumes, for planning purposes, that caps will be replaced every 50 years. DOE is committed to maintaining the necessary land use controls, including institutional controls, for as long as they are necessary to ensure that unacceptable exposures to residual contamination do not occur. Specific requirements for Bethel Valley will be documented in the ROD, with the details of land use controls to be developed in a future land use control implementation plan. Land use controls include a DOE-administered permit program that requires the appropriate safeguards and precautions whenever disturbance of a remediated area is needed. Regular monitoring will occur in accordance with agreements reached during closure. Effectiveness of the remedial actions and long-term stewardship activities will be validated and verified through the CERCLA five-year review process.

3.2.4 Facilities

Approximately 57 inactive buildings and other structures, generally of concrete block construction, are contaminated due to past operations. These buildings occupy an estimated two hectares (five acres) and are being remediated in accordance with CERCLA regulations. All but one of the inactive buildings are located in Central Bethel Valley. More buildings will become inactive in the future. Some buildings contain reactors, hot cells, and other areas that are highly contaminated with radioactive material. Activities in the experimental reactors and in the laboratories contributed to contaminated walls, floors, and equipment.

The proposed remedy is decontamination and demolition of the building surface features. The contaminated

material will be disposed either in the EMWMF or offsite. Some of the buildings have below-ground basements. These subsurface structures will be remediated by removal of loose contamination, followed by backfilling. For industrial areas outside the main plant area (East Bethel Valley), contaminated subsurface features of buildings will be removed to a depth of three meters (ten feet), if required. The demolition work at the Oak Ridge National Laboratory will be underway but not completed by 2006.

The only residual surface contamination would be at the Graphite Reactor. The Graphite Reactor will not be removed because it is designated as a National Historical Landmark. The Graphite Reactor operated until 1963. At shutdown, boron-steel rods were inserted into the roughly 30-by-46 meter (100-by-150 foot) reactor to ensure the reactor would not go critical. The fuel was removed in 1966. A negative pressure is maintained throughout the reactor and the exhaust is vented. Residual fixed (painted or grouted) contamination remains, as listed in the following table (*Graphite Reactor Contaminants of Concern*). However, the volume of residual fixed contamination is minor. Thin layers of contamination that are under paint could be anywhere, and, since the contamination is fixed in place, there are no specific target remediation levels. The additional CERCLA action is to remove the need for permanent negative pressure by grouting the reactor core.

Graphite Reactor Contaminants of Concern	
Plutonium-239	Strontium-90
Carbon-14	Asbestos
Iron-55	Lead
Cesium-137	

Facilities Long-Term Stewardship Activities

Upon completion of the demolition activities, land use restrictions will be required. The permit program used to prevent access to subsurface (greater than 0.6 meters (two feet)) soil will be used to prevent access to slightly contaminated subsurface structures. The only facility requiring unique institutional controls will be the Graphite Reactor. The Graphite Reactor will continue to be an historic monument and open to the public for tours. DOE Orders for levels of public exposure and maintenance/monitoring of the facility will continue to be followed.

To ensure that unacceptable exposure to residual subsurface contamination does not occur, DOE will maintain necessary land use restrictions. Specific requirements for Bethel Valley will be documented in the ROD, with details specified in a future land use control implementation plan to be developed after the watershed ROD is signed. The land use controls will include a DOE-administered permit program that requires appropriate safeguards and precautions whenever disturbance of a remediated area is needed. Controls also may include fences and signs for residual subsurface contamination. Regular monitoring will occur in accordance with agreements reached during closure. Effectiveness of the remedial actions and long-term stewardship activities will be validated and verified through the CERCLA five-year review process.

3.2.5 Estimated Long-Term Stewardship Costs for Bethel Valley Watershed

DOE anticipates that long-term stewardship activities for the Bethel Valley Watershed Portion will include monitoring and maintaining engineered units, monitoring groundwater, and enforcing institutional controls. For cost-estimating purposes, DOE assumes that the groundwater remedial actions are implemented through interim decisions, but no active restoration will occur. DOE assumes, for planning purposes, that engineered caps will be replaced every 50 years, resulting in a peak in long-term stewardship costs in the years 2051-2055. Regular monitoring will occur in accordance with agreements reached in the ROD. Monitoring efforts and costs are expected to decrease over time as site conditions stabilize. Although costs are only estimated to FY 2070, DOE anticipates that long-term stewardship activities will be required in perpetuity at most areas.

Currently, the environmental remediation project costs for the Reservation are not estimated by portion (watersheds), but rather, by three major areas (Oak Ridge National Laboratory, Y-12 Plant, and East Tennessee Technology Park). The estimated long-term stewardship costs for the Bethel Valley Watershed Portion is based on a percentage of the Oak Ridge National Laboratory's long-term stewardship costs.

Long-Term Stewardship Costs (Constant Year 2000 Dollars)							
FY 2000 - FY 2010	*FY 2011 - FY 2020*	*FY 2021 - FY 2030*	*FY 2031 - FY 2040*	*FY 2041 - FY 2050*	*FY 2051 - FY 2060*	*FY 2061 - FY 2070*	*Estimated Total*
$17,308,000	$28,825,000	$29,704,000	$30,005,000	$34,561,000	$53,252,000	$29,713,000	$223,368,000

3.3 Upper East Fork Poplar Creek Watershed Portion

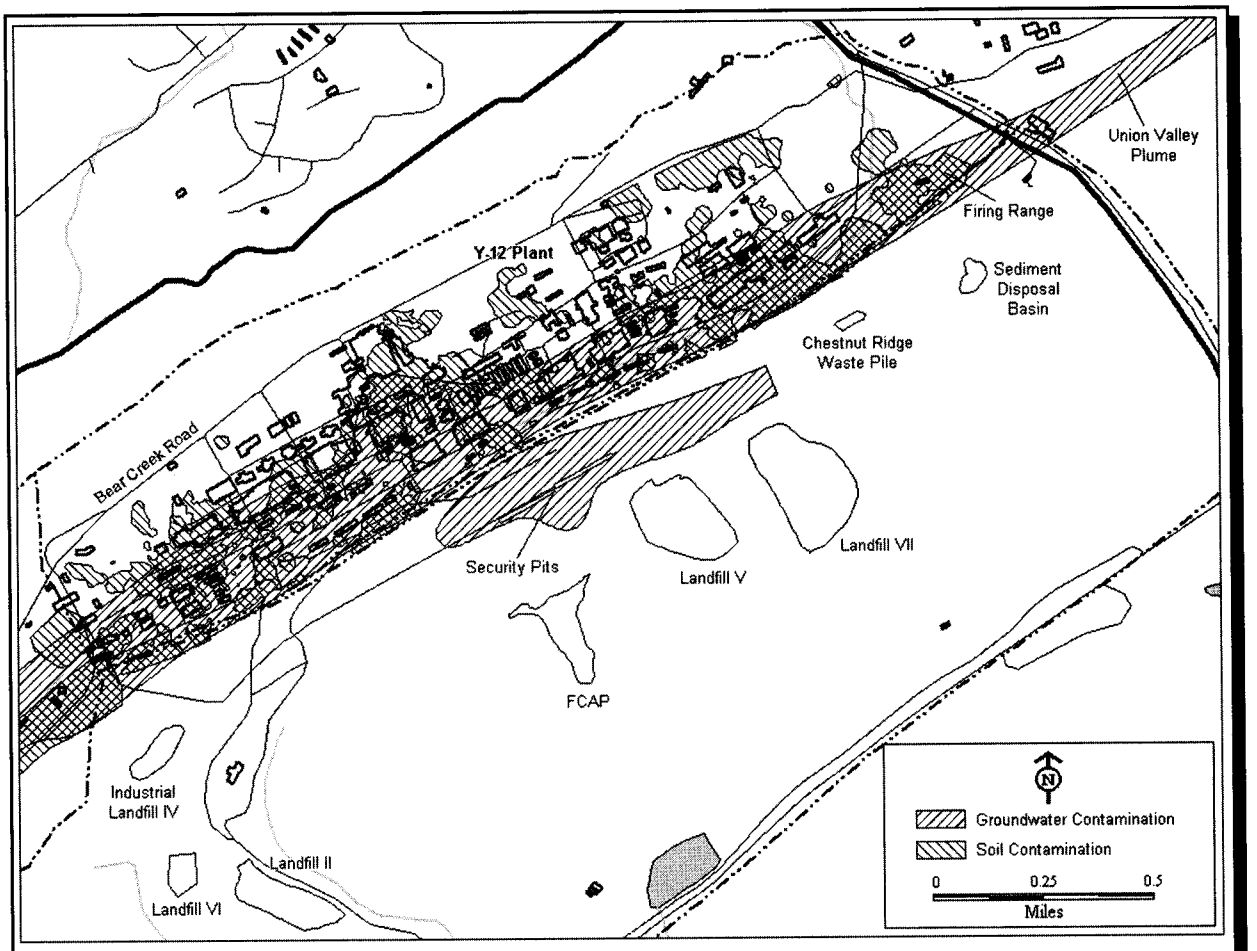
This portion includes the Y-12 Plant and the ridge south of the Plant. The Y-12 Plant encompasses about 300 hectares (800 acres) near the northeast corner of the Oak Ridge Reservation. It is separated from the City of Oak Ridge by a wooded ridge. The Y-12 Plant began operations in 1943 to enrich uranium and produce nuclear weapons as part of the Manhattan Project. Now the Y-12 Plant is a major manufacturing, development engineering, and technology center supporting DOE and other energy agency programs. Historic operations at the Y-12 Plant resulted in contaminated soil, groundwater, surface water, and sediment. The predominant contaminants of concern are mercury, PCBs, and uranium. This region is considered one portion because multiple areas within the plant are releasing contaminants into common ground and surface water migration pathways. Releases from contaminated soil and sediments to ground and surface water have resulted in offsite contamination (e.g., mercury in surface waters and VOCs in groundwater).

UPPER EAST FORK POPLAR CREEK WATERSHED PORTION HIGHLIGHTS

Major Long-Term Stewardship Activities - monitoring and maintaining engineered units; monitoring groundwater; enforcing institutional controls
Portion Size - 300 hectares (800 acres)
**Estimated Volume of Residual Contaminants* - soil unknown; groundwater unknown; engineered units 250,000 cubic meters (330,000 cubic yards)
Long-Term Stewardship Start-End Years - 2000-in perpetuity
Average Annual Long-Term Stewardship Costs FY 2000-2006 - $1,001,000
*The estimated volume indicates only the known amounts of residual contaminants.

The Y-12 plant has an ongoing Defense Program mission that is assumed to continue for the foreseeable future. Therefore, the projected future land use for the Y-12 Plant site will be controlled industrial use (restrictions below 0.6 meters (two feet)) in the West/South Central Y-12 Plant area (Defense Program) and unrestricted industrial use (restrictions below three meters (ten feet)) in the East/North Central Y-12 Plant area. These future anticipated land uses are based on DOE's estimates of which portion of the plant will no longer be needed to fulfill the government's mission. Access to the controlled industrial area will be restricted to workers and controlled by signs and fences. Chestnut Ridge, to the south of the Plant, contains several small disposal areas and large industrial waste landfills. The remediation program anticipates leaving some of the small units in place because the operating Plant will continue to use the adjacent landfills. Eventually (well after 2006), DOE will close the landfills in place under state regulations.

Each of the contaminated media (soil and groundwater) is discussed separately in the following sections. The groundwater discussion includes the Union Valley plume which is moving offsite, east of the Y-12 Plant. A mercury-contaminated building within the Y-12 Plant, Alpha 4, will be completely decontaminated and will not require long-term stewardship activities. Therefore, facilities are not discussed in this section. Surface water and sediments will be restored to their highest beneficial and classified use, and no institutional controls will be required. Therefore, surface water and sediment are not discussed in this section. The engineered units currently



Upper East Fork Poplar Creek Watershed

in the remediation program scope are associated with the Chestnut Ridge area.

3.3.1 Soil

Although soil contamination, 136 hectares (336 acres), is spread throughout the Y-12 Plant, contamination is most extensive in the western part of the Y-12 Plant. Due to past operations, the predominant contaminants of concern are uranium and mercury, although other contaminants, such as PCBs, cesium, beryllium, and radium, are present.

Early actions have been completed to excavate contaminated soils from the Y-12 Firing Range and Basin 9822. However, final decisions on the remediation strategy for soil are expected in late 2001 or 2002. The anticipated remedial action is the removal, treatment, and disposal (in the EMWMF) of soil contributing to future worker (industrial) risk. Some soil will be treated in place to remove mercury. Scrap will be removed from the site. By 2006, approximately two-thirds of the soil will be remediated. It is expected that uranium-238 and mercury in surface soils will remain at levels acceptable for industrial use. Mercury will remain below 0.6 meters (two feet), especially under buildings. The residual contamination will be scattered and an approximation of volume is not possible.

Soil Long-Term Stewardship Activities

Due to the residual contamination, long-term stewardship activities, such as access restrictions, institutional controls, and monitoring, will be required. Specific requirements for the Upper East Fork Poplar Creek portion will be documented in the ROD, with the details developed in a future land use control implementation plan to be developed after the CERCLA ROD is signed. The Y-12 Plant has an ongoing Defense Program mission that is assumed to continue for the foreseeable future. Access to the controlled industrial area is assumed to be restricted to workers through signs and fences. The excavation of soils will be limited to a depth of 0.6 meters (two feet) within the controlled area and to a depth of three meters (ten feet) in the unrestricted industrial area. These controls will be implemented through a permit program maintained by DOE. Regular monitoring will occur in accordance with agreements reached during closure. Effectiveness of the remedial actions and long-term stewardship activities will be validated and verified through the CERCLA five-year review process. Monitoring efforts will decrease over time as site conditions stabilize.

3.3.2 Groundwater

Groundwater contamination caused by multiple historic releases associated with the Y-12 Plant, extends over the southern half of the Upper East Fork Poplar Creek Portion, 162 hectares (400 acres). The contaminated area, consisting of a series of interconnected carbon tetrachloride groundwater plumes under the southern portion of the Y-12 Plant, extends offsite into Union Valley. Shallow (less than 30 meters (100 feet) deep) and deeper (greater than 30 meters (100 feet) deep) aquifers contain contaminants; however, most contaminants are transported through the shallow aquifer. The design of a groundwater extraction and treatment system to treat the contaminated groundwater plume that extends offsite is in progress as part of an interim action. By 2006, offsite migration into West Union Valley will have been halted by the East End Volatile Organic Compound Plume pump-and-treat activity. However, the predominant contaminants of concern, carbon tetrachloride, trichloroethylene (TCE), tetrachloroethylene (PCE), 1-2 dichloroethylene (DCE), arsenic, and nitrate, will remain onsite. Data indicate that dense non-aqueous phase liquids (DNAPLs), such as organic solvents, may also be present.

The final groundwater remediation has been deferred from all negotiations. There has been significant disagreement on the strategy, so the Federal Facility Agreement parties agreed to implement actions to prevent source contaminant releases and monitor the effects on groundwater before negotiating a final groundwater strategy. The groundwater contamination conditions are complex since the geology is karstic (fractures) and flow paths of contaminants are difficult to track. The sources of groundwater contamination are not well identified, contamination is deep, and secondary sources (free products) are assumed to be found hundreds of feet deep. For cost-estimating purposes, DOE assumes that, beyond 2015, a passive groundwater containment system on the eastern end of the Y-12 Plant will be the only groundwater action. The final remedial decision on groundwater will not be made until well after 2006 (assumed to be no earlier than 2010); however, interim remedial decisions to extract groundwater at the east end of the Plant are scheduled to begin this year (2000).

Groundwater Long-Term Stewardship Activities

Based on the interim action and the proposed remedial action, the required long-term stewardship activities will include surveillance and maintenance of the engineered controls, groundwater monitoring, and enforcing of institutional controls. Upper East Fork Poplar Creek engineered controls include extraction and ex-situ treatment of the East End groundwater plume. The groundwater monitoring wells will be flushed every 10 years and replaced at 50-year intervals. The controls will be in place with no end date planned. The exception is that the existing water treatment system is planned to be converted to a passive system by 2015. Groundwater will continue to be monitored.

DOE is committed to maintaining necessary land use controls to ensure that unacceptable exposures to residual contamination do not occur. A ROD has been signed to implement deed restrictions in the contaminated portion of Union Valley, where contamination has migrated from the Plant. Specific requirements for groundwater under the Y-12 Plant will be documented in other ROD(s) and detailed in future land use control implementation plan(s) to be developed after CERCLA ROD(s) are signed. These controls will be implemented through a permit program maintained by DOE. Regular monitoring will occur in accordance with agreements reached during closure. Effectiveness of the remedial actions and long-term stewardship activities will be validated and verified through the CERCLA five-year review process.

3.3.3 Engineered Units

The engineered units associated with the Upper East Fork Poplar Creek portion are located on Chestnut Ridge. The largest units are the five landfills (two construction/demolition landfills and three industrial landfills) used for Y-12 operations. These landfills are not associated with the remediation activities on the Reservation and will be closed eventually (after 2006) under State solid waste regulations. The landfills occupy approximately 20 hectares (45 acres) of land and have the potential to contain 1,656,000 cubic meters (2,168,000 cubic yards) of waste (non-hazardous). Once the landfills are closed, they will be capped in accordance with TDEC solid waste regulations.

On the same ridge as the landfills are several hazardous waste units, including two quarries (Rogers and Kerr Hollow), a coal ash pond (known as the Filled Coal Ash Pond), a Gully soil pile, and three capped areas. The Rogers quarry is approximately four hectares (ten acres) and the Kerr Hollow quarry is one hectare (three acres). The Rogers quarry contains coal ash, ammunition, and classified material from the Y-12 Plant, which are covered at the bottom by gravel. The Kerr Hollow quarry contains reactive material and plant debris, some of which was removed in an early remedial action. The exact volume of residual contamination is unknown in both quarries. The Filled Coal Ash Pond is four hectares (nine acres) with 188,300 cubic meters (246,300 cubic yards) of coal ash that was closed in place under a CERCLA ROD. The Gully soil pile of less than 0.4 hectare (one acre) contains less than 8,000 cubic meters (10,000 cubic yards) of plant (mercury) soil with a vegetative cover. The three capped areas include (1) a two-hectare (four-acre) area, known as the Sediment Disposal Basin, which contains 8,000 cubic meters (10,000 cubic yards) of soils, sludges, methanol, metals, and other organics; (2) a two-hectare (six-acre) area, called the Security Pits, with 15,000 cubic meters (20,000 cubic yards) of classified uranium contaminated material, beryllium, thorium and volatile organic compounds in trenches and auger holes; and (3) a 0.4-hectare (one-acre) area, called the United Nuclear Corporation Landfill, which contains 31,000 cubic meters (40,000 cubic yards) of uranium contaminated soils and debris. The hazardous waste units are assumed to be capped in place.

Engineered Units Long-Term Stewardship Activities

The required long-term stewardship activities will include maintaining caps, monitoring groundwater, and enforcing institutional controls. Caps are assumed to require periodic replacement and will be maintained in accordance with closure decisions or appropriate regulations. Specific requirements for the Chestnut Ridge sites will be documented in a future ROD and detailed in a land use control implementation plan. The land will remain under DOE ownership and current land use controls will be maintained. The closure plan for the industrial landfills under state regulations will include long-term stewardship requirements, such as monitoring and maintenance of the engineered cap for 30 years.

3.3.4 Estimated Long-Term Stewardship Costs for Upper East Fork Poplar Creek Watershed

The Upper East Fork Poplar Creek Watershed is anticipated to require long-term stewardship activities, including

monitoring and maintaining engineered units, monitoring groundwater, and enforcing institutional controls. For cost estimating purposes, DOE assumes that the engineered caps and the horizontal well will be replaced at 50-year intervals. The groundwater monitoring wells will be flushed every ten years and replaced at 50-year intervals, resulting in a peak in long-term stewardship costs around the year 2050. These controls will be in place, with no end date planned. The exception is that the existing water treatment system is planned to be converted to a passive system by 2015, resulting in a cost reduction. Regular monitoring will occur in accordance with agreements reached in the ROD. Effectiveness of the remedial actions and long-term stewardship activities will be validated and verified through the CERCLA five-year review process. Monitoring efforts and costs will decrease over time as a result of stabilizing site conditions. Although costs are only estimated to FY 2070, DOE anticipates that long-term stewardship activities will be required in perpetuity at most areas.

Currently, the environmental remediation project costs for the Reservation are not estimated by portion (watersheds), but rather, by three major areas (Oak Ridge National Laboratory, Y-12 Plant, and East Tennessee Technology Park). The estimated long-term stewardship costs for the Upper East Fork Poplar Creek Watershed Portion are based on a percentage of the Y-12 Plant's long-term stewardship costs.

Long-Term Stewardship Costs (Constant Year 2000 Dollars)							
FY 2000 - FY 2010	***FY 2011 - FY 2020***	***FY 2021 - FY 2030***	***FY 2031 - FY 2040***	***FY 2041 - FY 2050***	***FY 2051 - FY 2060***	***FY 2061 - FY 2070***	***Estimated Total***
$11,005,000	$9,050,000	$6,235,000	$5,364,000	$14,525,000	$4,099,000	$5,679,000	$55,957,000

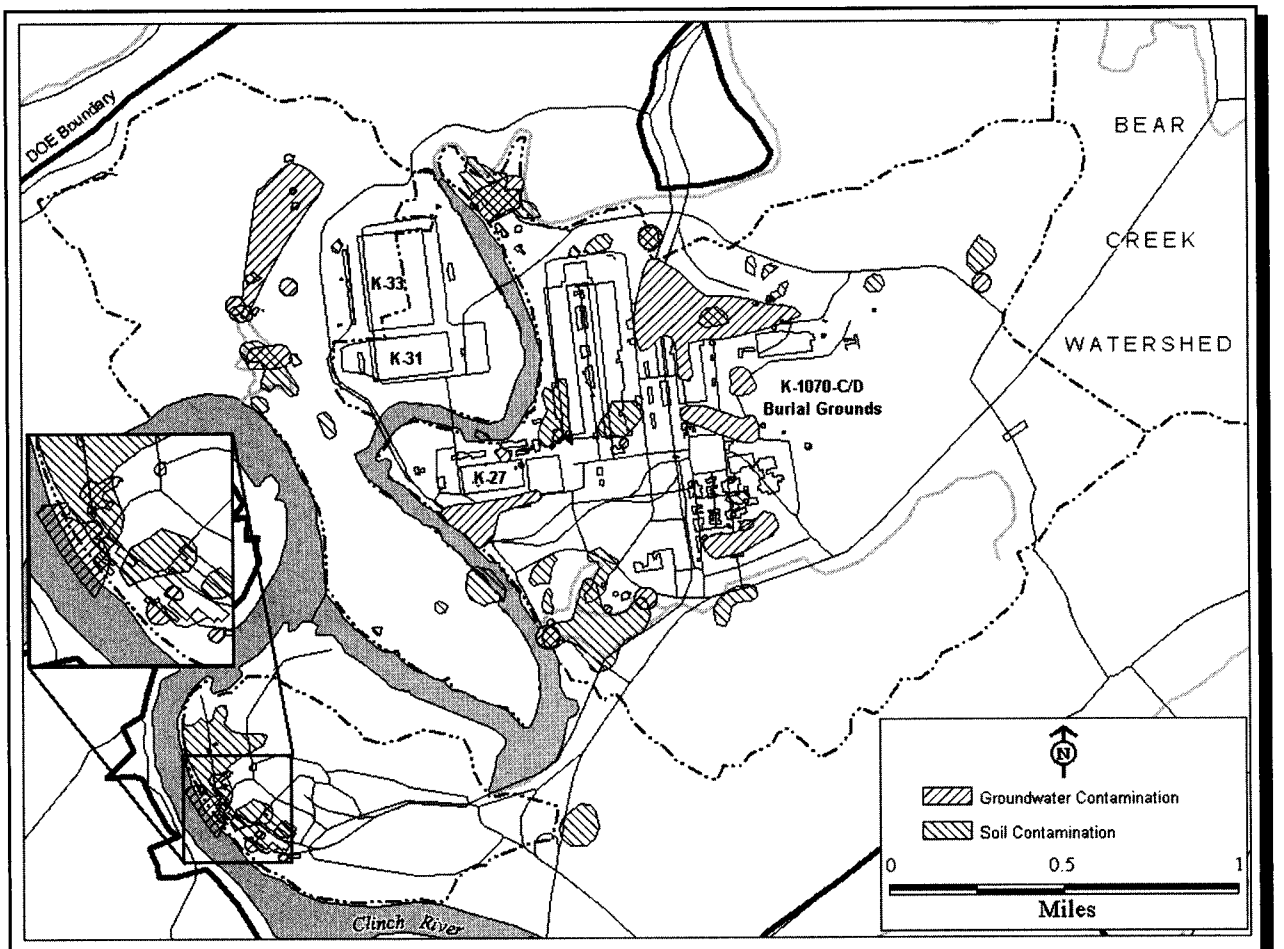
3.4 East Tennessee Technology Park Watershed Portion

East Tennessee Technology Park (formerly known as the K-25 Site) was built in 1943, during World War II, as part of the Manhattan Project to supply enriched uranium for nuclear weapons production. The K-25 building was the first diffusion facility for large-scale separation of uranium-235. Now, East Tennessee Technology Park is an inactive gaseous diffusion plant. As a result of past process activities, soil and groundwater are contaminated. The soil is contaminated primarily with radionuclides, and the groundwater with volatile organic compounds. Solid waste was disposed in burial grounds in several locations. Contamination moving from the subsurface to buried storm drains has exited to adjacent surface water bodies. Although the surface water is relatively clean, as a result of early remediation actions, the sediment and fish in adjacent ponds are contaminated with PCBs, metals, and radionuclides. The East Tennessee Technology Park facility is identified as a portion because it has multiple, interrelated contaminated areas with commingled plumes. A single land-use decision (unrestricted industrial) is anticipated for most of the portion and will necessitate a single set of land use controls.

EAST TENNESSEE TECHNOLOGY PARK WATERSHED PORTION HIGHLIGHTS

Major Long-Term Stewardship Activities - monitoring groundwater; enforcing institutional controls
Portion Size - 405 hectares (1,000 acres)
Estimated Volume of Residual Contaminants - soil unknown; groundwater unknown
Long-Term Stewardship Start-End Years - 2000-in perpetuity
Average Annual Long-Term Stewardship Costs FY 2000-2006 - $481,000

East Tennessee Technology Park is likely to be divided into two portions for decision making: the area outside the fence (Zone 1) and the area inside the fence (Zone 2). Surface facilities will be removed, the surface water and sediment restored to its highest classified use (recreational), and subsurface features decontaminated to limit the need for institutional controls. All engineered units (i.e., burial grounds) currently containing contamination will be removed, treated, and disposed at the Environmental Management Waste Facility and offsite. Therefore, no institutional controls will be needed for facilities, surface water bodies, or engineered units. Consequently,



East Tennessee Technology Park Watershed

these contaminated media are not addressed in this section.

Currently, DOE is reindustrializing portions of the East Tennessee Technology Park. DOE retains responsibility for all residual contamination and will complete the remediation of the Plant.

3.4.1 Soil

Approximately 400 hectares (1,000 acres) of potentially contaminated soil are located in the East Tennessee Technology Park within two zones, either outside or within the current fence (Zone 1 and Zone 2, respectively). In both zones there are two dominant types of soil contamination. Shallow soil is contaminated by radionuclides (uranium and small amounts of metals) as a result of surface spills, fallout, and surface runoff. Some areas of the surface have PCB contamination from electrical switchyards, beryllium contamination around buildings that used this metal, and chromium contamination around cooling towers. Much of this contamination is below applicable risk levels, although there are some unacceptable risks to future users of the site. Subsurface soil was contaminated as a result of subsurface leaks in pipelines and tanks or from burial grounds. This soil tends to be contaminated with more mobile contaminants, such as volatile organic compounds. The contamination levels are high in some areas, especially near the historic waste processing areas in Zone 2 (inside the fence) as a result of waste pipeline leaks. In Zone 1 (outside the fence) operational processes did not transport waste through the subsurface. In general, Zone 1 soils (outside the fence) are less contaminated than Zone 2 soils (inside the fence).

However, there continue to be uncertainties related to the extent of contamination, especially the depth of soil contamination. Consequently, the CERCLA decision-making process is in its early stages, and a remedial decision is not likely until 2004. However, there is a verbal understanding between the Federal Facility Agreement parties that the top three meters (ten feet) of soil are likely to be remediated to industrial use criteria. If similar strategies for remediation (excavation of contamination to three meters (ten feet)) are used in both zones, it is likely that no significant volumes of contaminated soil will remain in Zone 1 (except perhaps under the K-1070-A burial ground), while significant volumes of contaminated soil (volatile organic compounds) will remain at depths in Zone 2.

Soil Long-Term Stewardship Activities

Based on the assumption that contaminated soils in the top three meters (ten feet) will be removed and residual contamination will remain, below three meters (ten feet) in some locations, long-term stewardship activities such as institutional controls, will be required. Institutional controls for East Tennessee Technology Park include subsurface land (below three meters (ten feet)) restrictions, implemented through notices placed on the original acquisition records for DOE and through a permit program maintained by DOE (excavation permits below three meters (ten feet)). Specific requirements for East Tennessee Technology Park will be documented in future RODs, while the details will be developed in future land use control implementation plans. DOE will continue to ensure that the East Tennessee Technology Park area is not used for residential or agricultural purposes but rather for industrial use.

3.4.2 Groundwater

Groundwater monitoring at the East Tennessee Technology Park shows contamination in approximately 10 hectares (20 acres) of the site. Leaks of waste transfer pipelines, underground storage tanks, and impoundments have resulted in the release of radionuclides and volatile organic compounds. Contamination has also moved into groundwater from disposal practices, especially at the K-1070-A and K-1070-C/D burial grounds. The most frequently detected contaminants are trichloroethylene (TCE), tetrachloroethylene (PCE), various dichloroethylene (DCE) isomers, methylene chloride, and chloroform. Contamination in groundwater migrates though the bedrock and vadose zone. However, there is evidence of natural biodegradation occurring in some of the plumes at the East Tennessee Technology Park. All plumes are similar in nature and often commingled underneath the East Tennessee Technology Park. Contamination of groundwater primarily exists under the plant, but some volatile organic compound contamination from a burial ground has been found outside the fence but within the DOE property boundary. No known contamination is leaving the site at levels above regulatory limits.

The final groundwater remediation strategy has been deferred from all negotiations. There is significant disagreement on the strategy, so the Federal Facility Agreement parties have agreed to implement actions to prevent source contaminant releases and monitor the effects on groundwater before negotiating a final groundwater strategy. For cost-estimating purposes, the strategy is assumed to be natural attenuation, with no active restoration. Final groundwater remedial decisions will not be made until after 2006 (assumed to be no earlier than 2010).

Groundwater Long-Term Stewardship Activities

Based on the assumed remedial strategy, DOE will monitor groundwater to assess natural attenuation and to ensure that groundwater does not migrate offsite nor cause a problem in nearby surface water bodies, including Mitchell Branch and the K-1007 and K-901-A Ponds. To ensure that unacceptable exposures to residual contamination do not occur, DOE will maintain land use restrictions. Specific requirements for East Tennessee Technology Park will be documented in future RODs and will be detailed in future land use control

implementation plans. Institutional controls for East Tennessee Technology Park will likely include groundwater use restrictions (i.e., notices placed on the original acquisition records for DOE and a permit program maintained by DOE). In addition, the effectiveness of any remedial actions and residual groundwater contamination will be monitored as frequently as needed to identify changing conditions and will be reported at least every five years during the five-year review process.

3.4.3 Estimated Long-Term Stewardship Costs for East Tennessee Technology Park Watershed

Long-term stewardship activities that are anticipated for the East Tennessee Technology Park Portion include monitoring groundwater and enforcing institutional controls. The current costs assume no active groundwater restoration (only natural attenuation), and there are no appreciable anticipated changes in requirements over time. Although costs are only estimated to FY 2070, DOE anticipates that long-term stewardship activities will be required in perpetuity at most areas.

Long-Term Stewardship Costs (Constant Year 2000 Dollars)							
FY 2000 - FY 2010	*FY 2011 - FY 2020*	*FY 2021 - FY 2030*	*FY 2031 - FY 2040*	*FY 2041 - FY 2050*	*FY 2051 - FY 2060*	*FY 2061 - FY 2070*	*Estimated Total*
$5,334,000	$3,375,000	$3,489,000	$3,524,000	$3,317,000	$3,371,000	$3,488,000	$25,898,000

3.5 Melton Valley Watershed Portion

While Oak Ridge National Laboratory's main plant is located in Bethel Valley, most of its active and inactive waste management areas are in neighboring Melton Valley. Contamination in Melton Valley originated from operations of the Oak Ridge National Laboratory and other facilities over a 50-year period. Oak Ridge National Laboratory's historic missions of plutonium production and chemical separation during World War II and development of nuclear technology during the postwar era produced a diverse legacy of waste. In addition, from 1955 to 1963, Oak Ridge National Laboratory served as a major disposal site (known as the Southern Regional Burial Ground) for wastes from over 50 offsite government-sponsored installations, research institutions, and other isotope users. Transport from waste disposal areas to surface water via subsurface flow paths (e.g., leachate migration) is the predominant contaminant migration pathway. The contaminated areas in Melton Valley may be grouped for descriptive purposes as follows:

MELTON VALLEY WATERSHED PORTION HIGHLIGHTS

Major Long-Term Stewardship Activities - maintaining engineered barriers; monitoring groundwater; enforcing institutional controls
Portion Size - 648 hectares (1,600 acres)
**Estimated Volume of Residual Contaminants* - soil 420,000 cubic meters (550,000 cubic yards); groundwater unknown; surface water/ sediment 166,300 cubic meters (217,500 cubic yards); engineered units 2,627,000 cubic meters (3,815,000 cubic yards); facilities 1,500 cubic meters (2,000 cubic yards)
Long-Term Stewardship Start-End Years - 2000-in perpetuity
Average Annual Long-Term Stewardship Costs FY 2000-2006 - $1,124,000
*The estimated volume indicates only the known amounts of residual contaminants.

- inactive waste disposal sites containing buried radiological and chemical wastes;
- inactive liquid waste seepage pits and trenches;
- several inactive wastewater impoundments;
- abandoned underground liquid waste transfer pipelines and associated historic leak and spill sites;
- secondary contamination of soil adjacent to contaminant sources;
- contaminated floodplain soil and sediment;

- various inactive facilities and structures with no designated future use (excess); and
- deep-injected radiological waste and grout mixtures associated with four formerly used hydrofracture test/waste disposal facilities.

In general, the major problems in the watershed include (1) continuing contaminant releases (e.g., strontium-90, tritium, cesium-137) from sources to groundwater and surface water; (2) the presence of high inventories of short half-life radiological waste and lesser quantities of long half-life material, particularly within the burial grounds; and (3) widespread distribution of radiological contaminants in soil and groundwater. Contamination is present in soil, groundwater, surface water/sediments, engineered units, and facilities. Approval of a ROD for the Melton Valley watershed should occur in FY 2000. However, the ROD will not address two inactive reactors (Homogeneous Reactor Experiment and Molten Salt Reactor Experiment), active units, and contaminated units that are within Melton Valley but outside the Melton Valley watershed ROD area. The selected remedy will isolate, treat, or remove most of the known sources of contamination in the watershed and significantly reduce the release of contaminants from source areas into streams that carry contamination offsite. The eastern portion of Melton Valley, which contains the reactor sites, will be remediated to a condition that allows industrial use with limited restrictions. Much of the central and western portion of Melton Valley, occupied by the waste disposal sites, will continue to be a waste management area with wastes contained in place and access restricted.

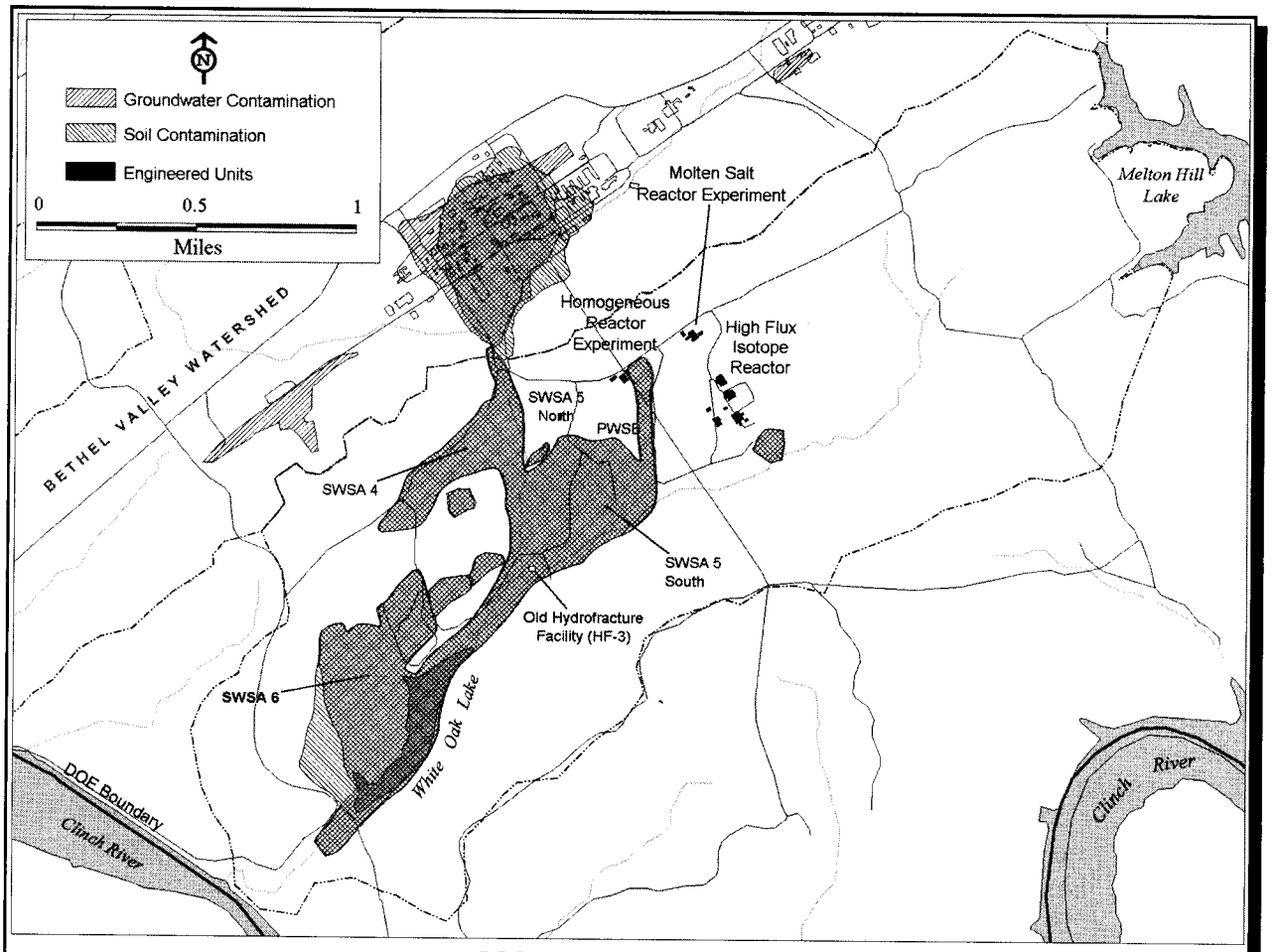
The Melton Valley Watershed ROD establishes two different remediation areas related to reasonably anticipated future land uses. However, the land use control objectives for the areas are similar. Acceptable uses of the remediation areas within the Melton Valley watershed include: industrial activities associated with ongoing Oak Ridge National Laboratory operations; remediation activities, including environmental monitoring of ground and surface water; surveillance and maintenance activities, including inspections or walkdowns of waste management areas; and routine security patrols. The land use controls are implemented through the permit program and through engineered controls, such as DOE excavation fences/gates, signs, and caps.

3.5.1 Soil

Soil in Melton Valley is treated as a single medium because the contaminants, causes of contamination, and remedial action objectives (e.g., mitigate further impact to groundwater, protect surface water, and protect post-remediation workers) are similar throughout the valley. (Note: Soil in this context does not include floodplain soil, which is combined with the surface water/sediment discussion.) Two hundred and twenty-five hectares (555 acres) of soil in Melton Valley are contaminated primarily with radionuclides, such as cesium-137 and cobalt-60. Causes of soil contamination include:

- material spills on the surface;
- contaminated biological material, including leaves and animal droppings;
- pipeline leaks;
- contaminated seepage during operation of the Seepage Pits and Trenches; and
- migration of contaminated seepage and groundwater originating as leachate in primary source areas, such as waste burial trenches.

Surface-contaminated areas range in size from small hot spots for material spills to areas less than 0.4 hectare (one acre) for most pipeline leaks. The primary subsurface contamination will be along contaminant migration pathways between sources and surface water. The many contaminated soil areas within the watershed release



Melton Valley Watershed

contaminants into common groundwater and surface water paths.

The remedial action for soils will generally be limited to the top three meters (ten feet) in the industrial area (eastern portion of the Melton Valley watershed containing the reactor sites) and to the top 0.6 meter (two feet) in the waste management area (western portion of the watershed containing the burial grounds). Contamination in the surface soils will be removed or covered to decrease potential risk to workers. Contamination in the subsurface (i.e., in secondarily contaminated areas along seepage discharge routes from source units) will generally remain in place unless contributing to surface water exceedances of standards, in which case it will be removed, capped, or treated. Soil remediation will only be partially completed by 2006. The estimated volume of residual contamination is 420,000 cubic meters (550,000 cubic yards). Residual contamination will exist below the prescribed remediation depths. The depth and extent of contaminated soil below the remediation levels is uncertain, but could extend down to bedrock or below in some cases.

Soil Long-Term Stewardship Activities

The selected remedial action will determine the required long-term stewardship activities for the Melton Valley Watershed. However, to ensure that unacceptable exposures to residual contamination do not occur, DOE will maintain necessary land use restrictions, including institutional controls. Specific requirements for Melton Valley are documented in the ROD, which is nearing signature, and will be detailed in a future land use control

implementation plan, which will be developed after the CERCLA ROD is signed. Institutional controls will include restricting access and prohibiting soil excavation through a permit program.

Contaminated soils contained in place with engineered caps require periodic surveillance, maintenance, and replacement of the caps.

3.5.2 Groundwater

A relatively continuous zone of groundwater contamination exists throughout Melton Valley, approximately 300 hectares (700 acres). Exceedances of Safe Drinking Water Act MCLs for chemicals (primarily organics) and radionuclides (primarily tritium and strontium-90) currently occur in groundwater in virtually all areas of the watershed. The degree of contaminant release to groundwater depends on the mode and duration of water contact with waste or contaminated material. For example, contaminant sources that are perennially inundated have a higher release potential than those that are above the water table. For the Melton Valley Watershed, five of the six most important contaminant-releasing subbasins have a large percentage of their contaminant inventory in perennially inundated trenches. Seasonal inundation and direct infiltration affect most other waste units to some extent. In the watershed, most contaminants derived from near-surface contaminant sources follow shallow, fracture-controlled seepage pathways, which discharge to local streams. Consequently, groundwater outside the current zone of groundwater contamination is not expected to exceed MCLs.

However, at least one zone of groundwater contamination is linked to the deeply injected wastes associated with the hydrofracture waste disposal process. The grouted waste and associated highly contaminated fluids have permeated fractures in the shale bedrock to distances in excess of 300 meters (1,000 feet) horizontally from the injection wells. The bedrock permeability is very low at depths of 200 to 300 meters (800 to 1,000 feet) below ground, where the grout was injected and fluid migration rates are slow in the deep, briney zone. Technically, retrieval of this contaminated material is all but impossible given current technologies.

As an interim action to minimize migration of contaminants from groundwater to surface water, sources of contamination have been controlled by using interceptor trenches and sumps to collect shallow groundwater. The final remedy for groundwater has been deferred to a future CERCLA decision. The purpose of the deferral was to allow the impacts of the source control actions on groundwater to manifest themselves, especially given the complexity of the geology and groundwater contamination conditions. For cost-estimating purposes, DOE assumes only continuation of shallow groundwater collection with no active restoration. The source control actions on the burial grounds are expected to reduce contaminant concentrations and flux in the groundwater but not to restore the groundwater to drinking water standards.

Groundwater Long-Term Stewardship Activities

Based on the assumed remedial strategy, DOE will monitor the groundwater in accordance with agreements reached during closure. Effectiveness of the remedial actions and long-term stewardship activities will be validated and verified through the CERCLA five-year review process. DOE assumes, for costing purposes, that any necessary groundwater interception/treatment trenches and wells will be replaced at 50-year intervals. To ensure that unacceptable exposures to residual contamination do not occur, DOE will maintain land use restrictions, including institutional controls, for as long as they are necessary. Specific requirements for Melton Valley have been documented in the ROD and will be detailed in a land use control implementation plan to be developed after the watershed ROD is signed. Land use controls will include a DOE-administered permit program that will require appropriate safeguards and precautions whenever contaminated groundwater is expected to be encountered.

3.5.3 Surface Water/ Sediment

Approximately 59 hectares (145 acres) of interconnected surface water bodies and sediment are contaminated in Melton Valley. Although diminished by several significant actions taken between 1994 and 1996, strontium-90 and tritium continue to be released in exceedance of MCLs and recreational risk levels. Contamination from groundwater, surface runoff, and storm flow releases have resulted in cesium-137 in sediment and floodplain soil.

The main contaminant migration pathway is White Oak Creek, which is fed by natural runoff and springs. However, the creek also receives process water discharges, treated sewage effluent, and cooling water from laboratory facilities in Bethel Valley before flowing into Melton Valley. White Oak Creek discharges to the Clinch River over White Oak Dam and a separate sediment retention structure implemented as an early interim action. The drainage area of the Melton Valley Watershed at the mouth of the White Oak Creek is approximately 16 square kilometers (6.2 square miles). Based on risk calculations, surface water releases beyond the waste management area are occurring that could be a risk to a hypothetical residential user. Source control actions, such as capping the burial grounds, are currently being planned and will significantly reduce contaminant contributions to surface water. Upon completion of these interim remedies, ambient water quality criteria for the protection of human health and aquatic organisms are anticipated to be met in all waters of the State in Melton Valley. The target remediation goal for surface water in White Oak Creek at the confluence with the Clinch River is to meet acceptable residential risk limits. This will occur after 2006. Remediation of surface water is based on the State of Tennessee's stream use classification (e.g., recreational), but DOE does not foresee recreational use of Melton Valley in the future.

The most contaminated areas of floodplain soil (exposure rate greater than 2,500 microR/hour) and sediment will be dredged and disposed at the EMWMF. The remainder of the contaminated floodplain soils (less than 2,500 microR/hour) and sediment will attenuate naturally to remediation levels within 200 years. However, the final remedial decision for these floodplain soils and sediments will be deferred until after 2006. The volume of residual contamination remaining in the floodplain soils and sediment is estimated to be 166,300 cubic meters (217,500 cubic yards).

Surface Water/ Sediment Long-Term Stewardship Activities

Based on the selected remedy, the required long-term stewardship activities will include monitoring surface water and enforcing a permit program. To ensure that unacceptable exposures to residual contamination do not occur, DOE will maintain necessary land use restrictions. Specific requirements for Melton Valley are documented in the Melton Valley ROD and will be detailed in the land use control implementation plan, which will be developed after the CERCLA ROD is signed. Institutional controls will include restricting access and prohibiting sediment excavation through a permit program.

3.5.4 Engineered Units

The Melton Valley watershed has 53 hectares (130 acres) of mixed waste and low-level waste units that release contaminants into common ground and surface water migration paths. The principal waste units include burial grounds, seepage pits and trenches, hydrofracture units (grout sheets and wells), and impoundments, as discussed in the following paragraphs.

Beginning in 1943, solid low-level waste was disposed by shallow land burial. The primary waste burial sites in Melton Valley are Solid Waste Storage Areas (SWSAs) 4, 5, and 6. Early burial procedures used unlined trenches and auger holes covered by either soil from the trench excavation or a combination of concrete caps and

soil. The concrete caps were used for disposal of high-activity radioactive wastes or wastes with transuranic constituents. These procedures ceased in 1986, when Oak Ridge National Laboratory began placing solid low-level waste in below-surface concrete-lined silos in SWSA 6. In 1970, the Atomic Energy Commission (a predecessor agency to DOE) established a transuranic waste classification that required solid waste to be segregated and stored pending final determination of long-term disposal. SWSA 5 North was designated as the transuranic storage area. Twenty-three trenches in SWSA 5 North are now considered retrievable storage for transuranic waste, which will be removed and disposed at the Waste Isolation Pilot Project. All the burial sites, containing approximately 600,000 curies of radioactive waste, will be hydraulically isolated through containment in place using a combination of multilayer caps, upgradient diversion trenches, and downgradient collection drains. The groundwater collected from the drains will be treated before release. Only SWSA 4 will have been remediated by 2006. Most of the current contamination will remain. Estimated material remaining in the burial grounds (not including surrounding soil) is 280,000-570,000 cubic meters (370,000-740,000 cubic yards).

During the early 1950s, chemically treated liquid low-level waste was disposed of in large seepage pits and trenches excavated in low-permeability soil. As intended, liquid low-level waste seeped into the surrounding clay soil. The clay soil acted as a sorption agent for some of the radionuclides. Seven seepage pits and trenches were used from 1951 until 1966, when the hydrofracture method of liquid waste disposal became operational. The seepage pits and trenches, containing approximately 400,000 curies, will be contained in place using multi-layer caps. The exceptions are two trenches that will be treated in place, using in-situ vitrification, and capped. Remediation of the seepage pits and trenches will occur after 2006. All of the current contamination will remain. The estimated volume of contaminated material (i.e., soil) in the pits and trenches is up to 57,000 cubic meters (75,000 cubic yards).

Four hydrofracture well injection sites are located in Melton Valley. Two were used for experimental purposes, but the Old Hydrofracture Facility and the New Hydrofracture Facility were used for waste disposal and resulted in the subsurface contaminated grout sheets. In the hydrofracture waste disposal process, a waste/grout slurry was pumped into the hydraulically fractured bedrock 200-300 meters (800-1,000 feet) below ground and allowed to harden. As intended, the waste and cement mixture spread in thin layers between the nearly horizontal bedrock strata for distances of several hundred feet. The cement in the grout mixture hardened to contain waste sludges, and most of the liquid in a solid form. A small fraction of radiological contaminants in the waste liquids separated from the slurry during the grout injection process. This contaminated liquid remains in the fractures and is detectable in deep monitoring wells located 300 meters (1,000 feet) from the hydrofracture waste injection sites. During operations, over 100 wells ranging in depth from approximately 180 to 300 meters (600 to 1,000 feet) deep were installed to monitor performance of the hydrofracture process. The grout sheets contain approximately 1.5 million curies of radioactive waste consisting of fission products, such as cesium-137 and strontium-90; an additional 2,000 curies of long-lived radionuclides in transuranic waste sludges were disposed in the New Hydrofracture Facility grout sheets. Under the Melton Valley ROD, the grout sheets will be left in place. Land use controls will be used to prevent inadvertent access (i.e., via drilling). The contaminated liquids surrounding the grout sheets will be monitored. Prior to 2006, the hydrofracture monitoring wells will be properly plugged and abandoned to cut off potential pathways for contaminated fluids to migrate from deep groundwater to shallower groundwater zones. The volume of residual contamination in the hydrofracture deep injection zone could be two million cubic meters (three million cubic yards) or more.

Several impoundments were created in Melton Valley to store wastewater and provide additional settling and storage capacity for liquid low-level waste. These impoundments were made of natural clays with no liners, with the exception of the Process Waste Sludge Basin that has a polyvinyl chloride liner. Impoundments in the Melton Valley Watershed include:

- Old Hydrofracture Facility Pond, which will soon be grouted and capped. The pond was an overflow

for hydrofracture operation.

- Homogeneous Reactor Experiment Pond, which has been filled, capped with asphalt, and cryogenically isolated in a technology demonstration. This pond will be excavated at a later date.
- Process Waste Sludge Basin, which is a settling basin that will be dredged and consolidated with the Old Hydrofracture Facility Pond before it is grouted.
- Emergency Waste Basin, which was built for use as a process liquid wastewater holding pond in an emergency but never received any wastewater. No action is planned.
- Four High Flux Isotope Reactor Waste Collection Basins, which were used as settling basins and will be removed.
- High Flux Isotope Reactor Cooling Tower Surface Impoundment, which was used to study chromate removal from cooling tower blowdown. The impoundment was filled with soil after use. If necessary, it will be removed to meet industrial use. Currently, this pond is not considered to require excavation.

Most impoundments (Homogeneous Reactor Experiment Pond and Four High Flux Isotope Reactor Basins) will be removed after 2006. Others will be consolidated at the Old Hydrofracture Facility Ponds, their sediments grouted and capped over with SWSA 5. Most of this work for the other two impoundments will occur prior to 2006. Residual contamination will remain only under the SWSA 5 cap.

Engineered Units Long-Term Stewardship Activities

The required long-term stewardship activities will include maintaining engineered barriers, monitoring groundwater, and enforcing institutional controls. Engineered controls for hydraulic isolation of buried wastes include multilayer caps, upgradient diversion trenches, and downgradient collection drains. At least one cap will need to be replaced within 30 years. Drains will be monitored and flushed as needed (e.g., every 10 years). Groundwater collected from the downgradient collection drains will be treated at one or more water treatment plants prior to release. Each of the engineered controls will receive periodic surveillance and maintenance.

To ensure that unacceptable exposures to residual contamination do not occur, DOE will maintain land use restrictions, including institutional controls, for as long as they are necessary. Specific requirements for Melton Valley are documented in the Melton Valley ROD and will be detailed in the land use control implementation plan to be developed after the watershed ROD is signed. Land use controls will include a DOE-administered permit program that will require appropriate safeguards and precautions whenever disturbance of the remediated area is needed. Regular monitoring will occur in accordance with agreements reached during closure. Effectiveness of the remedial actions and long-term stewardship activities will be validated and verified through the CERCLA five-year review process.

3.5.5 Facilities

An estimated 2,000 square meters (20,000 square feet) of facilities were contaminated due to past operations in Melton Valley. This includes approximately 35 inactive buildings, tanks, and other structures. The building and subsurface structures are generally of concrete block construction, and the tanks are made of steel. Surface features of contaminated buildings will be demolished and the material disposed of either in the EMWMF or offsite. The subsurface features, such as basements and underground tanks, will be decontaminated through removal of loose material, and the area will be backfilled (e.g., grout subsurface pits and vaults). Land use controls will prevent uncontrolled access to any structure that remains in place. Approximately 1,500 cubic meters (2,000 cubic yards) or less of residual contamination will remain after demolition. Only a portion of the demolition will be performed by 2006.

Facilities Long-Term Stewardship Activities

The required long-term stewardship activities will consist of surveillance and maintenance of facilities that have been deactivated before remediation and monitoring of waste that has been left in place. To ensure that unacceptable exposures to residual contamination do not occur, DOE will maintain land use restrictions, including institutional controls, for as long as they are necessary. Specific requirements for Melton Valley are documented in the Melton Valley ROD and will be detailed in the land use control implementation plan to be developed after the watershed ROD is signed. The land use controls will include a DOE-administered permit program that will require the appropriate safeguards and precautions whenever disturbance of the remediated area is needed.

3.5.6 Estimated Long-Term Stewardship Costs for Melton Valley Watershed

Long-term stewardship activities required for the Melton Valley Watershed include monitoring and maintaining engineered units, monitoring groundwater and surface water, and enforcing institutional controls. For cost-estimating purposes, DOE is assuming only continuation of shallow groundwater collection with no active restoration. DOE assumes, for cost estimating purposes, that the engineered caps and the trenches will be replaced at 50-year intervals, resulting in peaks in long-term stewardship costs between 2045 and 2060. The groundwater monitoring wells will be flushed every ten years and replaced at 50-year intervals, resulting in peaks in long-term stewardship costs around years 2045 to 2060. Replacement of water treatment equipment will cause more frequent peaks in costs. These controls will be in place with no end date planned. Regular monitoring will occur in accordance with agreements reached during closure. Effectiveness of the remedial actions and long-term stewardship activities will be validated and verified through the CERCLA five-year review process. Monitoring efforts will decrease over time as site conditions stabilize, resulting in a decrease in costs after year 2015. Although costs are only estimated to FY 2070, DOE anticipates that long-term stewardship activities will be required in perpetuity at most areas.

Currently, the environmental remediation project costs for the Reservation are not estimated by portion (watersheds), but rather, by three major areas (Oak Ridge National Laboratory, Y-12 Plant, and East Tennessee Technology Park). The estimated long-term stewardship costs for the Melton Valley Watershed Portion are a percentage of the Oak Ridge National Laboratory's long-term stewardship costs.

Long-Term Stewardship Costs (Constant Year 2000 Dollars)							
FY 2000 - FY 2010	***FY 2011 - FY 2020***	***FY 2021 - FY 2030***	***FY 2031 - FY 2040***	***FY 2041 - FY 2050***	***FY 2051 - FY 2060***	***FY 2061 - FY 2070***	***Estimated Total***
$17,308,000	$28,825,000	$29,704,000	$30,005,000	$34,561,000	$53,252,000	$29,713,000	$223,368,000

3.6 Offsite Portion

The Offsite Portion consists of sediments and surface waters leaving the Oak Ridge Reservation via White Oak Creek and Lower East Fork Poplar Creek. These discharges result in contamination of 61 kilometers (38 miles) of waterways interconnected by the Tennessee River (including Watts Bar), 55 kilometers (34 miles) of waterways interconnected by the Clinch River, and 23 kilometers (14 miles) of Lower East Fork Poplar Creek. These surface water bodies receive

OFFSITE PORTION HIGHLIGHTS

Major Long-Term Stewardship Activities - enforcing institutional controls
Portion Size - 700 hectares (1,800 acres)
Estimated Volume of Residual Surface Water/ Sediment Contaminants - unknown
Long-Term Stewardship Start-End Years - 1997-in perpetuity
Average Annual Long-Term Stewardship Costs FY 2000-2006 - $1,001,000

contamination from other sources including industrial and agricultural. Offsite groundwater contamination in Union Valley was addressed in the Upper East Fork Poplar Creek portion.

3.6.1 Surface Water/ Sediment

Approximately 700 hectares (1,800 acres) of contaminated surface water and sediment are located in the Clinch River/Poplar Creek (also including the Watts Bar and Melton Hill Reservoir sediment and biota) and the Lower East Fork Poplar Creek. The Clinch River/Poplar Creek area contains the contaminants listed in the table at right (*Clinch River/Poplar Creek Contaminants of Concern*). Contamination reaches as far as 19 kilometers (12 miles) downstream of the Reservation. Access to contamination is currently controlled through the use of dredging restrictions, fishing restrictions, and signs. An interagency agreement among DOE, TDEC, EPA, Tennessee Valley Authority and the U.S. Army Corps of Engineers, effective February 1991, provides for the coordination and review of permitting and other use activities that could result in the disturbance, resuspension, removal, and/or disposal of contaminated sediments or potentially contaminated sediments in Watts Bar Reservoir. A final remedial decision on the surface water will be made once the source remedial actions are complete on the Reservation (after 2010).

Clinch River/Poplar Creek Contaminants of Concern

Contamination Area	***Contaminant Name***
Deep Sediment	mercury, chromium, arsenic, cesium-137
Surface Water	none pervasive
Fish Tissue	PCBs

Lower East Fork Poplar Creek leaves the Y-12 Plant and flows through Oak Ridge. The creek contains primarily mercury from the Plant in surface water and sediments. In 1998, mercury in floodplain soils greater than 400 parts per million that might cause a risk to an unrestricted user or the environment was removed. However, a final decision on the surface water has been deferred to be consistent with decisions made for the Y-12 Plant (Upper East Fork Poplar Creek portion). Once the decision for the Y-12 Plant is implemented, the Lower East Fork Poplar Creek surface water will be in compliance with the National Pollution Discharge Elimination System permits, levels of mercury contamination in surface water will be reduced to 200 parts per trillion, and warning of any residual contamination will be posted.

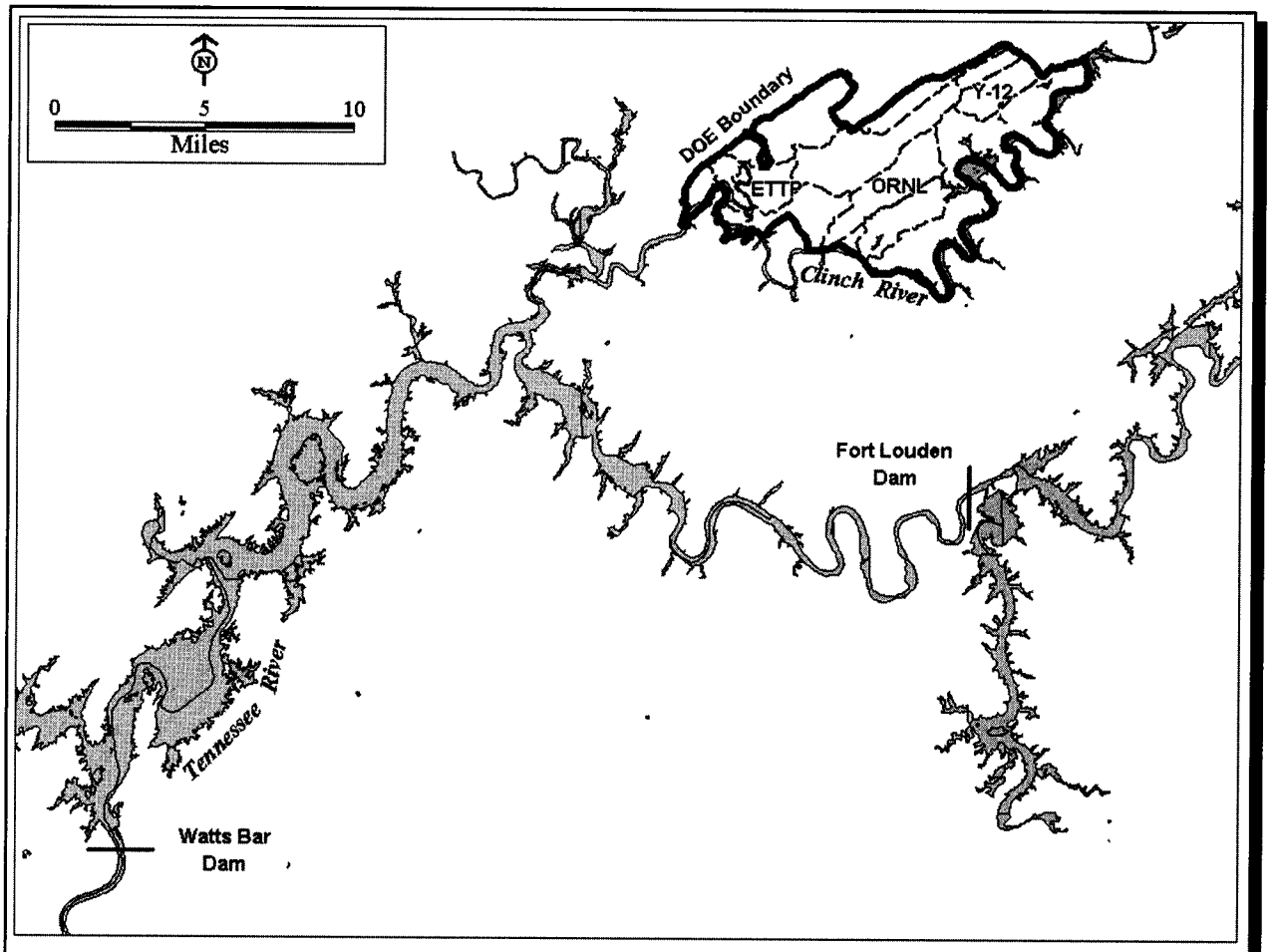
Surface Water/ Sediment Long-Term Stewardship Activities

Long-term stewardship of the Offsite Portion requires continuation of existing institutional controls on potential sediment-disturbing activities, fish consumption advisories, and annual monitoring. To ensure that unacceptable exposures to residual contamination do not occur, DOE will maintain land use restrictions, including institutional controls, for as long as they are necessary. Regular monitoring will occur in accordance with agreements reached during closure. Effectiveness of the remedial actions and long-term stewardship activities are being validated and verified through the CERCLA five-year review process.

3.6.2 Estimated Long-Term Stewardship Costs for Offsite

Costs for the Offsite Portion are included in the long-term stewardship costs for the Y-12 project. Therefore, the Offsite costs were calculated as a percentage of the Y-12 costs. As a result, the Y-12 project peaks are seen in the offsite costs; however, no peaks are expected. Although costs are only estimated to FY 2070, DOE anticipates that long-term stewardship activities will be required in perpetuity at most areas.

Currently, the environmental remediation project costs for the Reservation are not estimated by portions, but rather, by three major areas (Oak Ridge National Laboratory, Y-12 Plant, and East Tennessee Technology Park).



Offsite

The estimated long-term stewardship costs for the Offsite Portion is based on a percentage of the Y-12 Plant's long-term stewardship costs.

Long-Term Stewardship Costs (Constant Year 2000 Dollars)							
FY 2000 - FY 2010	*FY 2011 - FY 2020*	*FY 2021 - FY 2030*	*FY 2031 - FY 2040*	*FY 2041 - FY 2050*	*FY 2051 - FY 2060*	*FY 2061 - FY 2070*	*Estimated Total*
$11,005,000	$9,050,000	$6,235,000	$5,364,000	$14,525,000	$4,099,000	$5,679,000	$55,957,000

4.0 FUTURE USES

Remediation of contaminated areas on the Oak Ridge Reservation will support the following uses: approximately five percent controlled access, five percent controlled industrial (defined as industrial use for 0.6 meters (two feet)), 15 percent unrestricted industrial (defined as industrial use to three meters (ten feet)), and 75 percent unrestricted. The future land uses by portion are as follows:

- Bear Creek Valley Watershed - The contaminated portion of the valley will be controlled industrial with controlled access to the existing disposal areas.

- Bethel Valley Watershed - The Oak Ridge National Laboratory main plant area (Central Bethel Valley) is planned to be remediated to a controlled industrial land use. The remainder of the Oak Ridge National Laboratory, which is the developed area (East Bethel Valley) outside the main plant area, is planned to be remediated to unrestricted industrial land use. The burial grounds/landfills will be controlled as waste management areas with limited surface use.

- Upper East Fork Poplar Creek Watershed - The Y-12 Plant has an ongoing Defense Programs mission that is assumed to continue into the foreseeable future. Therefore, the projected future land use for the Y-12 Plant site will be controlled industrial use in the West/South Central Y-12 Plant area (Defense Programs) and unrestricted industrial use in the East/North Central Y-12 Plant area. Access to the controlled industrial area will be restricted to workers.

- East Tennessee Technology Park Watershed - The East Tennessee Technology Park will be remediated to levels compatible with unrestricted industrial use.

- Melton Valley Watershed - The eastern portion of Melton Valley, which contains the reactor sites, will be remediated to a condition that allows industrial use with limited restrictions. Much of the central and western portion of Melton Valley, occupied by the waste disposal sites, will continue to be a waste management area with wastes contained in place and access controlled.

- Offsite - The future use of the surface water and sediment Offsite Portion is dependent on source control effectively reducing the contamination leaving the Reservation. However, the surface water is currently used for recreational purposes and drinking. These uses are expected to be maintained. More than likely, use controls on the sediment will need to continue.

For additional information about the Oak Ridge Reservation, please contact:

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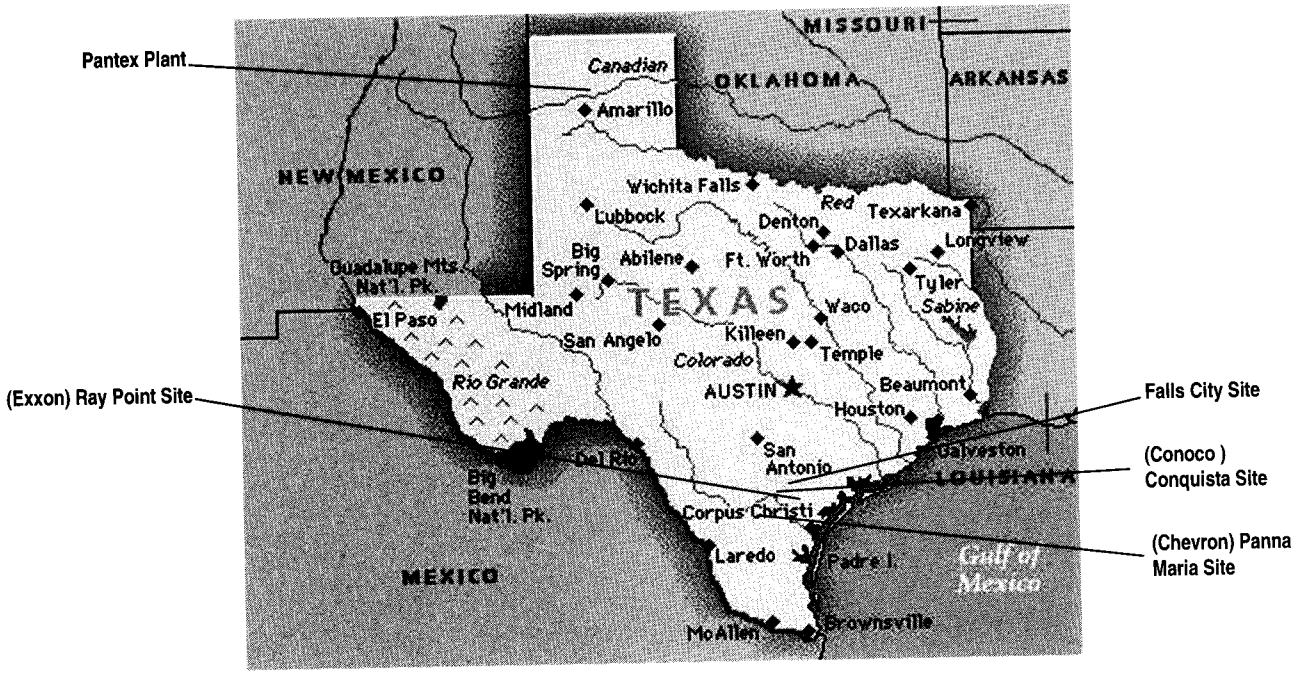
U.S. Department of Energy, Oak Ridge Operations Office
200 Administration Road
55 JEFF Building
Oak Ridge, TN 37831
Phone: 865-576-7403
or e-mail at SkinnerRM@oro.doe.gov

Texas



Long-Term Stewardship Site Highlights

(Chevron) Panna Maria Site (page 3)
Major Activities - disposal cell monitoring; groundwater monitoring; access restrictions; erosion control; maintenance; inspections
Site Size - 121 hectares (300 acres)
Start/End Years - 2001/in perpetuity
Estimated Average Annual Cost FY 2000-2006 - $26,100

(Conoco) Conquista Site (page 7)
Major Activities - groundwater monitoring; disposal cell monitoring; inspections; access restrictions
Site Size - 243 hectares (600 acres)
Start/End Years - 2002/in perpetuity
Estimated Average Annual Cost FY 2000-2006 - $38,943

(Exxon) Ray Point Site (page11)
Major Activities - disposal cell monitoring; inspections; access restrictions
Site Size - 24 hectares (60 acres)
Start/End Years - 2001/in perpetuity
Estimated Average Annual Cost FY 2000-2006 - $25,600

Falls City Site (page 15)
Major Activities - groundwater monitoring; disposal cell monitoring and maintenance; inspections; access restrictions
Site Size - 96 hectares (232 acres)
Start/End Years - 1997/in perpetuity
Estimated Average Annual Cost FY 2000-2006 - $139,300

Pantex Plant (page 21)
Major Activities - groundwater and soil cleanup; groundwater monitoring
Site Size - 4,119 hectares (10,177 acres)
Estimated Average Annual Cost FY 2000-2006 - $1.4 million

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(CHEVRON) PANNA MARIA SITE

1.0 SITE SUMMARY

1.1 Site Description and Mission

The (Chevron) Panna Maria Site is the location of a former uranium milling site that operated from 1979 to 1992. The 121-hectare (300-acre) site is owned by the Chevron Corporation and is located in Karnes County in southern Texas. The Chevron Corporation operated the mill to process uranium ore for commercial purposes. Wastes from the ore processing operations are consolidated in the onsite disposal cell, which comprises 61 hectares (150 acres) of the site.

LONG-TERM STEWARDSHIP HIGHLIGHTS

Major Long-Term Stewardship Activities - disposal cell monitoring; groundwater monitoring; access restrictions; erosion control; maintenance; inspections
Total Site Area - 121 hectares (300 acres)
Estimated Volume of Residual Contaminants - disposal cell 5.7 million cubic meters (7.4 million cubic yards); groundwater unknown
Long-Term Stewardship Start-End Years - 2001-in perpetuity
Average Annual Long-Term Stewardship Cost FY 2000-2006 - $26,100
Landlord - currently Chevron Corporation; beginning in 2001, the U.S. Department of Energy's Grand Junction Office

The current mission of the site is to complete remediation. The (Chevron) Panna Maria Site is subject to Title II of the *Uranium Mill Tailings Radiation Control Act of 1978* (UMTRCA). UMTRCA Title II sites are privately owned and operated sites that were licensed when UMTRCA was passed, or thereafter. The majority of the mining and milling conducted at these sites was for the private sale of uranium, but a portion of the uranium may have been sold to the U.S. Government. None of the ore milled at the (Chevron) Panna Maria Site was sold to the U.S. Government. As such, DOE is responsible for long-term stewardship activities but not remediation of the site. Based on ongoing discussions with the Texas Bureau of Radiation Control, DOE anticipates that the (Chevron) Panna Maria Site will be transferred from Chevron Corporation to DOE in 2001. Once the site is transferred to DOE, its only mission will be long-term surveillance and maintenance of the disposal cell, and monitoring of the groundwater.

1.2 Site Cleanup and Accomplishments

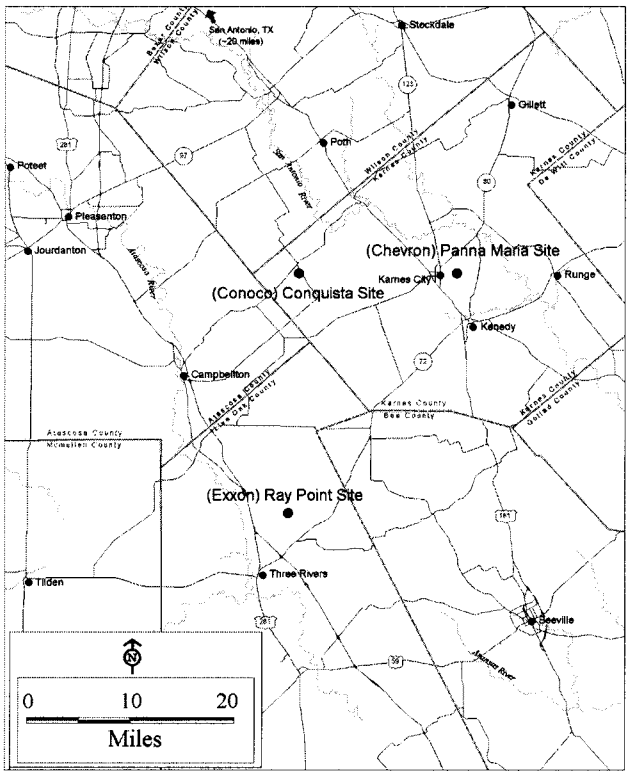
The Chevron Corporation is currently completing reclamation activities at the site. Approximately 5.7 million cubic meters (7.4 million cubic yards) of mill tailings from the former tailings pond, as well as contaminated soil and construction debris, will be encapsulated onsite. The mill tailings, soil, and construction debris are contaminated with uranium, radium, and thorium. Current plans are to consolidate all contaminated materials in an onsite engineered disposal cell. The disposal cell will be capped when remediation activities are completed. Soils surrounding the site will be remediated to levels that comply with standards set by the U.S. Environmental Protection Agency (EPA).

Groundwater at the site is contaminated with uranium as a result of the former uranium processing activities. The specific groundwater remediation strategy has not yet been determined but information from the Texas Bureau of Radiation Control indicates that alternate concentration limits (ACLs), cleanup standards that are based on site-specific considerations, have been sought for, and active remediation will not continue. For ACLs to be approved, evidence must be provided that the ACLs will not adversely impact human health or the environment.

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

The DOE Grand Junction Office will begin conducting long-term stewardship activities at the (Chevron) Panna Maria Site in 2001, when the site is transferred to DOE. To terminate the site's radioactive material license, Chevron Corporation must conduct state-approved reclamation of any onsite radioactive waste. The Texas Bureau of Radiation Control will then determine when the site will be transferred to DOE for custody and long-term care. For the site to be transferred to DOE, the Chevron Corporation must make a one-time payment to the U.S. Treasury fully funding inspections and anticipated maintenance.



(Chevron) Panna Maria Site

Access to the site will be restricted through the use of fencing and posting warning signs, as necessary, along the site boundary. Fences and signs will be repaired or replaced on an as-needed basis. DOE will staff a 24-hour phone line for reporting site concerns. Drilling and other intrusive activities will be prevented within site boundaries through the use of institutional controls.

Site records will be kept in permanent storage at the DOE Grand Junction Office in Colorado. The types of records that will be maintained include site characterization data, remedial action design information, the site completion report, long-term monitoring plans, annual inspection reports, and current and historical monitoring data. A report is submitted annually to the U.S. Nuclear Regulatory Commission (NRC) that summarizes, describes, and evaluates all surveillance and maintenance actions, as required under Title 10 of the *Code of Federal Regulations,* Part 40.

2.2 Specific Long-Term Stewardship Activities

Engineered Unit

The disposal cell will cover approximately 61 hectares (150 acres) of the 121-hectare (300-acre) site area. The cell will be designed with a low-permeability radon barrier and a grass surface layer for erosion control. Erosion control will be provided for all potentially vulnerable features, and the site will be graded to provide positive drainage. All disturbed areas will be revegetated.

STAKEHOLDER INVOLVEMENT

When licensed and transferred to DOE, copies of the annual inspection report for the (Chevron) Panna Maria Site will be distributed to the local library and any stakeholders requesting them. The annual inspection report will also be available on the DOE Grand Junction Office website at: www.doegjpo.com.

DOE will conduct annual inspections to ensure the integrity of the cell cover and other engineered features, the effectiveness of institutional controls, and the compliance of the disposal cell with applicable requirements. The disposal cell at the (Chevron) Panna Maria Site will be designed and constructed to last for remain effective for 200 to 1,000 years, in accordance with EPA standards. However, DOE's responsibility for the safety and integrity of the disposal cell is expected to continue in perpetuity.

Groundwater

Annual groundwater monitoring will be conducted at the (Chevron) Panna Maria Site to ensure that the site is in compliance with ACLs, if approved, and to demonstrate the effectiveness of the engineered disposal cell in isolating the encapsulated wastes from the local environment. Groundwater monitoring is expected to continue in perpetuity.

2.3 Regulatory Regime

Remediation of the (Chevron) Panna Maria Site is expected to be complete by 2001. Following NRC concurrence that cleanup has been achieved, NRC will issue a general license for the long-term care of the residual radioactive disposal cell (contained in Title 10 of the *Code of Federal Regulations,* Part 40.28). The purpose of the license is to ensure the site will be cared for in a manner that protects human health and safety and the environment. The license also represents that NRC formally accepts the site-specific long-term surveillance plan.

Long-term stewardship activities at the (Chevron) Panna Maria Site are governed by several requirements in the following regulations: UMTRCA; the *Atomic Energy Act of 1954,* as amended; EPA Groundwater Protection Standards, including Title 40 of the *Code of Federal Regulations*, Part 192, Subparts D and E; and the *National Environmental Policy Act of 1969,* as amended.

2.4 Assumptions and Uncertainties

Long-term stewardship costs are estimated based on actual long-term stewardship costs at similar sites currently managed by DOE. However, actual costs may vary as a result of the remediation strategies employed by the Chevron Corporation.

DOE assumes that groundwater monitoring will only be necessary on an annual basis and that ACLs will be applied to the groundwater contamination underlying the site.

The site is expected to be transferred to DOE in 2001.

3.0 ESTIMATED LONG-TERM STEWARDSHIP COSTS

The costs estimated for fiscal year (FY) 2000 are associated with preparing the site's long-term surveillance plan, and preparing the site for transfer from Chevron Corporation to DOE. The costs estimated for the remaining years are for monitoring and maintenance of the disposal cell and monitoring of the groundwater, and reflect the assumptions listed above.

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	***Amount***	***Year(s)***	***Amount***	***Year(s)***	***Amount***
FY 2000	$5,200	**FY 2008**	$35,100	**FY 2036-2040**	$170,500
FY 2001	$41,600	**FY 2009**	$35,000	**FY 2041-2045**	$170,400
FY 2002	$36,100	**FY 2010**	$34,300	**FY 2046-2050**	$170,500
FY 2003	$34,900	**FY 2011-2015**	$163,500	**FY 2051-2055**	$170,400
FY 2004	$35,300	**FY 2016-2020**	$159,200	**FY 2056-2060**	$170,500
FY 2005	$35,500	**FY 2021-2025**	$159,700	**FY 2061-2065**	$170,400
FY 2006	$34,800	**FY 2026-2030**	$168,700	**FY 2066-2070**	$170,500
FY 2007	$35,300	**FY 2031-2035**	$170,400		

4.0 FUTURE USES

Once the site's license is transferred to DOE in 2001, activity at the site is expected to be restricted to long-term monitoring and maintenance of the disposal cell and long-term monitoring of the groundwater. Under UMTRCA provisions, public access to the disposal cell will be restricted indefinitely.

For more information about the (Chevron) Panna Maria Site, please contact:

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U.S. Department of Energy, Grand Junction Office
2597 B3/4 Road, Grand Junction, CO 81503
Phone: 970-248-6037
or visit the Internet website at http://www.doegjpo.com

(CONOCO) CONQUISTA SITE

1.0 SITE SUMMARY

1.1 Site Description and Mission

The (Conoco) Conquista Site is located in Karnes County, Texas, southwest of Falls City. The (Conoco) Conquista Site is a uranium milling site site owned and operated by the Continental Oil Company (CONOCO). The (Conoco) Conquista Site encompasses 243 hectares (600 acres) and has an onsite, 101-hectare (250-acre) mill tailings disposal cell.

CONOCO's current site mission is to complete remediation activities. Once remediation is complete and the site is transferred to the U.S. Department of Energy's (DOE) Grand Junction Office in 2002, DOE's sole mission at the site will be to conduct long-term stewardship activities.

LONG-TERM STEWARDSHIP HIGHLIGHTS

Major Long-Term Stewardship Activities - groundwater monitoring; disposal cell monitoring; inspections; access restrictions
Total Site Area - 243 hectares (600 acres)
Estimated Volume of Residual Contaminants - disposal cell 5.9 million cubic meters (6.5 million cubic yards); groundwater unknown
Long-Term Stewardship Start-End Years - 2002-in perpetuity
Average Annual Long-Term Stewardship Cost FY 2000-2006 - $38,943
Landlord - Continental Oil Company; U.S. Department of Energy, Grand Junction Office (beginning in 2002)

In the early 1970s, CONOCO, in cooperation with Pioneer Nuclear Corporation, began a venture known as the Conquista Project to mine uranium and build and operate a 1,750-ton-per-day processing mill southwest of Falls City in Karnes County. The project called for mining ore by open pit methods within a 56-kilometer (35-mile radius) of the plant and hauling it back to the mill by truck. Mining began in 1971, followed by milling operation between 1972 and 1982.

The (Conoco) Conquista Site is subject to Title II of the *Uranium Mill Tailings Radiation Control Act of 1978* (UMTRCA). UMTRCA Title II sites are privately owned and operated sites that were licensed when the Act was passed or thereafter. The majority of the uranium produced at these sites was for private sale, but a portion was sold to the U.S. Government. Under UMTRCA Title II, DOE is responsible for long-term stewardship activities, by the site's owner, CONOCO, is responsible for remediation.

1.2 Site Cleanup and Accomplishments

Remedial actions at the site of the former uranium milling site were carried out by CONOCO under provisions of UMTRCA. The cost of the (Conoco) Conquista Site's reclamation and closure is borne by CONOCO, the commercial owner of the processing facility. CONOCO began decommissioning the site in 1982, and finished in 1984. The site's closure plan was submitted in 1987 and was approved in 1988, at which time the site was reclaimed to comply with applicable standards. Mill tailings, contaminated soils, and construction debris were remediated to EPA standards, and then disposed of in an unlined disposal cell. The cell was then capped with grass and soil. The cell encompasses approximately 101 hectares (250 acres), and is designed and located to achieve maximum protection from erosion and other geologic or environmental hazards, as well as provide the required protection of human health and safety and the environment. The volume of the residual contamination in the disposal cell is approximately 5.9 million cubic meters (6.5 million cubic yards). The strip mines have been converted into fish-stocked ponds, and the mill's remediated tailings pond was converted into a sustainable hay-growing business.

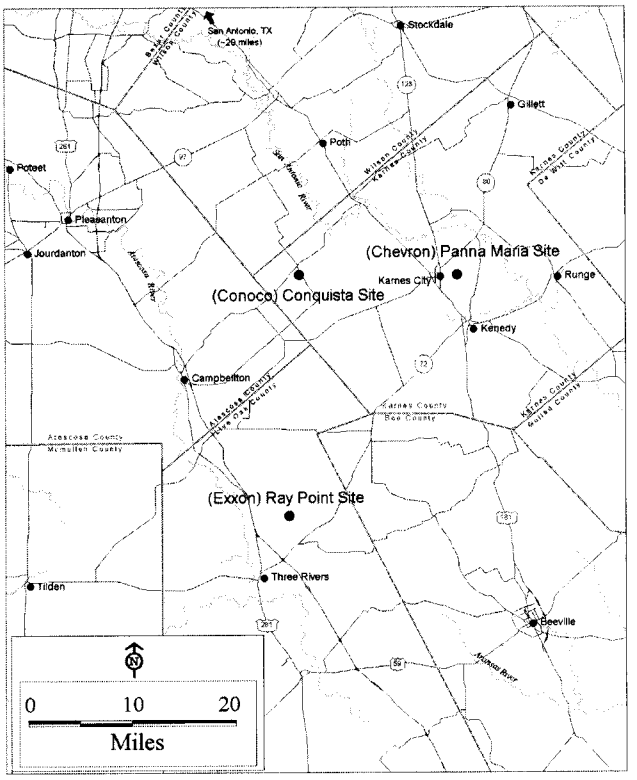
The groundwater at the site is believed to be contaminated by radionuclides, including radium and uranium. No

groundwater remediation has occurred, and supplemental standards, as defined in Title 40 of the *Code of Federal Regulations* Part 192.22, will likely be applied. Groundwater monitoring will be required to ensure compliance with the supplemental standards and the effectiveness of the disposal cell. A request has not yet been made for the application of supplemental standards to the contaminated groundwater. CONOCO is working with the State of Texas (an Agreement State) to determine if supplemental standards can be used, and will be submitting a request to the State of Texas in the near future.

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

The (Conoco) Conquista Site will be transferred to DOE's Grand Junction Office in 2002 for custody and long-term care. Upon transfer, DOE will be responsible for conducting long-term stewardship activities, including groundwater and disposal cell monitoring. DOE will be responsible for ongoing regulatory compliance at the site. DOE will inspect the site and report site conditions to the NRC annually. Inspection parameters will be developed as part of the site's long-term surveillance plan.



(Conoco) Conquista Site

The site inspections will identify conditions that might affect site integrity. The recommended changes will be evaluated, and DOE will conduct any needed maintenance or monitoring. Maintenance activities could include repairs to fences and site access controls; adjustments to drainage and construction of drainage structures to correct erosion problems; and vegetation control, including periodic mowing. Specific environmental monitoring activities will be specified in the long-term surveillance plan. Monitoring will likely include an annual inspection to ensure the integrity of the cell cover and other engineered features, and to ensure that institutional controls are effective and the site complies with applicable requirements.

Access to the site will be restricted through the use of fencing and posting warning signs, as necessary, along the site boundary. DOE will staff a 24-hour phone line for reporting site concerns. Drilling and other intrusive activities will be prevented within site boundaries through institutional control.

Site records will be kept in permanent storage at the DOE Grand Junction Office in Grand Junction, Colorado. The types of records to be kept include characterization data, the remedial action design, the completion report, the long-term monitoring plan, annual inspection reports, and monitoring data.

2.2 Specific Long-Term Stewardship Activities

> ***STAKEHOLDER INTERACTION***
>
> When licensed and transferred to DOE, the annual inspection report for the (Conoco) Conquista Site will be distributed to the local libraries and any stakeholder requesting one. The report will also be published on the GJO website at www.doegjpo.com.

Groundwater

This site has residually contaminated groundwater underlying the area around the cell. It is likely the groundwater is contaminated by radionuclides, including radium and uranium. Specific monitoring requirements will be prescribed in the site's long-term surveillance plan. However, it is likely that the groundwater will require annual monitoring for an unspecified period of time to ensure the effectiveness of the selected cleanup remedy and compliance with supplemental standards, as defined in Title 40 of the *Code of Federal Regulations* Part 192.22.

Engineered Units

DOE will conduct annual inspections of the disposal cell to ensure the integrity of the cap and other engineered features. Maintenance and repairs will be conducted on an as-needed basis. Long-term stewardship activities will continue for the disposal cell in perpetuity. The disposal cell will have access controls that include warning signs and a fence with locked gates.

2.3 Regulatory Regime

Long-term stewardship activities at the (Conoco) Conquista Site will be governed by several requirements in the following regulations: *UMTRCA*; the *Atomic Energy Act of 1954,* as amended; Title 10 of the *Code of Federal Regulations* Part 40; and the *National Environmental Policy Act of 1969.*

2.4 Assumptions and Uncertainties

DOE assumes that it will be responsible for long-term stewardship activities at the site starting in 2002.

DOE assumes the frequency of groundwater monitoring will be comparable to the groundwater monitoring frequency at similar sites.

The approval and application of supplemental standards, as defined in Title 40 of the *Code of Federal Regulations* Part 192.22, to the site's contaminated groundwater is also anticipated.

The disposal cell cap is not expected to be replaced for a least 200 years.

3.0 Estimated Long-Term Stewardship Costs

The cost estimate for the (Conoco) Conquista Site is based on the known long-term stewardship activity costs at other sites managed by DOE's Grand Junction Office that are similar to the (Conoco) Conquista Site.

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	***Amount***	***Year(s)***	***Amount***	***Year(s)***	***Amount***
FY 2000	$4,700	**FY 2008**	$52,700	**FY 2036-2040**	$255,700
FY 2001	$3,100	**FY 2009**	$52,600	**FY 2041-2045**	$255,700
FY 2002	$54,200	**FY 2010**	$51,500	**FY 2046-2050**	$255,800
FY 2003	$52,300	**FY 2011-2015**	$245,300	**FY 2051-2055**	$255,700
FY 2004	$52,900	**FY 2016-2020**	$238,700	**FY 2056-2060**	$255,700
FY 2005	$53,200	**FY 2021-2025**	$239,500	**FY 2061-2065**	$255,800
FY 2006	$52,200	**FY 2026-2030**	$253,100	**FY 2066-2070**	$255,700
FY 2007	$53,000	**FY 2031-2035**	$255,700		

4.0 FUTURE USES

The site will be a permanent uranium mill tailings repository and will continue to be used for hay production. Once NRC includes the site within DOE's general license for custody and long-term care in 2002, the disposal site will be owned by the Federal Government, which will control land use within site boundaries. DOE will perform long-term stewardship activities, as required under the NRC general license, to maintain protectiveness and regulatory compliance.

For more information about the (Conoco) Conquista Site, contact:

Art Kleinrath, Long-Term Surveillance and Maintenance Program Manager
U.S. Department of Energy, Grand Junction Office
2597 B3/4 Road, Grand Junction, CO 81503
Phone: 970-248-6037
or visit the Internet website at http://www.doegjpo.com

(EXXON) RAY POINT SITE

1.0 SITE SUMMARY

1.1 Site Description and Mission

The (Exxon) Ray Point Site is a privately owned and operated site that was formerly used for the milling of uranium ore. The site is located near the southern Texas town of Ray Point, approximately 113 kilometers (70 miles) southeast of San Antonio. The site covers approximately 24 hectares (60 acres) and has a 16-hectare (39-acre) onsite disposal cell for wastes that were generated during uranium mining operations.

LONG-TERM STEWARDSHIP HIGHLIGHTS

Major Long-Term Stewardship Activities - disposal cell monitoring; inspections; access restrictions
Total Site Area - 24 hectares (60 acres)
Estimated Volume of Residual Contaminants - disposal cell 275,400 cubic meters (360,000 cubic yards)
Long-Term Stewardship Start-End Years - 2001-in perpetuity
Average Annual Long-Term Stewardship Cost FY 2000-2006 - $25,600
Landlord - U.S. Department of Energy, Grand Junction Office (beginning in 2001)

The current mission of the site is to complete remediation of onsite radioactive mill tailings and waste. The (Exxon) Ray Point Site is subject to Title II of the *Uranium Mill Tailings Radiation Control Act of 1978* (UMTRCA). UMTRCA Title II sites are privately owned and operated sites that were licensed when UMTRCA was passed, or thereafter. The majority of the mining and milling conducted at these sites was for the private sale of uranium, but a portion of the uranium was sold to the U.S. Government. As such, the U.S. Department of Energy (DOE) is responsible for long-term stewardship activities but not remediation of the site. Based on ongoing discussions with the Texas Bureau of Radiation Control, DOE expects that the (Exxon) Ray Point Site will be transferred from Exxon Corporation (now called Exxon Mobil Corporation) to DOE's Grand Junction Office in 2001 for long-term stewardship. At that time, the only mission for the site will be the ongoing monitoring and maintenance of the disposal cell.

The historic mission of the site was the processing of uranium ore with an alkaline-leach process. The uranium milled at the site was for private sale, but a portion was sold to the U.S. Government. The (Exxon) Ray Point Site was originally owned by Susquehanna-Western, Inc., who acquired the property in 1969 and constructed a uranium mill tailings impoundment. Susquehanna-Western, Inc. operated the mill from 1970 through 1973, processing approximately 490,000 tons of ore during this period. In 1973, Exxon Corporation purchased the Ray Point tract, including the mill and tailings impoundment. No further uranium was processed at the site. In 1979, Exxon began decommissioning the mill and completed reclamation activities in 1987.

To terminate the Texas Bureau of Radiation Control license, Exxon Mobil Corporation must conduct state-approved reclamation of the site's radioactive waste. The U. S. Nuclear Regulatory Commission (NRC) will concur with the state concerning when the site will be transferred to DOE for custody and long-term care. In order for the site to be transferred to DOE, Exxon Mobil Corporation must make a one-time payment to the U.S. Treasury fully funding inspections and ongoing maintenance.

1.2 Site Cleanup and Accomplishments

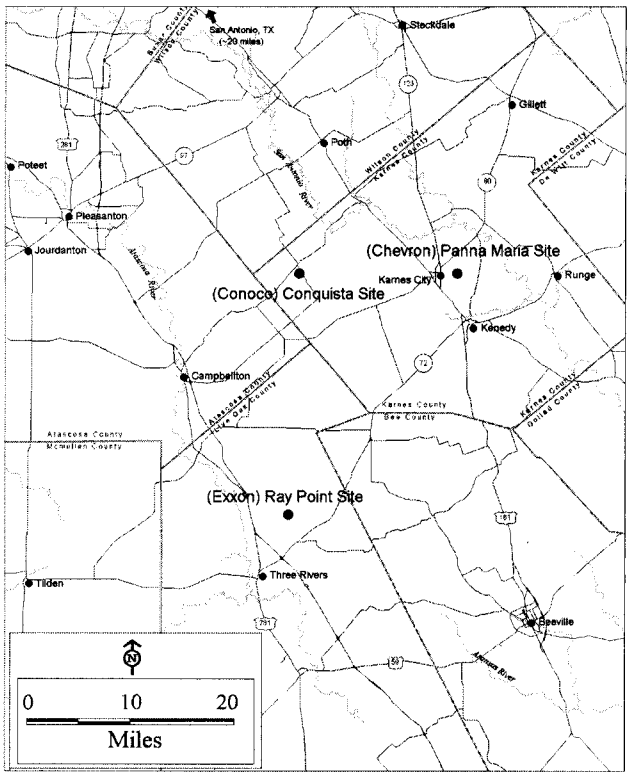
Exxon Corporation was responsible for conducting all remediation activities at this site. Contamination resulting from the uranium milling operations was consolidated into an onsite disposal cell. The 16-hectare (39-acre) cell contains approximately 275,400 cubic meters (360,000 cubic yards) of uranium mill tailings. The disposal cell has a 1-meter thick, low-permeability radon barrier cover and a grass surface layer for erosion control. Erosion control has been provided for all potentially vulnerable features, and the site was graded to provide positive drainage. All disturbed areas were revegetated.

Groundwater remediation is not necessary at the (Exxon) Ray Point Site, and no groundwater monitoring is expected. Groundwater beneath the site is limited to perched zones of water with no alluvial groundwater table. This situation eliminates the potential for groundwater yield and reduces the likelihood of contaminant migration.

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

When Exxon completed remedial action on the tailings pond, a 2-meter (6-foot) high fence was installed around the perimeter of the property to protect the public from unauthorized intrusion onto the property. Anticipated site-wide long-term stewardship activities include restricting access through the use of the existing fence and warning signs posted along the site boundary. DOE will repair the fence and replace signs as necessary. DOE will staff a 24-hour phone line for reporting site concerns. Drilling and other intrusive activities will be prevented within site boundaries through institutional controls. DOE's Grand Junction Office will be responsible for performing long-term stewardship activities for the disposal cell at the (Exxon) Ray Point Site upon transfer to DOE.



(Exxon) Ray Point Site

Site records will be stored at DOE's Grand Junction Office in Colorado. The types of records that will be maintained include site characterization data, remedial action design information, the site completion report, long-term monitoring plans, annual inspection reports, and current and historic monitoring data.

2.2 Specific Long-Term Stewardship Activities

Engineered Units

The site has one disposal cell containing approximately 275,400 cubic meters (360,000 cubic yards) of residual contamination. The mill tailings, soils, and construction debris within the cell are contaminated with uranium, radium, and thorium. DOE will conduct annual inspections of the 16-hectare (39-acre) disposal cell to ensure the integrity of the cap and other engineered features. Maintenance and repairs will be conducted on an as-needed basis.

2.3 Regulatory Regime

Long-term stewardship activities at the (Exxon) Ray Point Site will be governed by several requirements in the following regulations: UMTRCA; the *Atomic Energy Act of 1954,* as amended; Title 10 of the *Code of Federal Regulations* Part 40, and the *National Environmental Policy Act of 1969.*

STAKEHOLDER INVOLVEMENT

Community interaction is expected to be minimal once the site is transferred. Copies of the annual inspection report for the (Exxon) Ray Point Site and other sites will be distributed to the local library and to any stakeholder requesting one. The site's annual inspection reports will also be published on the DOE Grand Junction Office website at www.doegjpo.com.

2.4 Assumptions and Uncertainties

Cost estimates are based on the actual costs of long-term stewardship activities at similar disposal cells currently managed by DOE's Grand Junction Office.

No groundwater monitoring is anticipated at the site based on ongoing conversations with the Texas Department of Health, as well as experience with similar sites.

3.0 Estimated Long-Term Stewardship Costs

Long-term stewardship costs for the (Exxon) Ray Point Site are estimated to include an initial start-up cost of $25,000 in 2001, when the site is transferred to the Grand Junction Office. Costs incurred before that time are associated with developing the initial site long-term surveillance plan and conducting activities necessary for the site's transfer to DOE. Following initial start-up, costs are associated with the ongoing monitoring and maintenance of the disposal cell. Costs are expected to remain relatively constant over the cost estimate's lifespan.

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	***Amount***	***Year(s)***	***Amount***	***Year(s)***	***Amount***
FY 2000	$15,200	**FY 2008**	$26,300	**FY 2036-2040**	$127,900
FY 2001	$31,200	**FY 2009**	$26,300	**FY 2041-2045**	$127,800
FY 2002	$27,100	**FY 2010**	$25,700	**FY 2046-2050**	$127,900
FY 2003	$26,100	**FY 2011-2015**	$122,700	**FY 2051-2055**	$127,800
FY 2004	$26,400	**FY 2016-2020**	$119,400	**FY 2056-2060**	$127,900
FY 2005	$26,600	**FY 2021-2025**	$119,800	**FY 2061-2065**	$127,800
FY 2006	$26,100	**FY 2026-2030**	$126,600	**FY 2066-2070**	$127,900
FY 2007	$26,500	**FY 2031-2035**	$127,800		

4.0 Future Uses

The future use of the site will be limited to monitoring and maintaining the disposal cell. Under UMTRCA provisions, access to the site will be restricted indefinitely.

For more information about the (Exxon) Ray Point Site, please contact:

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FALLS CITY SITE

1.0 SITE SUMMARY

1.1 Site Description and Mission

The Falls City Site is the location of a former uranium milling site that operated from 1961 until 1973. The site contains a disposal cell for the uranium mill tailings and process-related wastes resulting from mill operations. The site is located in Karnes County, Texas, approximately 74 kilometers (46 miles) southeast of San Antonio, and approximately 13 kilometers (8 miles) southwest of Falls City. The site covers 96 hectares (232 acres) and contains a 51-hectare (125-acre) disposal cell.

LONG-TERM STEWARDSHIP HIGHLIGHTS

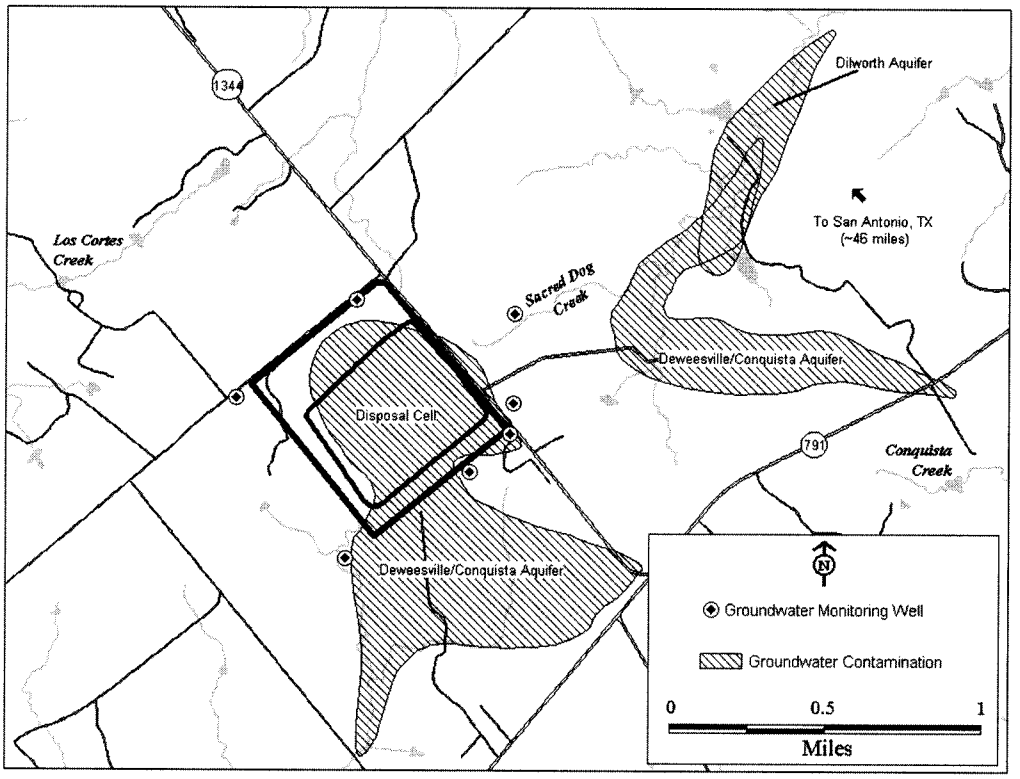
Major Long-Term Stewardship Activities - groundwater monitoring, disposal cell monitoring and maintenance; inspections; access restrictions
Total Site Area - 96 hectares (232 acres)
Estimated Volume of Residual Contaminants - groundwater 4.5 million cubic meters (1.2 billion gallons); disposal cell 4.4 million cubic meters (5.8 million cubic yards)
Long-Term Stewardship Start-End Years - 1997-in perpetuity
Average Annual Long-Term Stewardship Cost FY 2000-2006 - $139,300
Landlord - U.S. Department of Energy, Grand Junction Office

The mill used a sulfuric acid leach extraction process to produce uranium oxide from approximately 2.3 metric tons (2.5 million tons) of ore. As a result of these operations, more than 2.8 metric tons (3.1 million tons) of tailings (a sand-like, radioactive waste product) were discharged to tailings ponds, four of which were open pit mines excavated into the ore-bearing sandstone. The tailings ponds were nine to 11 meters (30 to 35 feet) deep and unlined, except for the naturally clayey foundation soils and sediments.

The processing site consisted of two parcels, approximately 1.6 kilometers (one mile) apart. Parcel A was fenced and encompassed 191 hectares (473 acres), including the former mill site, the mill building, five tailings piles, and a tailings pond. Parcel B encompassed 49 hectares (120 acres) and included a sixth tailings pile in the northeast area of the parcel. Windblown contamination from the tailings piles were deposited on both parcels: 121 hectares (298 acres) at Parcel A and 32 hectares (80 acres) at Parcel B. An estimated 4.4 million cubic meters (5.8 million cubic yards) of residual radioactive materials were contained within both parcels. The disposal cell is located on Parcel A.

The current mission at the Falls City Site is conducting long-term stewardship activities, including disposal cell and groundwater monitoring. The Falls City Site is subject to Title I of the *Uranium Mill Tailings Radiation Control Act of 1978* (UMTRCA). As such, the U.S. Department of Energy's (DOE) Albuquerque Office remediated the site and the Grand Junction Office is responsible for conducting long-term stewardship activities. DOE began conducting long-term stewardship activities at the site in 1997.

The historic mission of the Falls City Site was to process uranium for sale to the U.S. Government for its national defense program. The original mill was built, owned, and operated from 1961 to 1973 by Susquehanna-Western, Inc., of San Antonio, Texas. Uranium extracted from sandstone ore was subjected to a sulfuric acid leaching process, which created approximately 2.8 metric tons (3.1 million tons) of tailings. These tailings were deposited in unlined ponds on the site. Solution Engineering, Inc., purchased the site in 1975, and conducted secondary solution mining from four tailings piles between 1978 and 1982. In 1982, the liquid in the ponds was evaporated, and the tailings were covered with soil and revegetated.



Falls City Site

1.2 Site Cleanup and Accomplishments

DOE conducted an environmental assessment of the Falls City Site and selected the remedial action alternative of consolidating the tailings onsite in a disposal cell. DOE began remedial action at the Falls City Site in 1992 and completed site remediation in 1994. The cleanup involved consolidation of seven tailings piles and additional contaminated material from 13 vicinity properties, totaling approximately 4.4 million cubic meters (5.8 million cubic yards) of residual radioactive material, into a stabilized, 51-hectare (125-acre) disposal cell. The affected area was remediated to U.S. Environmental Protection Agency (EPA) standards. The lined disposal cell has a radon barrier cover, rock side slopes, and a grass-covered top surface layer to control erosion. The Nuclear Regulatory Commission (NRC) concurred in the DOE certification that the site was remediated to NRC-accepted design. In 1997, the site's disposal cell came under NRC's general license for the custody and long-term care of residual radioactive material disposal cells.

Groundwater beneath the Falls City Site is contaminated by past uranium ore processing activities, open pit mining, and in situ solution leaching of tailings. Open pit mining occurred on Parcels A and B of the site before milling activities began in 1961. Also, the shallow groundwater in the mined areas is of naturally poor quality because of ore bodies in the aquifer matrix. As a result, approximately 4.5 million cubic meters (1.2 billion gallons) of groundwater are contaminated. The groundwater is classified as limited use because of the naturally occurring contamination. Consequently, supplemental standards, as defined in Title 40 of the *Code of Federal Regulations* Part 192.22, have been applied and no groundwater remediation is expected.

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

The Grand Junction Office is responsible for long-term monitoring and maintenance at the Falls City Site. DOE manages the site according to an NRC-approved long-term surveillance plan prepared specifically for the Falls City Site. The site is owned by the Federal Government, which controls land use within site boundaries.

DOE is responsible for conducting long-term stewardship activities, and maintaining access restrictions and institutional controls. Access is restricted by a locked gate, a wire fence, and warning signs posted every 152 meters (500 feet) along the site boundary. DOE staffs a 24-hour phone line for reporting site concerns. Drilling and other intrusive activities are prevented within site boundaries through institutional controls. DOE conducts an annual inspection to assess the integrity of the cell cover and other engineered features, and to ensure that institutional controls are effective and the site complies with applicable requirements. DOE also performs site maintenance, as necessary, including removal of woody vegetation from the rock armor and annual hay harvesting from the grass-covered areas. Groundwater is sampled and analyzed periodically, and water levels are monitored in selected wells.

The site records for the Falls City Site are kept in permanent storage at the DOE Grand Junction Office in Colorado. The types of records kept include characterization data, the remedial action design, completion report, the long-term monitoring plan, annual inspection reports, and monitoring data. Real property records are maintained at the DOE Albuquerque Operations Office.

2.2 Specific Long-Term Stewardship Activities

Groundwater

Contaminated groundwater has been identified in three plumes in the shallow bedrock aquifers. Approximately 4.5 million cubic meters (1.2 billion gallons) of groundwater are contaminated with arsenic, cadmium, chromium, lead, mercury, molybdenum, net gross alpha, nitrate, radium, selenium, and uranium, which have exceeded maximum concentration limits at least twice since 1990.

STAKEHOLDER INTERACTION

Community interaction has been minimal since the remedial action was completed. Copies of the annual inspection report for the Falls City Site are distributed to the local library and any stakeholders requesting them. The report is also published on the DOE Grand Junction Office website at www.doegjpo.com.

No groundwater remediation is expected because supplemental standards, as defined in Title 40 of the *Code of Federal Regulations* Part 192.22, have been approved. However, groundwater must be monitored for at least five years. The groundwater protection strategy is to apply supplemental standards, as the groundwater in the uppermost aquifer is classified as 'limited use' because of its poor ambient quality and because it is not a current or potential source of drinking water. Groundwater from the uppermost aquifer contains widespread ambient contamination resulting from naturally occurring conditions and from the effects of human activity unrelated to uranium milling operations. The groundwater cannot be effectively cleaned up for drinking purposes with the treatment methods currently and reasonably employed by public water supply systems. NRC and the State of Texas concurred with the groundwater protection strategy for the disposal site in September 1992, and NRC approved the site's groundwater compliance action plan in September 1998. Monitoring will continue until 2003. At that time, the need to continue monitoring will be evaluated.

Engineered Units

Remedial action at the site was completed in July 1994, when all radioactive materials and tailings were consolidated into an EPA-compliant, onsite disposal cell and all remediated areas were regraded and reseeded. The disposal cell contains 7,143,000 dry tons of radioactive material with a total activity of 1,277 curies of radium-226. The cell, which measures 792 meters by 671 meters (2,600 feet by 2,200 feet) at the base and rises 19 meters (62 feet) above the surrounding land, is sited at grade on a drainage divide. It occupies 51 hectares (127 acres) and is enclosed by a posted security fence. A clayey soil layer serves as a low-permeability radon barrier. A vegetated layer of top soil over a compacted soil layer covers the top of the cell. The cell was designed to promote rapid runoff of precipitation to minimize leachate. Riprap with a median diameter of 18 centimeters (seven inches) overlays a granular bedding layer on the side slopes of the cell. This 20-percent side-slope grade allows water to run off the cell sides into the surrounding six meter (20 foot) wide rock apron. The riprap protects the side slopes from erosion.

The surface conditions of the disposal cell will be monitored during annual inspections to determine whether the disposal cell and erosion protection components of the cell are performing as intended. The disposal cell at the Falls City Site was designed and constructed to last for 200 to 1,000 years. DOE's responsibility for the safety and integrity of the Falls City Site will continue in perpetuity.

2.3 Regulatory Regime

In 1997, the Falls City Site came under a general license issued by NRC for custody and long-term care of residual radioactive material disposal sites (contained at Title 10 of the *Code of Federal Regulations,* Section 40.27). The purpose of the general license is to ensure that such sites will be cared for in a manner that protects human health and safety and the environment. The general license went into effect when NRC concurred that the site conformed to cleanup standards and formally accepted the site-specific long-term surveillance plan.

Long-term stewardship activities at the Falls City Site are governed by several other requirements in the following regulations: the *Uranium Mill Tailings Radiation Control Act of 1978*; the *Atomic Energy Act of 1954,* as amended; EPA groundwater protection standards, including Subparts B and C of Title 40 of the *Code of Federal Regulations*, Part 192; a cooperative agreement between DOE and the State of Texas; and the *National Environmental Policy Act of 1969,* as amended.

2.4 Assumptions and Uncertainties

Because the site is already performing long-term stewardship activities, long-term stewardship activities are well known and are not expected to change dramatically. DOE assumes the annual groundwater monitoring frequency will be reduced to once every three years after 2003. DOE also assumes that monitoring will continue indefinitely until the disposal cell demonstrates infiltration control. It is expected that the cap will not be replaced for a minimum of 200 years.

3.0 Estimated Long-Term Stewardship Costs

The following table shows the estimated costs of the long-term stewardship activities at the Falls City Site. The estimated costs are based on actual costs of long-term stewardship activities at this and other sites. Contingency costs, such as cap replacement, have not been incorporated into the cost estimates.

DOE will monitor groundwater at the site annually through 2003, and then, after an evaluation of the need, will monitor likely once every three years thereafter. Fiscal Years (FY) 2001-2006 include costs for well decommissioning.

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	*Amount*	*Year(s)*	*Amount*	*Year(s)*	*Amount*
FY 2000	$82,100	**FY 2008**	$39,700	**FY 2036-2040**	$225,400
FY 2001	$173,400	**FY 2009**	$55,400	**FY 2041-2045**	$242,200
FY 2002	$181,700	**FY 2010**	$39,700	**FY 2046-2050**	$225,500
FY 2003	$165,400	**FY 2011-2015**	$220,800	**FY 2051-2055**	$242,200
FY 2004	$153,500	**FY 2016-2020**	$204,900	**FY 2056-2060**	$225,400
FY 2005	$101,100	**FY 2021-2025**	$225,300	**FY 2061-2065**	$242,200
FY 2006	$117,600	**FY 2026-2030**	$223,300	**FY 2066-2070**	$225,500
FY 2007	$ 39,900	**FY 2031-2035**	$242,200		

4.0 FUTURE USES

Public access to the disposal cell will be restricted indefinitely. The site is owned by the Federal government and the future land use is not anticipated to change.

For more information about the Falls City Site, please contact:

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U.S. Department of Energy, Grand Junction Office
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or visit the Internet website at http://www.doegjpo.com

PANTEX PLANT

1.0 SITE SUMMARY

1.1 Site Description and Mission

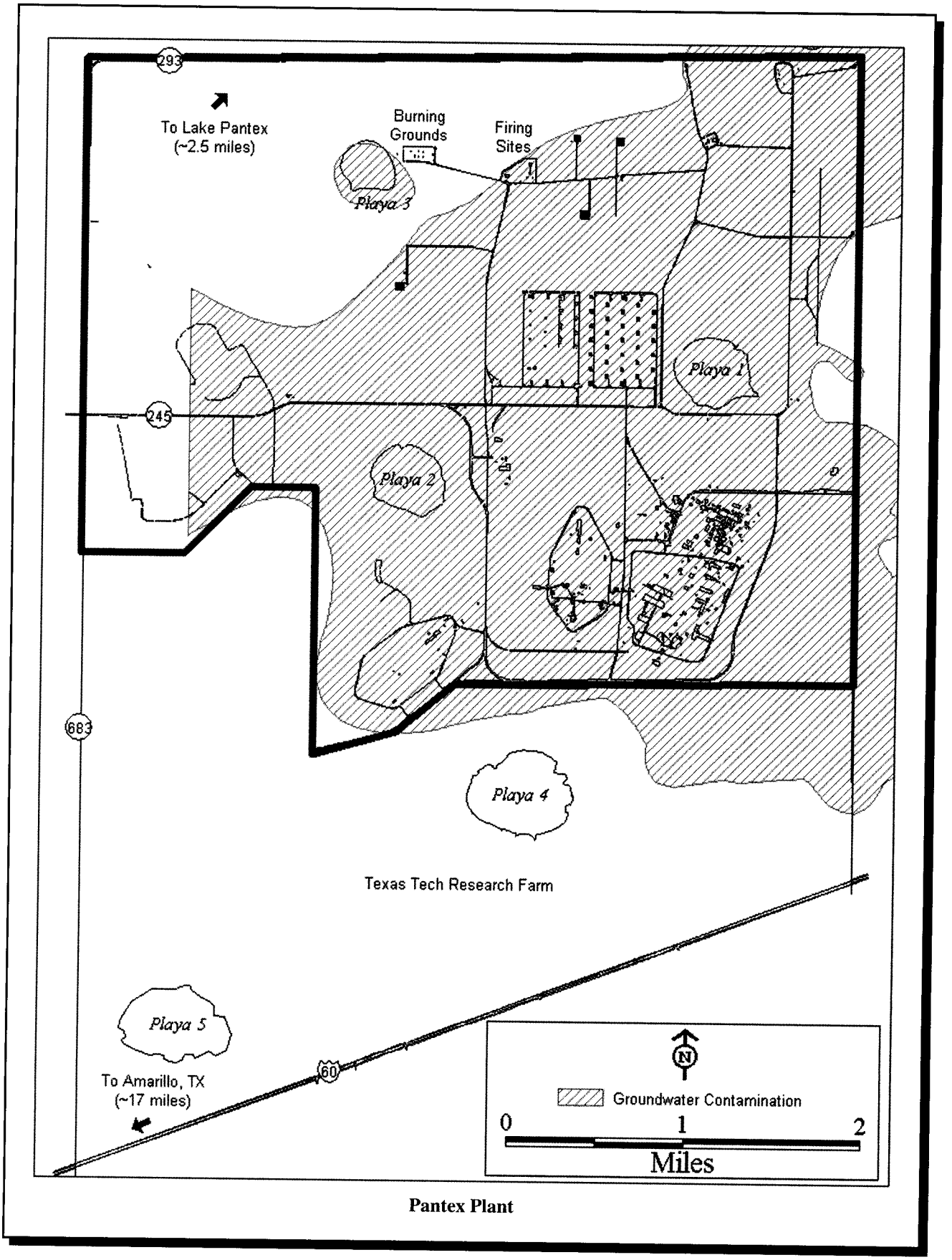
The Pantex Plant was built by the United States Army in 1942 as a conventional bomb plant. At the end of World War II, the Plant was deactivated and the property eventually reverted to the War Assets Administration. In 1949, the entire installation was sold to Texas Tech University to be used for experimental farming, subject to recall, if necessary. Following an extensive survey of World War II ordnance plants, the Atomic Energy Commission (which later became the Department of Energy) in 1951 chose the Pantex site for expansion of its nuclear weapons assembly facilities. The Army Ordnance Corps reclaimed the site for the Atomic Energy Commission and contracted with the Silas Mason Company to rehabilitate it. From 1956 to the present, the Pantex Plant has been operated by the Mason & Hanger Corporation (MHC).

LONG-TERM STEWARDSHIP HIGHLIGHTS

Major Long-Term Stewardship Activities - groundwater and soil cleanup; groundwater monitoring
Total Site Area – 4,119 hectares (10,177 acres)
Estimated Volume of Residual Contaminants - groundwater 5.7 billion liters (1.5 billion gallons); playa/ditch sediment 100 hectares (250 acres); soil 250 hectares (610 acres); engineered units 16 hectares (40 acres)
Portions Requiring Long-Term Stewardship as of 2006 - 2
Average Annual Long-Term Stewardship Cost FY 2000-2006 - $1.4 million
Landlord - U.S. Department of Energy, Office of Defense Programs

Located in the Texas Panhandle in Carson County north of U.S. 60, the Plant lies 27 kilometers (17 miles) northeast of downtown Amarillo. The Pantex Plant site consists of land owned and leased by the U.S. Department of Energy (DOE). DOE owns 4,119 hectares (10,177 acres), including 3,683 hectares (9,100 acres) in the main Plant area and 436 hectares (1,077 acres) at Pantex Lake, which lies approximately 4 kilometers (2.5 miles) northeast of the main Plant area. Currently, no government industrial operations are conducted at the Pantex Lake property. In addition, 2,347 hectares (5,800 acres) of land south of the main Plant area are leased from Texas Tech University for a safety and security buffer zone. The Plant is composed of several functional areas, commonly referred to as numbered zones. These include a weapons assembly/disassembly area (Zone 12), a weapons staging area (Zone 4), an area for experimental explosive development (Zone 11), a drinking water treatment plant, a sanitary wastewater treatment facility, and vehicle maintenance and administrative areas. Other functional areas include a utilities area for steam and compressed air, explosive test-firing facilities, a burning ground for thermally treating (i.e., burning) explosive materials, landfills, and Zone 10, which is currently used only for storage. Overall, there are more than 400 buildings at the Plant.

DOE's Office of Defense Programs (nuclear weapons mission) and Office of Environmental Management (environmental restoration) are jointly responsible for activities at the site. The nuclear weapons mission of the Pantex Plant, which is under the Office of Defense Programs, involves the assembling and disassembling, evaluating, repairing, and retrofitting nuclear weapons in the nations stockpile; sanitizing components from dismantled nuclear weapons; providing interim storage for plutonium pits from dismantled weapons; and developing, fabricating, and testing of chemical explosives and explosive components for nuclear weapons in support of DOE initiatives. These activities involve handling (but not processing) highly enriched uranium, plutonium, and tritium. Other activities include managing classified components that result from dismantling nuclear explosives, as well as a variety of non-radioactive toxic chemicals. Although government-owned, the Plant is a contractor-operated and managed facility since 1956.



Pantex Plant

1.2 Site Cleanup and Accomplishments

During more than 50 years of operation of the Pantex Plant to support defense missions, contaminants were released to the surface environment. Key contaminants include volatile and semi-volatile organic compounds, high explosives, and heavy metals. Contamination was found in the perched groundwater beneath the Zone 12 operations area, in the soil near operations areas, in previously operated landfills, and in the ditches and playas that form the Plant's drainage system. Contaminants were also found in the perched aquifer on properties neighboring the Plant to the south and southeast. A large-scale pump-and-treat system continues to operate to remove explosives, organic compounds, and chromium from the perched aquifer onsite and to reduce migration of contaminated groundwater offsite. More than 295 million liters (78 million gallons) of contaminated water has been treated, removing over 500 kilograms (1,100 lbs.) of high explosives. Interim corrective measures conducted at various areas of the Plant include:

- innovative in-situ biologic treatment and ex-situ composting of high-explosives-contaminated soil;
- excavation and disposal of more than 11,469 cubic meters (15,000 cubic yards) of soil contaminated with high explosives, volatile and semi-volatile organic compounds, and heavy metals; and
- removal of depleted uranium contamination, which included radiation surveys, identification, and excavation of over 1,400 cubic meters (1,830 cubic yards) of contaminated soil.

In addition, construction of more than 2.8 hectares (seven acres) of administrative landfill covers at four sites has been completed.

There are 249 identified release sites within 144 solid waste management units and areas of concern at Pantex. These sites are managed as 14 release site groupings for investigation and remediation purposes. DOE anticipates that, with the exception of perched groundwater and three-to-five soil/sediment solid waste management units, interim corrective measure cleanup

PAST ACCOMPLISHMENTS

- 42 of 43 release sites are now in steady-state and the Resource Conservation and Recovery Act (RCRA) Facility Investigation for the 43 rd site (95 th Terrace Site) is under Environmental Protection Agency (EPA) review
- Completed the Corrective Measures Study to determine which cleanup method to use for the 95th Terrace Site

PLANNED ACCOMPLISHMENTS

- Complete the Corrective Measures Implementation Design which specifies construction details for cleanup of the 95 th Terrace Site
- Continue groundwater treatment and monitoring activities, including well monitoring and maintenance, preparing regulatory reports, and groundwater interceptor well design

STAKEHOLDER INTERACTION

Public participation associated with the Pantex Environmental Restoration Program includes monthly meetings with the Pantex Plant Citizen's Advisory Board; quarterly public meetings that are open to the community; and various presentations provided to local special interest groups, such as the League of Women Voters, the Pantex Plant Environmental Task Force, and owners of land adjacent to the Pantex Plant. An electronic reading room has been established at a local community college, in addition to the Administrative Record file located at Pantex, which allows the public access to technical documents that provide investigation and assessment results that support decisions regarding corrective actions at Pantex. Public notice and comment periods are required for review of corrective measures and preferred alternative selection; public notice is also required once a final preferred corrective action design is approved. In addition, press releases, public tours, and videos are provided to update the public on the status.

results will meet regulatory closure requirements. For those solid waste management units not closed by interim corrective measures, final corrective action design and construction activities to implement preferred remediation alternatives will be conducted. Interim corrective measures for the perched aquifer will continue through 2004, when completion of construction activities for the final preferred remediation alternative is scheduled to occur. Completion of final preferred alternative construction activities for soil/sediment sites that require corrective action is also scheduled to be completed by 2004.

2.0 SITE-WIDE LONG-TERM STEWARDSHIP DISCUSSION

2.1 Site-Wide Long-Term Activities

> ***LONG-TERM STEWARDSHIP GOALS***
>
> Long-term stewardship goals at Pantex include restoring impacted groundwater to beneficial use quality and ensuring soil/sediment sites requiring post closure care are managed in a manner that prevents adverse effects to human health and the environment.

As the site landlord, DOE Defense Programs has stewardship responsibilities for all Pantex facilities and will determine their future use after the current cleanup end-states are achieved. All release sites at Pantex will be remediated to achieve closure designation in accordance with the cleanup levels specified by the Texas Risk Reduction Standards regulations and associated site-specific guidance for soils and groundwater cleanup. It is anticipated that groundwater pump-and-treat operations will continue through 2055 to effectively treat groundwater contamination; however, the long-term efficiency and capability of the groundwater extraction and treatment system is uncertain, and additional time could be required to fully achieve groundwater remediation objectives. The assumed date for the project end-state will be evaluated periodically, as additional operational effectiveness information becomes available. Further, regulatory requirements for landfill/soil/sediment cover maintenance, and groundwater monitoring and treatment operations will be negotiated with the regulatory agency periodically.

2.1.1 Institutional and Engineered Controls

Institutional and engineered controls for the Pantex Plant will vary depending on the level of residual contamination remaining at the release site. These controls may include, as appropriate, deed recordation and land use restrictions according to residual contaminant levels remaining and cleanup levels achieved; in-situ containment by use of landfill covers/caps and ditch liners; fencing; and administrative controls, such as operating procedures that limit exposure to environmental media with residual contamination.

2.1.2 Record-Keeping Activities

Record-keeping activities for the Pantex Plant Environmental Restoration Program are directed under Title 42 United States Code (42 U.S.C.) 9613, Section 113(k) Administrative Record and Public Participation; Title 40 Code of Federal Regulations (40 CFR) Part 300, Subpart I - Administrative Record for Selection of Response Action; 36 CFR Chapter XII, National Archives and Records Administration Requirements (Subchapter B), and record-keeping requirements stipulated in the Pantex Plant's *Resource Conservation and Recovery Act* (RCRA) Hazardous Waste Operating Permit. Governing documents include DOE Orders 1324.2A, Records Disposition; 5500.7A, Vital Records Protection Program; 1325.5A, Records Management Program; and various Pantex Plant records manuals, directives, standards and internal operating procedures. These regulatory drivers and governing documents, along with guidance documents, provide for what records must be maintained, where they must be maintained, the duration of document maintenance, and final disposition requirements. In general, operating records, investigation, assessment, remediation, monitoring, interaction documentation between Pantex and regulatory agencies, and public participation records will be kept onsite at the Pantex Plant as part of an Administrative Records file.

The Pantex Plant is on the National Priorities List and, therefore, the Administrative Records file at Pantex will maintain official records that relate to response/remedial action decisions for environmental corrective action for a period of time identified as the Statute of Limitations time period specified for sites on the National Priorities List. General DOE record-keeping requirements stipulate that unscheduled records, such as environmental records, must be maintained for 75 years. Records are microfilmed for long-term retrieval purposes. DOE maintains a public reading room for the Pantex Plant at Amarillo College, located in Amarillo, Texas. Documents that are generated and placed in the Pantex Administrative Records file are provided in hard copy or electronic form to Amarillo College for public access purposes.

2.2 Assumptions and Uncertainties

The possibility exists that additional investigations may be necessary to resolve regulatory comments on documents previously provided due to the fact that not all investigation and cleanup reports have been reviewed and approved by the applicable regulatory agencies. In addition, corrective measures studies/designs approval and subsequent final corrective action construction activities are dependent on final approval of the investigations. Additional investigations have the potential to identify conditions requiring revision of previous recommendations or future corrective actions planned. Input received from regulatory authorities and/or the public on proposed final corrective actions may result in final corrective action alternative selections differing from those currently anticipated.

2.3 Regulatory Regime

Site-wide assessments and environmental monitoring programs have been and are being conducted. The first environmental characterization began in 1981 in order to prepare an Environmental Impact Statement. This activity was followed by a multi-phased Comprehensive Environmental Restoration Program assessment from 1985 through 1986. A 1986 environmental survey found soil contamination in various locations at the Pantex Plant. A RCRA Facility Assessment, completed in 1989, identified solid waste management units that required characterization to ensure potential threats to human health and the environment were identified and minimized. There are currently 14 groupings of solid waste management units based on suspected types of contaminants and potential source areas.

Restoration activities at the Pantex Plant are regulated jointly by the Texas Natural Resources Conservation Commission (TNRCC) and the U. S. Environmental Protection Agency (EPA), and the agencies have signed a memorandum of understanding for activities at Federal facilities. As a permitted hazardous waste facility, the Pantex Plant is regulated under RCRA, and the TNRCC has been granted authority to administer the RCRA Program in Texas. An Administrative Order on Consent was signed by EPA and DOE in 1990, outlining the remedial response actions under RCRA for the Pantex Plant. In May 1994, the Pantex Plant was added to the National Priorities List, thereby subjecting Pantex to *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA) requirements. EPA and TNRCC have allowed an integration of RCRA and CERCLA processes to continue closure of contaminated sites. The Pantex Plant is still on the National Priorities List.

Closure of release sites with residual contamination is classified in the State of Texas by contaminant levels that correspond to one of three Risk Reduction Standards. Risk Reduction Standard 1 closures represent release sites with no residual contamination remaining above established background levels. Risk Reduction Standard 2 closures represent release sites with residual contamination that is protective of human health and the environment without implementation of post-closure care. Risk Reduction Standard 3 closures represent release sites with residual contamination at levels that require post-closure care in the form of administrative, and/or institutional, and/or engineering controls.

2.4 Estimated Site-Wide Long-Term Stewardship Costs

Costs for long-term stewardship at Pantex consist primarily of groundwater corrective actions and monitoring. Groundwater corrective actions may consist of both pump-and-treat and in-situ treatment methodologies. Costs associated with long-term groundwater treatment, in addition to actual equipment maintenance, system augmentation, technical oversight, utility costs, and infrastructure costs, include both regulatory-required corrective action and compliance monitoring. Corrective action and compliance monitoring costs include personnel costs to maintain equipment and collect samples, system operation costs, and analytical costs to evaluate contaminant reduction. It is estimated that groundwater treatment and corrective action monitoring will continue at Pantex through Fiscal Year 2055. The time period for conducting groundwater compliance monitoring will be negotiated between DOE and the TNRCC but is anticipated to continue indefinitely (for purposes of this report, through Fiscal Year (FY) 2070). Long-term stewardship costs for Risk Reduction Standard 3 closures of soil/sediment sites include engineered unit maintenance and, as needed, replacement. Also included are the technical oversight costs necessary to evaluate the effectiveness of the implemented corrective action and costs necessary to maintain administrative controls. It is estimated that approximately 5 percent of the total long-term stewardship costs at Pantex will be a result of maintaining administrative controls for release sites closed under Risk Reduction Standard 2. The remaining costs are attributable to meeting cleanup objectives, maintaining, and monitoring the cleanup of sites closed under Risk Reduction Standard 3.

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	***Amount***	***Year(s)***	***Amount***	***Year(s)***	***Amount***
FY 2000	$0	**FY 2008**	$1,381,000	**FY 2036-2040**	$6,374,000
FY 2001	$0	**FY 2009**	$1,411,000	**FY 2041-2045**	$6,945,000
FY 2002	$0	**FY 2010**	$1,624,000	**FY 2046-2050**	$7,566,000
FY 2003	$1,496,000	**FY 2011-2015**	$8,240,000	**FY 2051-2055**	$8,547,000
FY 2004	$1,418,000	**FY 2016-2020**	$9,351,000	**FY 2056-2060**	$4,195,000
FY 2005	$1,317,000	**FY 2021-2025**	$10,463,000	**FY 2061-2065**	$4,843,000
FY 2006	$1,374,000	**FY 2026-2030**	$11,337,000	**FY 2066-2070**	$5,060,000
FY 2007	$1,471,000	**FY 2031-2035**	$12,745,000		

3.0 PORTION OVERVIEW

The regulatory regime in Texas identifies three closure standards (Risk Reduction Standards) for release sites depending on residual contamination remaining in environmental media, subsequent risk to human health and the environment resulting from the residual contamination, and the controls required to maintain acceptable risk levels. Therefore, for the purpose of this document, long-term stewardship activities are discussed in terms of "portions," which correspond to Risk Reduction Standard closures that have long-term stewardship requirements. Portions have been further subdivided into the type of environmental media or units (i.e. soil, groundwater, surface water/sediment, engineered units) that are subject to closure under the Risk Reduction Standards.

Release sites approved for closure under Risk Reduction Standard 1 do not require administrative, institutional, engineered controls, or monitoring. Release sites approved for closure under Risk Reduction Standard 2 require long-term stewardship in the form of deed recordation that restricts use of the property to activities that correspond to the cleanup levels achieved (residential vs. non-residential). Release sites at Pantex closed under

Risk Reduction Standard 2 will primarily be cleaned up to levels that restrict, by implementation of deed restrictions, the future use of the site to activities that are allowed for property zoned for industrial use (non-residential). It is currently planned that contaminated perched groundwater within the Pantex Plant property boundaries will be cleaned up to approved Risk Reduction Standard 3 residual concentration levels (alternate concentration levels) that result in contaminant concentrations that meet Risk Reduction Standard 2 residential cleanup levels at the property boundary. It is currently planned that cleanup levels for offsite perched groundwater will achieve Risk Reduction Standard 2 levels for residential use; however, final cleanup levels achieved will depend on technical limitations for remediating the groundwater and negotiations with offsite landowners. Release sites at Pantex recommended for closure under Risk Reduction Standard 2 include certain soils, sediments, and surface water solid waste management units.

Release sites approved for closure under Risk Reduction Standard 3 require post-closure care in the form of continued remedial actions until approved cleanup levels are met and/or it can be demonstrated that residual contamination does not represent risk to human health and the environment above approved cleanup levels in the absence of post-closure care. Release sites closed under Risk Reduction Standard 3 also require corrective action monitoring and maintenance until the post-closure care period is complete. Release sites closed under Risk Reduction Standard 3 will have institutional and/or engineered controls that limit the future use of the release site on a site-specific basis. Generally, when closed under Risk Reduction Standard 3, the future use of the release site will be restricted to activities allowed in areas zoned for industrial activities. However, in some Risk Reduction Standard 3 closures, post-closure care requirements and residual contamination will limit future use of the release site to activities associated with monitoring and maintenance of the engineered control or activities allowed by institutionalized access control. Release sites that are anticipated to require the complete RCRA corrective action process (Baseline Risk Assessment, Corrective Measure Study, Corrective Measure Design, and Corrective Measure Construction) to achieve closure under Risk Reduction Standard 3 include several inactive landfill solid waste management units, several solid waste management units that consist of ditches previously used for waste water transport, perched groundwater, and one solid waste management unit associated with previous discharges of high explosives waste water.

The primary contaminants at both Risk Reduction Standard 2 and Risk Reduction Standard 3 sites include the metals chromium, lead, and barium; the high explosives RDX, HMX, and TNT; and volatile and semi-volatile organic compounds, including trichloroethylene, chrysene, acetone, benzo(a)pyrene and benzo(a)anthracene. Current estimates indicate that 5.7 billion liters (1.5 billion gallons) of contaminated perched groundwater require treatment and approximately 364 hectares (900 acres) of soil/sediments/surface water sites will be closed under Risk Reduction Standard 2 and Risk Reduction Standard 3. Planned engineered units include ditch liners, engineered soil coverings, and a groundwater treatment and processing system and facility. All final preferred alternative corrective measures construction activities are scheduled to be completed by 2004.

The tables on the following pages provide a correlation of the proposed Risk Reduction Standard closure to each solid waste management unit and area of concern that comprise the operable unit groupings at Pantex.

Portion	*Long-Term Stewardship Start-Year*	*Long-Term Stewardship End-Year*
Risk Reduction 2	2003	in perpetuity
Risk Reduction 3	2003	in perpetuity

Operable Unit	*Solid Waste Management Units (SWMUs), Areas of Concern (AOCs), and Other Potential Release Sites*	*RRS 1*	*RRS 2*	*RRS3*
AL- PX- 01 Burning Ground	SWMUs 14 to 27 - Explosive Burn Pads			X
	SWMUs 37 to 44 - Landfills			X
	SWMU 47 - Chemical Burn/ Evaporation Pits			X
	Unassigned (UA) SWMU - Demonstration Facilities		X	
AL- PX- 02 High Priority Potential Release Sites	SWMU 11 - Building FS- 16 – Surface Impondment in Zone 5		X	
	SWMU 13 - Former Solar Evaporation Pond (Building 11- 51)		X	
	SWMU 109 - Concrete Sump (Building 12- 68)		X	
	SWMU 136 - Subsurface Leaching Beds (Building 12- 59)		X	
	SWMU 139 - Photo Processing Leaching Bed (Building FS- 10)		X	
	AOC 12 Building 12- 5D Paint Shop Area		X	
	Unassigned - Firing Site 1 (FS- 1) - Unlined Landfill	X		
	Firing Site 20 (FS- 20) – Equipment		X	
	Firing Site 24 (FS- 24) - Concrete Sump		X	
AL- PX- 03 Former Cooling Tower	AOC 13 - Former Cooling Tower in Zone 12		X	
AL- PX- 04 Old Sewage Treatment	SWMU 140 - Old Sewage Treatment Plant Sludge Beds		X	
AL- PX- 05 Fire Training Area Burn Beds	AOC 11 - Fire Training Area Burn Pits		X	
AL- PX- 06 Zone 12 Groundwater	Site-Wide Groundwater			X
AL- PX- 07 Landfills	Construction Debris Landfills:			
	SWMU 54 - Landfill 3			X
	SWMU 55 - Landfill 4	X		
	SWMU 56 - Landfill 5		X	
	SWMU 57 - Landfill 6		X	
	SWMU 58 - Landfill 7		X	
	SWMU 59 - Landfill 8		X	
	SWMU 60 - Landfill 9		X	
	SWMU 61 - Landfill 10		X	
	SWMU 62 - Landfill 11	X		
	SWMU 63 - Landfill 12		X	
	SWMU 64 - Landfill 13		X	
	SWMU 66 - Landfill 15		X	
	General Purpose General Sanitary Landfills:			
	SWMU 68a - Original Landfill		X	
	SWMU 68b - Landfill 1			X
	SWMU 68c - Landfill 2		X	
	SWMU 68d - Sanitary Landfill		X	
AL- PX- 08 Ditches and Playas	SWMU 1 - Building 12- 17 - Drainage Ditch			X
	SWMU 2 - Building 12- 43 - Drainage Ditch			X
	SWMU 3 - Building 11- 44 - Drainage Ditch		X	
	SWMU 4 - Building 11- 50 - Drainage Ditch		X	
	SWMU 5- 01 - Buildings 12- 5 and 12- 5B Ditches			X
	SWMU 5- 02 - Buildings 12- 51, 12- 67, and 12- 110 Ditches		X	
	SWMU 5- 03 - Buildings 12- 9, 12- 10, 12- 18, and 12- 68 Ditches		X	
	SWMU 5- 04 - Buildings 12- 19 and 12- 73 Ditches			X
	SWMU 5- 05 - Buildings 12- 21 and 12- 24 Ditches			X
	SWMU 5- 06 - Buildings 12- 44E and 12- 81 Ditches			X
	SWMU 5- 07 - Building 12- 41 Ditches		X	
	SWMU 5- 08 - Building 11- 36 Ditches		X	
	SWMU 5- 09 - Buildings 11- 17, 11- 20, and Pond 11- 51 Ditches		X	
	SWMU 5- 10 - Ditches Near the Old Sewage Treatment Plant		X	
	SWMU 5- 11 - Zone 11 Main Perimeter Ditch		X	
	SWMU 5- 12 - Zone 12 Main Perimeter Ditch			X
	SWMU 5- 13 - Three Main Ditches to Playa 1		X	
	SWMU 5- 14 - Main Ditches to Playa 2		X	
	SWMU 5- 15 - Main Ditches to Playa 4		X	
	SWMU 6 - Playa 1		X	
	SWMU 7 - Playa 2		X	
	SWMU 8 - Playa 3		X	
	SWMU 9 - Playa 4		X	
	SWMU 10 - Pantex Lake		X	
	SWMU 12 - Main Ditch to SWMU 3		X	

Operable Unit	*Solid Waste Management Units (SWMUs),Areas of Concern (AOCs), and Other Potential Release Sites*	*RRS 1*	*RRS 2*	*RRS3*
AL- PX- 09 Firing Sites	SWMU 70 - Firing Site 5		X	
	SWMU 71 - Firing Site 6		X	
	SWMU 73 - Firing Site 15		X	
	SWMU 69 – Firing Site 4 (Active)	N/A	N/A	N/A
	SWMU 72 – Firing Site 10 (Active)	N/A	N/A	N/A
	SWMU 74 – Firing Site 21 (Active)	N/A	N/A	N/A
	SWMU 75 – Firing Site 22 (Active)	N/A	N/A	N/A
AL-PX-10 Leaking USTs at Buildings 12-35 and 16-1	AOC 6 – Gasoline Leaks at Buildings 12-35 and 16-1	N/A	N/A	N/A
AL- PX- 11 Miscellaneous High Explosives/ Rad Sites	SWMU 53 - Temporary HE Burning Grounds		X	
	SWMU 82 - Nuclear Weapon Accident Residue Storage		X	
	SWMU 135 - Leaching Bed Building 12- 44E		X	
	Zone 10 TNT Settling Pits:			
	SWMU 144 Building 10- 13		X	
	SWMU 145 Building 10- 17		X	
	SWMU 146 Building 10- 26		X	
	Zone 11 TNT Settling Pits:			
	SWMU 147 Building 11- 13		X	
	SWMU 148 Building 11- 17		X	
	SWMU 149 Building 11- 26		X	
	SWMU 150 Building 11- 12		X	
	Building 11- 44 - Wastewater Treatment Unit:			
	SWMU 117 HE Settling Tank		X	
	SWMU 118 Equalization Basin		X	
	SWMU 119a HE Filters		X	
	SWMU 120a Carbon Filters		X	
	Building 12- 43 - Wastewater Treatment Unit:			
	SWMU 119b HE Filters		X	
	SWMU 120b Carbon Filters		X	
	SWMU 121 HE Settling Tank		X	
	SWMU 122 Equalization Basin		X	
	SWMU 122b Building 12- 24N & Building 12- 43 Upland Soils			X
	SWMU 123 Concrete Sump		X	
AL- PX- 12 Miscellaneous Chemical Spills/ Release Sites	SWMU 84 - Building 10- 9, Scrap Salvage & Storage Yard		X	
	SWMU 103 - Former Battery Storage Area, Building 12- 81	X		
	SWMU 143 - Former Waste Drum Storage Areas, Buildings 10-9&10-7		X	
	AOC 1 - Transformer Leak, Building 11- 14A		X	
	AOC 3 - Former Boiler House Areas			
	Zone 10 - AOC 3a		X	
	Zone 11 - AOC 3b		X	
	AOC 5 - Electrical Equipment Bone Yard		X	
	AOC 7 - Sulfuric Acid Spills:			
	Building 11- 36 - AOC 7a		X	
	Building 12- 4 - AOC 7b		X	
	Building 12- 64 - AOC 7c		X	
	AOC 8 - Solvent Leaks:			
	Pad 11- 2 - AOC 8a		X	
	Pad 11- 13 - AOC 8b		X	
	Building 11- 17 - AOC 8c		X	
	Building 11- 22 -AOC 8d		X	
	Building 11- 36 - AOC 8e		X	
	AOC 10 - Pesticide Rinse Areas:			
	Building 12- 43A - AOC 10a		X	
	Building 12- 51 - AOC 10b		X	
	AOC 14 - Battery Storage Area, Building 12- 18		X	
	AOC 15 - DDT Release at Building 12- 35		X	
	Unassigned - Capacitor Bank Rupture		X	
	Unassigned - Evaporation Pit East of Bay 3, Building 11-20		X	
	Unassigned - Evap. Pit South of Bay 11 & West of Bay 6, Bldg 11- 20		X	
	Unassigned-Form. Leaching Bed N. of Bldg 11-50 & W. of Bldg 11-36		X	
	SWMU 113 – Overflow From 11-36 Collection System/Sump		X	
	AOC 2 – Main Electrical System Subsystem		X	

Operable Unit	*Solid Waste Management Units (SWMUs),Areas of Concern (AOCs), and Other Potential Release Sites*	*RRS 1*	*RRS 2*	*RRS3*
AL- PX- 13 Supplemental Verification Sites	SVS 1 - Denuded Area near Playa 1		X	
	SVS 2 - Parallel Depressions Near Building 11- 26		X	
	SVS 3 (SWMU 67) - Carbon Black Burial Area near Building 10- 7		X	
	SVS 4 – Old Pistol Range (Active)	N/A	N/A	N/A
	SVS 5 - Zone 11 Landfill East of Pad 11- 13		X	
	SVS 6 (SWMU 65) - Unnumbered Zone 7 Landfills		X	
	SVS 7 - Igloo Demolition Debris Landfills, Zone 4 & Zone 5		X	
AL-PX-14 USTs at Other Locations	UST #9 – Building 12-17E	N/A	N/A	N/A
	UST #7 – Building 12-5B	N/A	N/A	N/A
	UST #38 – Building 12-84A	N/A	N/A	N/A
	SWMU 133 - Waste Oil Tank at Building 16-1	N/A	N/A	N/A

3.1 Risk Reduction Standard 2 Sites Portion

Risk Reduction Standard 2 Sites portion at Pantex comprises a total of approximately 280 hectares (700 acres). The Portion size does not include surface area covering Risk Reduction Standard 2 areas of the perched aquifer (estimated at 320 hectares, 800 acres). Of the 249 identified release sites at Pantex that correspond to solid waste management units and areas of concern, approximately 150 of the sites, including soils, sediments, offsite impacted perched groundwater, and surface water sites, have been or will be recommended for closure under Risk Reduction Standard 2. Release sites approved for closure under Risk Reduction Standard 2 are sites with residual contaminant levels that are protective of human health and the environment and that allow for continued use of the site, consistent with deed restrictions imposed. Pantex has a site-specific Risk Reduction Standard closure guidance document that has been approved by the TNRCC. This document is used to establish cleanup levels for individual contaminants and provides the statistical and confirmation framework to ensure cleanup levels are met.

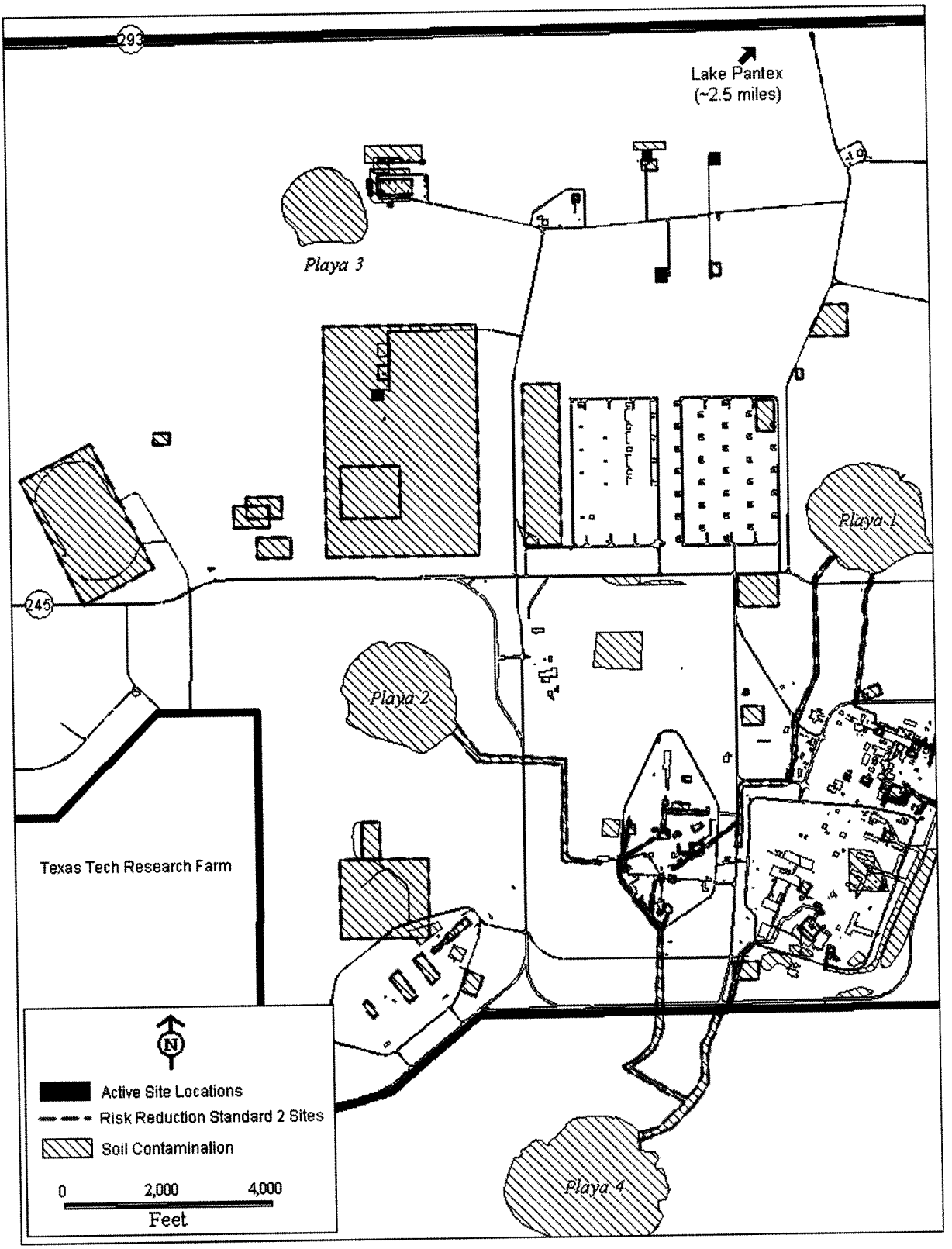
RISK REDUCTION STANDARD 2 SITES PORTION HIGHLIGHTS

Major Long-Term Stewardship Activities - deed recordation that restricts use of the property/media to activities that correspond to the cleanup levels achieved (residential vs. non-residential)
Portion Size - 280 hectares (700 acres)
Estimated Volume of Residual Contamination - soil 200 surface hectares (500 acres); groundwater 1,890 million liters (500 million gallons); sediment 81 surface hectares (200 acres)
Long-Term Stewardship Start-End Years - 2003-indefinitely
Average Annual Long-Term Stewardship Costs FY 2003-2006 -

For the general purpose of release site closure under Risk Reduction Standard 2, cleanup levels for individual contaminants are represented by Texas or federal promulgated heath-based standards, or, when these are not available or do not provide appropriate protection for human health or the environment, cleanup levels (identified as medium specific concentrations) must be developed. The medium specific concentrations address a single contaminant in a medium and consider one or more exposure pathways -- specifically, water ingestion and soil ingestion with inhalation of volatiles and particulates. Where a contaminant in one medium has the potential to contaminate another medium, additional numeric criteria are developed as cleanup levels. The cleanup levels must correspond to contaminant concentrations that represent: 1) upper bound lifetime cancer risk of 0.000001 for class A and B carcinogens and 0.00001 for class C carcinogens; and 2) for systemic toxicants, exposure cannot result in any deleterious effect.

Additional medium-specific requirements for soil/sediments include the following:

1) Residual contamination must not exhibit the hazardous waste characteristic of ignitability, reactivity or corrosivity;



Risk Reduction Standard 2 Portion

2) The sum of volatile organic compounds in vapor phase must not exceed 1,000 parts per million by weight or volume;

3) For closure to residential use criteria, residual contaminant concentrations throughout the soil column shall not exceed the lower of the soil medium-specific concentration, based upon residential human ingestion of soil and inhalation of particulates and volatiles and the residential soil-to-groundwater cross-media protection concentration. The residential soil-to-groundwater cross-media protection concentration is equivalent to one hundred times the residential groundwater cleanup level or a concentration in soil that does not produce a leachate in excess of maximum contaminant levels or medium specific concentrations;

4) For closure to non-residential use criteria, contaminant concentrations shall not exceed one hundred times the non-residential groundwater cleanup level or a concentration in soil that does not produce a leachate in excess of the non-residential groundwater cleanup level.

Additional medium-specific concentration cleanup levels for groundwater include the following:

1) For residential exposure, promulgated Safe Drinking Water Act maximum contaminant levels. If maximum contaminant levels do not exist, cleanup levels are calculated medium-specific concentrations for human ingestion with no resulting adverse affect ;

2) For non-residential exposure, maximum contaminant levels, or if maximum contaminant levels do not exist, calculated medium specific concentration levels that have been multiplied by 3.36 for carcinogens and 2.8 for systemic toxicants.

Pantex has a site-specific Risk Reduction Standard closure guidance document that has been approved by the TNRCC. This document is used to establish cleanup levels for individual contaminants and provides the statistical and confirmation framework to ensure cleanup levels are met. However, due to the fact that not all investigation and cleanup reports have been reviewed and approved by the TNRCC, the possibility exists that additional investigations may be necessary to resolve regulatory comments on documents previously provided. Additional investigations have the potential to identify conditions requiring revision of previous recommendations. In addition, ultimate cleanup goals for offsite property that is not owned by the DOE are subject to negotiation with offsite landowners.

Institutional and Engineered Controls

Deed recordation, which limits the use of the land that is closed under Risk Reduction Standard 2, is the applicable institutional control. Implementing mechanisms to ensure that deed restrictions are adhered to include management controls provided in Plant Standards, Directives, and Operating Procedures for activities conducted on land owned by the DOE. The placement of deed restrictions on property not owned by DOE will require negotiation with the landowners. It is anticipated that, in some cases, fencing, signs, and access restriction will accompany deed restriction of Risk Reduction Standard 2 sites to ensure land use is consistent with covenant restrictions.

3.1.1 Soil

Releases affecting soil at Pantex have resulted from past production operations associated with fabrication of chemical explosive components for nuclear weapons, nuclear weapon assembly/disassembly, weapon modification and repair, surveillance testing of weapon components, and treatment/disposal of chemical explosives and non-radioactive components. Media contamination from these operations occurred by discharging

wastewater to unlined ditches, onsite treatment/disposal of high explosives contaminated solvents, spills and leaks of raw and produced materials, onsite landfilling of solid wastes, and onsite discharge of wastewater to playa lakes. The primary contaminants at Risk Reduction Standard 2 soil sites include the metals chromium, lead, and barium; the high explosives RDX, HMX, and TNT; and volatile and semi-volatile organic compounds, including trichloroethylene, chrysene, acetone, benzo(a)pyrene and benzo(a)anthracene. It is estimated that approximately 200 surface hectares (500 acres) of soil media will be closed under Risk Reduction Standard 2.

Soil sites closed under Risk Reduction Standard 2 include soils less than 0.6 meter (two feet) below surface elevation (surface soils) and greater than 0.6 meter (two feet) below surface elevation (subsurface soils). Risk Reduction Standard 2 sites are determined to be protective of human health and the environment as long as land use and activity restrictions match deed restrictions.

Long-Term Stewardship Activities

Long-term stewardship goals for soil sites closed under Risk Reduction Standard 2 are to ensure land use is consistent with restrictions imposed by deed recordations and to ensure controls are maintained that comply with closure requirements. In general, Risk Reduction Standard 2 closures of sites will be conducted to meet non-residential cleanup requirements. Activities conducted to meet these goals may include implementation of procedural limitations for site use, construction and maintenance of signs, fencing, etc., and administrative limitations of site operations.

3.1.2 Groundwater

The estimated volume of offsite groundwater that requires treatment to meet Risk Reduction Standard 2 cleanup levels is approximately 1,890 million liters (500 million gallons). Approximately 320 hectares (800 acres) is the estimated total offsite surface area below which perched groundwater requires cleanup. Releases affecting perched groundwater at Pantex have resulted from past production operations associated with fabrication of chemical explosive components for nuclear weapons, nuclear weapon assembly/disassembly, weapon modification and repair, surveillance testing of weapon components, and treatment/disposal of chemical explosives and non-radioactive components. Perched groundwater contamination from these operations is believed to have occurred primarily by discharging wastewater to unlined ditches, on-site treatment/disposal of high explosives contaminated solvents, and spills and leaks of raw and produced materials. The primary contaminants in offsite perched groundwater are the high explosives RDX and HMX. The primary contaminants in onsite perched groundwater are high explosives (primarily RDX, TNT, and HMX), heavy metals (primarily chromium), and volatile organic compounds (primarily trichloroethylene). It is anticipated that onsite perched groundwater will be closed under Risk Reduction Standard 3 while offsite perched groundwater will be closed under Risk Reduction Standard 2.

The two principal aquifers beneath the Pantex Plant and adjacent areas are the Ogallala aquifer and the underlying Dockum Group aquifer. Approximately 140 meters (450 feet) of unsaturated vadose zone is present between the ground surface and the Ogallala aquifer. A perched water zone (perched aquifer) is present in the middle of the Ogallala formation at a depth of approximately 82 meters (270 feet) below ground surface and is generally continuous beneath the main facilities of the Pantex Plant and some adjacent areas. The saturated thickness in this perched aquifer ranges from a few feet at the southern margin to greater than 15 meters (50 feet). The main Ogallala aquifer is unconfined and lies beneath the perched aquifer. The main Ogallala aquifer, the saturated portion of the Ogallala formation, is the principal water supply of the Southern High Plains. The regional groundwater flow in the main Ogallala aquifer beneath most of the Southern High Plains is to the southeast. Groundwater flow in the Ogallala aquifer beneath the Pantex Plant and adjacent area is toward the north-northeast. The north-north-east flow is controlled by the east-northeast slope of the Southern High Plains and the Canadian River Valley to the north and also by a large cone of depression surrounding the City of

Amarillo-Carson County Well Field, located immediately north of the Pantex Plant.

Groundwater contamination at Pantex is primarily restricted to the perched aquifer. Detection of contaminants above drinking water standards have recently been identified in samples collected from Ogallala aquifer monitoring wells near the northwest boundary of the Pantex Plant and in an Ogallala well southeast of the Plant. Investigation of the nature and extent of the contamination in the Ogallala aquifer is currently being conducted at Pantex. The Dockum Group aquifer lies under the Ogallala aquifer beneath the Pantex Plant and to the south. No detailed information is available on the potentiometric surface of the Dockum Group aquifer for the Pantex Plant area.

Specific Risk Reduction Standard 2 residential remedial action objectives for the primary contaminants in perched groundwater at Pantex are 0.00774 milligrams per liter for RDX; 0.018 milligrams per liter for TNT; 1.825 milligrams per liter for HMX; and 0.005 milligrams per liter for trichloroethylene. Current fate and transport modeling does not indicate that chromium contamination in the perched aquifer will migrate off-site; therefore, a Risk Reduction Standard 3 alternate concentration level will be developed for this contaminant. Ultimate cleanup goals for offsite property that is not owned by DOE are subject to negotiation with offsite landowners. Therefore, the overall level of confidence for cleanup of offsite perched groundwater to Risk Reduction Standard 2 residential levels is low due to the fact that ultimate cleanup requirements are subject to negotiation and technical feasibility.

Long-Term Stewardship Activities

Long-term stewardship goals for closure of perched groundwater under Risk Reduction Standard 2 are to protect the Ogallala aquifer and restore perched groundwater to beneficial use. Activities necessary to obtain these goals include implementation of corrective actions, which consist of both pump-and-treat and in-situ treatment methodologies to reduce contaminant concentration levels to those that allow for offsite unrestricted perched groundwater residential use, groundwater monitoring, and deed recordation.

3.1.3 Surface Water/Sediment

DOE estimates that approximately 81 surface hectares (200 acres) of sediment will be closed under Risk Reduction Standard 2. A volume estimation of surface water/sediment with residual contamination that will be closed under Risk Reduction Standard 2 does not provide a useful tool because use restrictions of residually contaminated environmental media are identified and implemented by surface surveys. The primary contaminants at Risk Reduction Standard 2 surface water/sediment sites include the metals chromium, lead, and barium; the high explosives RDX, HMX, and TNT; and volatile and semi-volatile organic compounds including trichloroethylene, chrysene, acetone, benzo(a)pyrene and benzo(a)anthracene. The primary reason for residual contamination of surface water/sediments is the historical practice of discharging untreated wastewater. Untreated wastewater is no longer discharged to ditches or surface water bodies (playas).

Surface water/sediment sites recommended for closure under Risk Reduction Standard 2 include several surface water sites (playas) and primarily ditch sediments that are less than 0.6 meter (two feet) below surface elevation (surface sediments). Sediments greater than 0.6 meter (two feet) below surface elevation are categorized as subsurface soils. Although the playas at Pantex are ephemeral water bodies often containing water only seasonally, many playas meet the soils, hydrology, and vegetation criteria for classification as jurisdictional wetlands. Sediments at Pantex are associated primarily with a network of constructed ditches, including some that direct surface water flow away from buildings within interior zones of the Pantex Plant.

For release sites associated with surface water/sediments at Pantex that have been recommended for closure under Risk Reduction Standard 2, the level of confidence for attaining regulatory approval is medium. Pantex

has a site-specific Risk Reduction Standard closure guidance document that has been approved by the TNRCC. This document is used to establish cleanup levels for individual contaminants and provides the statistical and confirmation framework to ensure cleanup levels are met. Because of the fact that not all investigation and cleanup reports have been reviewed and approved by the TNRCC, the possibility exists that additional investigations may be necessary to resolve regulatory comments on documents previously provided. Additional investigations have the potential to identify conditions requiring revision of previous recommendations.

Long-Term Stewardship Activities

Long-term stewardship goals for surface water/sediment sites closed under Risk Reduction Standard 2 are to ensure land use is consistent with restrictions imposed by deed recordations and to ensure controls are maintained that comply with closure requirements. In general, Risk Reduction Standard 2 closures of sites will be conducted to meet non-residential cleanup requirements. Activities conducted to meet these goals may include implementation of procedural limitations for site use, construction and maintenance of signs, fencing, etc., and administrative oversight of site operations.

3.1.4 Estimated Long-Term Stewardship Costs for Risk Reduction Standard 2 Sites Portion

The table below identifies the estimated costs for performing long-term stewardship activities at the Risk Reduction Standard 2 Sites portion. Costs to implement and maintain Risk Reduction Standard 2 closures represent about five percent of the total long-term stewardship costs for release site closures at Pantex.

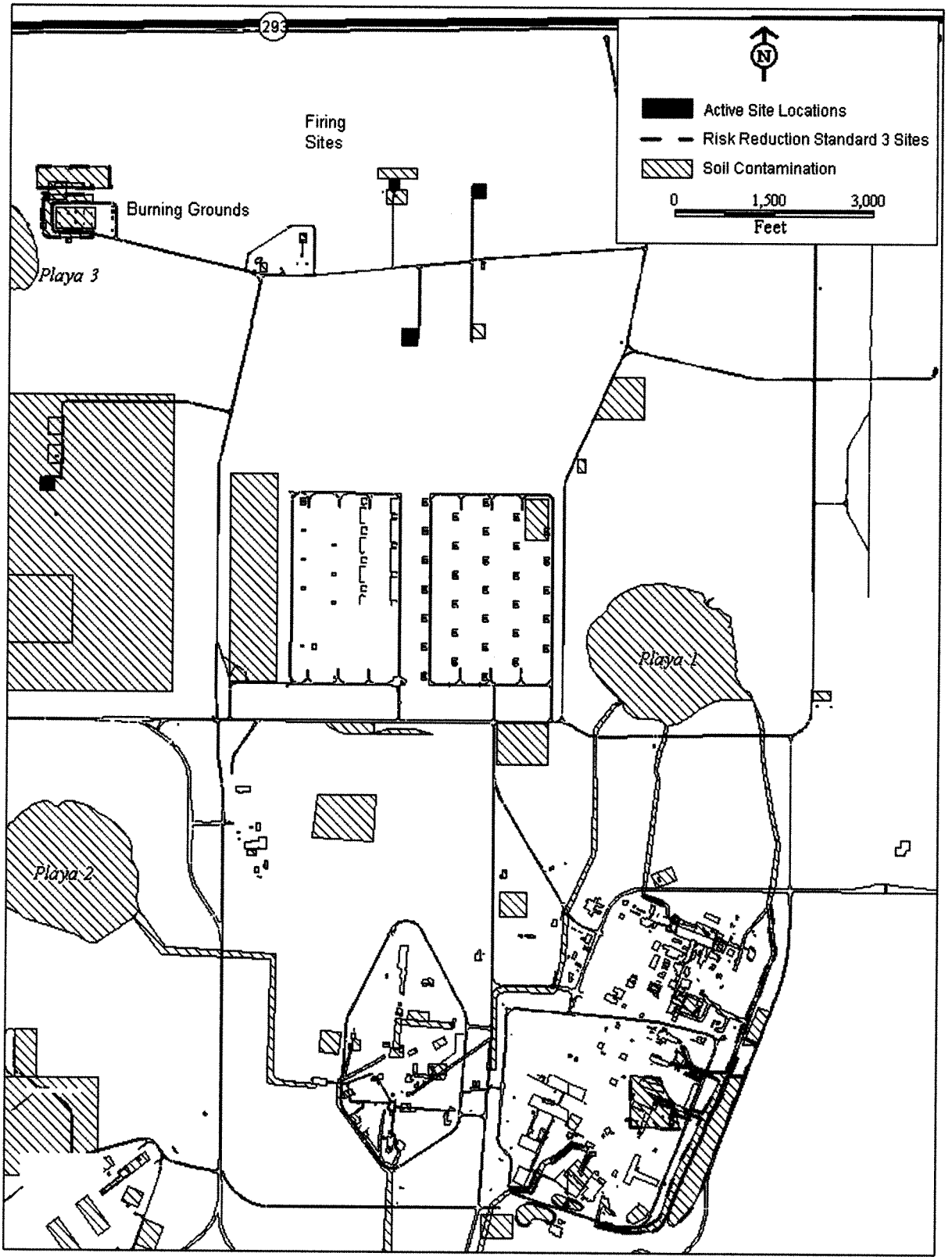
Long-Term Stewardship Costs (Constant Year 2000 Dollars)							
FY 2000-FY 2020	*FY 2011 - FY 2020*	*FY 2021 - FY 2030*	*FY 2031 - FY 2040*	*FY 2041 - FY 2050*	*FY 2051 - FY 2060*	*FY 2061 - FY 2070*	*Estimated Total*
$576,000	$880,000	$1,090,000	$956,000	$726,000	$637,000	$495,000	$5,360,000

3.2 Risk Reduction Standard 3 Sites Portion

The Risk Reduction Standard 3 Sites portion comprises a total of 81 hectares (200 acres). This size represents the estimated total area of all sites recommended for closure under Risk Reduction Standard 3 but does not include the estimated total onsite surface area below which perched groundwater requires cleanup (557 hectares, 1,376 acres). The volume of perched groundwater that is anticipated to be closed under Risk Reduction Standard 3 is approximately 3.8 billion liters (one billion gallons). Of the 249 identified release sites at Pantex that correspond to solid waste management units and areas of concern, approximately 50 of the sites, including soils (landfills, historical spill/discharge, historical waste processing sites), sediments (ditches), and onsite perched groundwater, will be recommended for closure under Risk Reduction Standard 3. It is currently anticipated that approximately 16 hectares (40 acres) of the total 81 hectares (200 acres) that will be recommended for closure under Risk Reduction Standard 3 will require engineered controls (caps/covers, liners, etc.).

RISK REDUCTION STANDARD 3 SITES PORTION HIGHLIGHTS

Major Long-Term Stewardship Activities - deed recordation; maintaining administrative; institutional and/or engineered controls
Portion Size - approximately 81 hectares (200 acres) of soil/sediment solid waste management units, of which approximately 16 hectares (40 acres) will be comprised of engineered corrective action units such as landfill caps/soil covers and ditch liners
Estimated Volume of Residual Contaminants - soil 45 surface hectares (110 acres); onsite perched groundwater 3.8 billion liters (one billion gallons); sediment 20 surface hectares (50 acres); engineered units 16 surface hectares (40 acres)
Long-Term Stewardship Start-End Years - 2003-indefinitely
Average Annual Long-Term Stewardship Costs FY 2003-2006 - $5,324,000



Risk Reduction Standard 3 Portion

For release sites at Pantex recommended for closure under Risk Reduction Standard 3, the level of confidence for attaining regulatory approval is medium. A Baseline Risk Assessment is required for Risk Reduction Standard 3 sites. Pantex has submitted a draft Baseline Risk Assessment to the TNRCC. The majority of issues concerning contaminants of concern selection and exposure modeling have been resolved. The objective of the Baseline Risk Assessment is to analyze Pantex Plant site conditions in the absence of remedial action and to provide human health and environmental baseline data to be used in evaluating remedial action alternatives. Human health impacts are quantified through a process that estimates average daily doses (i.e., intake) for likely exposure scenarios that could place humans in contact with contaminated environmental media. Exposure to contaminated media can occur through a number of exposure routes such as ingestion, dermal contact, and inhalation. Health impacts are expressed differently depending on the type of health impact caused by the contaminant. The health impact end-point for carcinogenic chemical contaminants is expressed as the lifetime risk of cancer incidence (i.e., the probability of contracting cancer from exposure to the contaminant over a lifetime). Health impacts for exposure to non-carcinogenic chemicals are expressed as a hazard quotient, which is the ratio of the estimated average daily dose to the reference dose for the chemical.

General target cleanup levels for media closed under Risk Reduction Standard 3 are concentrations that: 1) represent upper-bound lifetime cancer risk of individual carcinogenic contaminants of 0.000001 and a cumulative excess cancer risk from all carcinogens combined not to exceed 0.0001, each in consideration of all applicable exposure pathways and standard exposure scenarios; 2) comply with National Ambient Air Quality Standards; and 3) for systemic toxicants, do not exceed a hazard index or hazard quotient of one.

For groundwater that is a current or potential source of drinking water and is closed under Risk Reduction Standard 3, specific cleanup levels must not exceed maximum contaminant levels promulgated under the Safe Drinking Water Act. If maximum contaminant levels do not exist, calculated medium-specific concentrations apply, using standard exposure factors consistent with current, historical, and/or probable future land use. If future land use other than residential is appropriate for the site/release area, and demonstration can be made that institutional or legal controls will effectively prevent use of contaminated groundwater, the extent of plume remediation may be revised to allow cleanup to alternate concentration levels.

Specific media cleanup levels for soil/sediment closed under Risk Reduction Standard 3 include medium-specific contaminant concentrations that are protective of air, surface water, and groundwater based on sound scientific principles, including fate and transport modeling. Contaminant concentrations determined protective of other media must be maintained over time, taking into account any implemented engineering controls.

Institutional and Engineered Controls

Deed recordation, which limits the use of media closed under Risk Reduction Standard 3, is required. In addition to deed recordation, post-closure care is required, which may be in the form of engineered controls and/or access/activity restrictions that limit exposure to contaminants to durations that result in excess risk levels below Risk Reduction Standard 3 cleanup levels. Exposure limitations can include construction of engineered controls, procedural restrictions that limit access to specified duration and frequency, and/or procedural implementation of protective equipment protocols that decrease or eliminate exposure to contaminant concentrations. Implementing mechanisms to ensure that deed restrictions are adhered to include management controls provided in Plant Standards, Directives, and Operating Procedures for activities conducted on land owned by the DOE. Deed restrictions and other institutional controls placed on property not owned by the DOE will require negotiation and agreement with the applicable landowners.

It is anticipated that, in some cases, fencing to provide access restriction will accompany deed restriction of Risk Reduction Standard 3 sites to ensure land use is consistent with covenant restrictions. Other engineered controls currently planned are containment technologies, including soil/sediment liners (for certain ditches) and

caps/covers (for certain landfills and other soil contamination areas). It is anticipated that pump and treat and a combination of barriers (bio and/or hydraulic) and in-situ bioremediation/chemical treatment will be the primary activities conducted after completion of perched groundwater corrective action construction.

3.2.1 Soil

Of the 249 identified release sites at Pantex that correspond to solid waste management units and areas of concern, approximately 50 of the sites, including soils sites, sediments sites, and onsite perched groundwater, have been or will be recommended for closure under Risk Reduction Standard 3. Of the 50 sites recommended for closure under Risk Reduction Standard 3, approximately 37 of the sites deal specifically with residually contaminated soil. It is estimated that approximately 110 surface acres of soil will be closed under Risk Reduction Standard 3.

Releases affecting soil at Pantex have resulted from past production operations associated with fabrication of chemical explosive components for nuclear weapons, nuclear weapon assembly/disassembly, weapon modification and repair, surveillance testing and thermal treatment/disposal of chemical explosives and non-radioactive components. Media contamination from these operations occurred by discharging wastewater to unlined ditches, onsite treatment/disposal of high explosives contaminated solvents, spills and leaks of raw and produced materials, onsite landfilling of solid wastes, and onsite discharge of wastewater to playa lakes. The primary contaminants at Risk Reduction Standard 3 sites include the metals chromium, lead, and barium; the high explosives RDX, HMX, and TNT; and volatile and semi-volatile organic compounds, including trichloroethylene, chrysene, acetone, benzo(a)pyrene and benzo(a)anthracene.

Risk Reduction Standard 3 soil sites include soils less than 0.6 meter (two feet) below surface elevation (surface soils) and greater than 0.6 meter (two feet) below surface elevation (subsurface soils). The significance of delineating the soil sites regarding the upper 0.6 meter (two feet) vs. below 0.6 meter (two feet) in surface grade is the exposure pathway analysis required by environmental regulations. The primary exposure pathway for surface soils is the air ingestion pathway. The primary exposure pathways for subsurface soils is the soil-to-groundwater and subsequent groundwater exposure pathway and soil-to-air ingestion pathway for construction/excavation workers. Risk Reduction Standard 3 sites require post-closure care once the remedy is implemented to maintain protectiveness of human health and the environment.

For soil media release sites at Pantex that have been or will be recommended for closure under Risk Reduction Standard 3, the level of confidence for attaining regulatory approval is medium. Because of the fact that not all investigation and cleanup reports have been reviewed and approved by TNRCC, and due to the fact that corrective measures studies/designs approval are dependent on final approval of the investigations, the possibility exists that additional investigations may be necessary to resolve regulatory comments on documents previously provided. Based on regulatory and public input received on proposed corrective actions, the final preferred corrective action alternative may differ than that currently anticipated. Additional investigations have the potential to identify conditions requiring revision of previous recommendations.

Long-Term Stewardship Activities

Long-term stewardship goals for soil sites closed under Risk Reduction Standard 3 are to ensure land use is consistent with restrictions imposed by deed recordations and to ensure controls are maintained that comply with closure requirements. In general, Risk Reduction Standard 3 closures of sites will be conducted to meet non-residential cleanup requirements. Activities conducted to meet these goals may include implementation of procedural limitations for site use, construction and maintenance of signs, fencing, etc., and administrative limitations of site operations.

3.2.2 Groundwater

The estimated volume of onsite perched groundwater that requires treatment to meet Risk Reduction Standard 3 cleanup levels is approximately 3.8 billion liters (one billion gallons). Releases affecting perched groundwater at Pantex have resulted from past production operations associated with fabrication of chemical explosive components for nuclear weapons, nuclear weapon assembly/disassembly, weapon modification and repair, and surveillance testing and disposal of chemical explosives and non-radioactive components. Perched groundwater contamination from these operations is believed to have occurred primarily by discharging wastewater to unlined ditches, onsite treatment/disposal of high explosives contaminated solvents, and spills and leaks of raw and produced materials. The primary contaminants in onsite perched groundwater are the high explosives RDX, TNT, and HMX; the heavy metal chromium; and the volatile organic compound trichloroethylene.

Groundwater closed under Risk Reduction Standard 3 requires post-closure care after remedy implementation to maintain protectiveness of human health and the environment. Groundwater use must be consistent with deed restrictions (such as restrictions for industrial use only or no allowed use). The groundwater contamination at Pantex is primarily restricted to a perched aquifer located at a depth of approximately 82 meters (270 feet) below surface level. Detection of contaminants above drinking water standards have recently been discovered in the Ogallala aquifer in a monitoring well near the northwest boundary of the Pantex Plant and in an Ogallala well located southeast of the Plant. The Ogallala aquifer is the primary irrigation and drinking water source for the Texas Panhandle. Investigation is currently ongoing to determine the nature and extent of the newly identified contaminants.

For impacted groundwater at Pantex that will be recommended for closure under Risk Reduction Standard 3, the level of confidence for attaining regulatory approval is medium. Because of the fact that not all investigation and cleanup reports have been reviewed and approved by the TNRCC, and due to the fact that corrective measures studies/designs approval are dependent on final approval of the investigations, the possibility exists that additional investigations may be necessary to resolve regulatory comments on documents previously provided. Based on regulatory and public input received on proposed corrective actions, the final preferred corrective action alternative may differ than that currently anticipated. Additional investigations have the potential to identify conditions requiring revision of previous recommendations.

Long-Term Stewardship Activities

The remediation and long-term stewardship goals for onsite perched groundwater are the protection of the Ogallala aquifer, reduction of contaminant concentrations to levels that are protective of residential use at the Pantex Plant property boundary and offsite, and to identify and implement beneficial uses for treated groundwater.

3.2.3 Surface Water/Sediment Area

It is estimated that approximately 20 surface hectares (50 acres) of sediment media will be closed under Risk Reduction Standard 3. The primary contaminants at Risk Reduction Standard 3 sediment sites include the metals chromium, lead, and barium; the high explosives RDX, HMX, and TNT; and volatile and semi-volatile organic compounds, including trichloroethylene, chrysene, acetone, benzo(a)pyrene and benzo(a)anthracene. The primary reason for residual contamination of surface water/sediments is the historical practice of discharging untreated wastewater. Untreated wastewater is no longer discharged to ditches or surface water bodies.

There are currently no surface water sites at Pantex identified for closure under Risk Reduction Standard 3. Surface sediments are less than 0.6 meter (two feet) below surface elevation. Sediments greater than 0.6 meter (two feet) below surface elevation are categorized as subsurface soils. Sediments at Pantex are associated

primarily with a network of constructed ditches, including some that direct surface water flow away from buildings within interior zones of the Pantex Plant.

For release sites associated with sediments at Pantex that have been or will be recommended for closure under Risk Reduction Standard 3, the level of confidence for attaining regulatory approval is medium. Because of the fact that not all investigation and cleanup reports have been reviewed and approved by the TNRCC, and due to the fact that corrective measures studies/designs approval are dependent on final approval of the investigations, the possibility exists that additional investigations may be necessary to resolve regulatory comments on documents previously provided. Based on regulatory and public input received on proposed corrective actions, the final preferred corrective action alternative may differ than that currently anticipated. Additional investigations have the potential to identify conditions requiring revision of previous recommendations.

Long-Term Stewardship Activities

Long-term stewardship goals for sediment sites closed under Risk Reduction Standard 3 are to ensure land use is consistent with restrictions imposed by deed recordations and to ensure controls are maintained that comply with closure requirements. In general, Risk Reduction Standard 3 closures of sites will be conducted to meet non-residential cleanup requirements. Activities conducted to meet these goals may include implementation of procedural limitations for site use, construction and maintenance of signs, fencing, etc., and administrative limitations of site operations.

3.2.4 Engineered Units

It is estimated that up to five solid waste management units, comprising approximately 16 surface hectares (40 acres or 1,742,400 square feet) of soil/sediment, will be closed under Risk Reduction Standard 3 using engineered controls. Releases affecting soil at Pantex have resulted from past production operations associated with fabrication of chemical explosive components for nuclear weapons, nuclear weapon assembly/disassembly, weapon modification and repair, surveillance testing and disposal of chemical explosives and non-radioactive components. Media contamination from these operations occurred by discharging wastewater to unlined ditches, onsite treatment/disposal of high explosives contaminated solvents, spills and leaks of raw and produced materials, on-site landfilling of solid wastes, and on-site discharge of wastewater to playa lakes. The primary contaminants at sites for which engineered units will be constructed to contain and limit exposure include the metals chromium, lead, and barium; the high explosives RDX, HMX, and TNT; and volatile and semi-volatile organic compounds including trichloroethylene, chrysene, acetone, benzo(a)pyrene and benzo(a)anthracene.

Containment in the form of engineered caps/covers/ have been planned for up to three sites at Pantex to eliminate exposure pathways and receive Risk Reduction Standard 3 closure approval. Ditch liners are also being considered for Risk Reduction 3 closure of ditch sediments at two solid waste management units that can not be economically remediated by interim corrective measures such as hot-spot removal. Design/structural features of currently considered engineered containment units include asphaltic concrete caps with compacted soil and limestone bases; traditional multi-layer RCRA caps; innovative water harvesting covers; and compacted soil coverings. Fencing, high-density liners, and asphaltic concrete liners are also being considered for ditch/sediment sites.

For release sites at Pantex that have been or will be recommended for closure under Risk Reduction Standard 3, the level of confidence for attaining regulatory approval is medium. Because of the fact that not all investigation and cleanup reports have been reviewed and approved by the Texas Natural Resource Conservation Commission, and due to the fact that corrective measures studies/designs approval are dependent on final approval of the investigations, the possibility exists that additional investigations may be necessary to resolve regulatory comments on documents previously provided. Based on regulatory and public input received on

proposed corrective actions, the final preferred corrective action alternative may differ than that currently anticipated. Additional investigations have the potential to identify conditions requiring revision of previous recommendations.

Long-Term Stewardship Activities

The long-term stewardship goals for sites that require engineered units to meet closure requirements of Risk Reduction Standard 3 include protection of human health and the environment in the most effective, cost-efficient, and most unobtrusive manner possible; and to continuously evaluate performance of the units to determine if new or different technologies can be implemented that will result in less expensive or more effective remediation of residual contamination. Activities necessary to achieve these goals include routine maintenance and monitoring, replacement, as necessary, and continued research of innovative remediation methodologies and alternatives.

3.2.5 Estimated Long-Term Stewardship Costs for Risk Reduction Standard 3 Sites

The table below identifies the estimated costs for performing long-term stewardship activities at the Risk Reduction Standard 3 Sites portion (by ten-year intervals). Risk Reduction Standard 3 closures represent about 95% of long-term stewardship costs at Pantex. Costs include corrective action system operation, monitoring, maintenance, and remedial system upgrade. The primary costs entail groundwater treatment associated with an estimated 60 extraction, 15 injection, and 100 corrective action monitoring wells; associated operation and upkeep; monitoring and analytical costs; and treatment system management. The primary costs associated with engineered controls for Risk Reduction Standard 3 soil/sediment site closures include monitoring, maintenance, and, as necessary, replacement.

Long-Term Stewardship Costs (Constant Year 2000 Dollars)							
FY 2000-FY 2010	*FY 2011 - FY 2020*	*FY 2021 - FY 2030*	*FY 2031 - FY 2040*	*FY 2041 - FY 2050*	*FY 2051 - FY 2060*	*FY 2061 - FY 2070*	*Estimated Total*
$10,916,000	$16,711,000	$20,710,000	$18,163,000	$13,785,000	$12,105,000	$9,408,000	$101,798,000

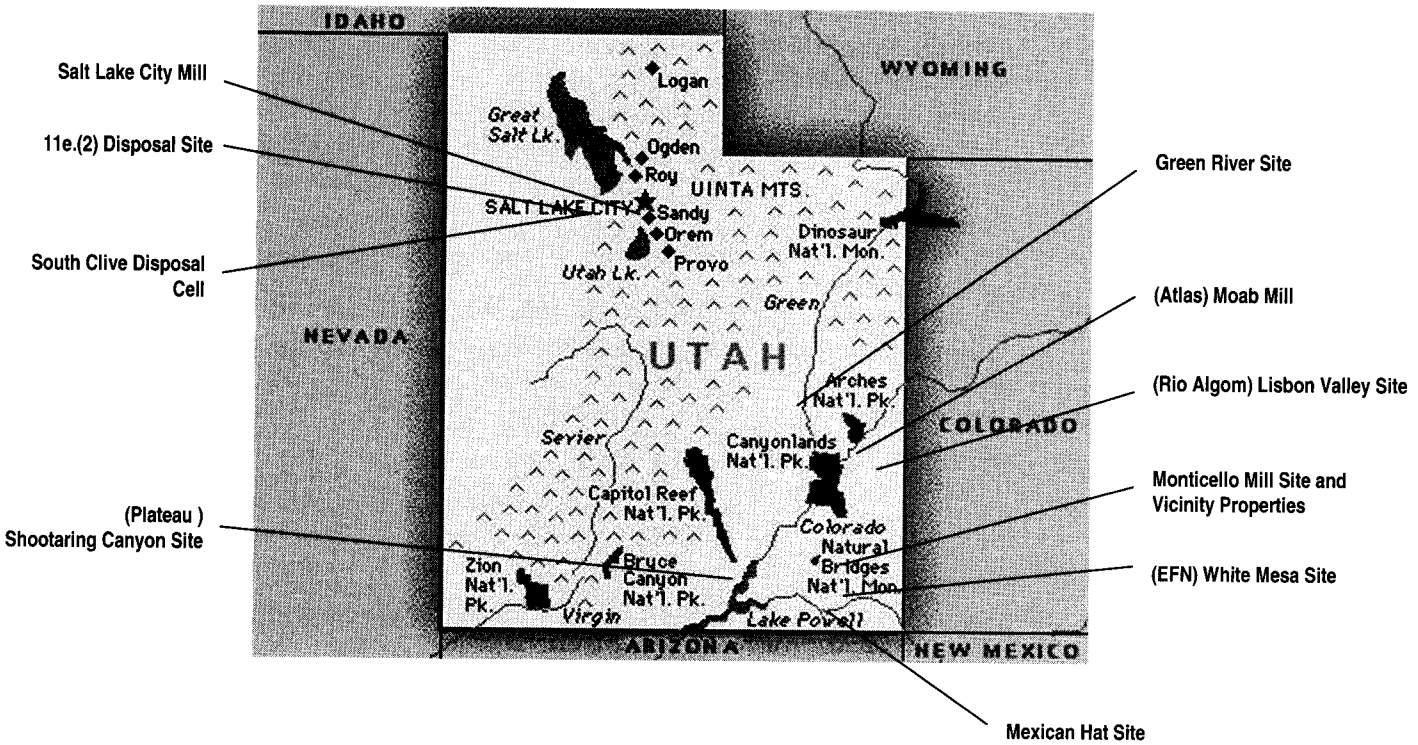
4.0 FUTURE USES

Release sites closed under Risk Reduction Standard 2, corresponding to approximately 280 surface hectares (700 acres), will be cleaned up to approved residual contaminant levels allowed for industrial use and will be deed-restricted for industrial activities. Release sites closed under Risk Reduction Standard 3, corresponding to approximately 81 surface hectares (200 acres), will be cleaned up to approved residual contaminant levels allowed for site specific and/or industrial use and will be deed restricted for use, depending on cleanup levels achieved and applicable post-closure care requirements. It is not anticipated that controls placed on residually contaminated sites and perched groundwater at Pantex will affect the ongoing site mission. If technical limitations result in not achieving remediation goals for perched groundwater, use of that resource may be restricted or eliminated.

For more information about the Pantex site, please contact:

Hugh Hanson, Environmental Restoration Engineer
U.S. Department of Energy , Amarillo Area Office
P.O. Box 30030
Amarillo, TX 79120
Phone: 806-477-3164
or visit the Internet website at http://www.em.doe.gov

Utah



Long-Term Stewardship Site Highlights

11e.(2) Disposal Site (page 3)
Site Size - 14.6 hectares (36.2 acres)
Current Landlord - Envirocare of Utah
Expected Future Landlord - U.S. Department of Energy

(Atlas) Moab Mill (page 5)
Major Activities - disposal cell monitoring; groundwater monitoring; access restrictions; erosion control
Site Size - 162 hectares (400 acres)
Start/End Years - yet to be determined
Estimated Average Annual Cost FY 2005-2006 - $16,500

(EFN) White Mesa Site (page 9)
Site Size - 202 hectares (500 acres)
Current Landlord - International Uranium Corporation
Expected Future Landlord - U.S. Department of Energy, Grand Junction Office

Green River Site (page 13)
Major Activities - disposal cell monitoring; groundwater monitoring; access restrictions; inspections; maintenance
Site Size - 10 hectares (25 acres)
Start/End Years - engineered unit - 1989/in perpetuity, groundwater - 2009-2018
Estimated Average Annual Cost FY 2000-2006 - $88,300

Mexican Hat Site (page 17)
Major Activities - groundwater monitoring; disposal cell monitoring
Site Size - 48 hectare (119 acre)
Start/End Years - disposal cell 1997 - in perpetuity; groundwater 1999-2004
Estimated Average Annual Cost FY 2000-2006 - $139,000

Monticello Mill Site and Vicinity Properties (page 23)
Major Activities - disposal cell monitoring; institutional control enforcement; supplemental standards area monitoring; groundwater monitoring
Site Size - 2,300 hectares (5,700 acres)
Start/End Years - 2001/in perpetuity
Estimated Average Annual Cost FY 2000-2006 - $286,000

(Plateau) Shootaring Canyon Site (page 33)
Total Site Area - unknown
Current Landlord - U.S. Energy Corporation through its subsidiary, Plateau Resources Limited
Expected Future Landlord - U.S. Department of Energy, Grand Junction Office

(Rio Algom) Lisbon Valley Site (page 37)
Site Size - 130 hectares (330 acres)
Current Landlord - Rio Algom through its subsidiary, Rio Algom Mining Corporation
Expected Landlord - U.S. Department of Energy, Grand Junction Office

Salt Lake City Mill (page 41)
Major Activities - groundwater monitoring; land use restrictions; record keeping
Site Size Area - 52 hectares (128 acres)
Start-End Years - 1989-2004
Estimated Average Annual Cost FY 2000-2006 - $25,000

South Clive Disposal Cell (page 45)
Major Activities - disposal cell monitoring
Site Size - 40 hectares (99 acres)
Start/End Years - 1997/in perpetuity
Estimated Average Annual Cost FY 2000-2006 - $32,342

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11e.(2) DISPOSAL SITE[1]

1.0 SITE SUMMARY

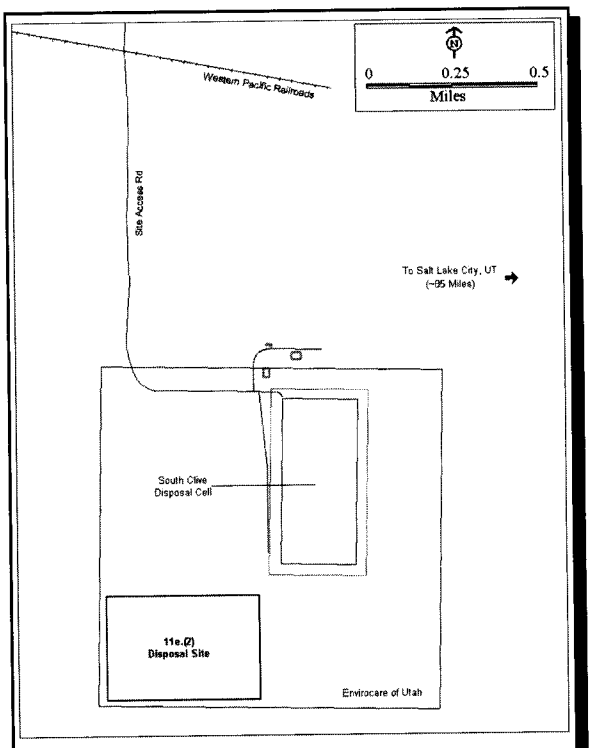
1.1 Site Description and Mission

Envirocare of Utah, which is a commercial low-level waste disposal site, contains within its boundaries a disposal cell for byproduct material defined under the Atomic Energy Act, as amended. This disposal cell, known as the "11e.(2) Disposal Site," is located approximately 137 kilometers (85 miles) west of Salt Lake City and 4 kilometers (2.5 miles) south of U.S. Interstate 80 in Tooele County, Utah. The disposal cell is currently 14.6 hectares (36.2 acres), but could ultimately be 37.1 hectares (91.7 acres) and hold up to 4.2 million cubic meters (5.5 million cubic yards) of waste.

SITE HIGHLIGHTS

Total Site Area - 14.6 hectares (36.2 acres)
Estimated Volume of Residual Contaminants - 900,000 cubic meters (1 million cubic yards)
Current Landlord - Envirocare of Utah
Expected Future Landlord - U.S. Department of Energy

Envirocare of Utah owns a license to receive, store, and dispose of 11e.(2) byproduct material onsite. 11e.(2) byproduct material is defined by law under Section 11e.(2) of the *Atomic Energy Act*, as amended by Title II of the *Uranium Mill Tailings Radiation Control Act of 1978*, as: tailings or waste produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material (i.e., uranium or thorium) content. A portion of the material disposed at the 11e.(2) Disposal Site originated from the removal of waste from sites remediated under the Formerly Utilized Sites Remedial Action Program (FUSRAP).



11e.(2) Disposal Site

To date, approximately 900,000 cubic meters (one million cubic yards) of material have been disposed in the cell. The active portion of the cell occupies 10 hectares (24.9 acres) and a cap has been placed over 4.6 hectares (11.3 acres). The disposal cell lies in a flat ancient lake bed along the eastern edge of the Great Salt Lake Desert, which extends approximately 80 kilometers (50 miles) from the Nevada/Utah border. The surrounding area is sparsely

[1]This report is developed in response to a Congressional request in the Fiscal Year (FY) 2000 National Defense Authorization Act (NDAA). As requested by the Act, this report addresses current and anticipated long-term stewardship activities at each site or portion of a site by the end of calendar year 2006 ("Conference Report on S.1059, National Defense Authorization Act for Fiscal Year 2000," *Congressional Record*, August 5, 1999).

Based on current planning, the 11e.(2) Disposal Site is not expected to require long-term stewardship until after 2006, and for this reason the site is not the primary focus of this report. This brief summary of the site cleanup activities is provided for background information and potential future long-term stewardship activities. (See Section 3.2 of Volume I).

populated, with the nearest residences at least 48 kilometers (30 miles) from the site. Roads in the area are used for recreation and for access to military firing ranges south of the site. Vegetation in the area is sparse, and the semi-arid low shrub land is used primarily for grazing.

For additional information about the 11e.(2) Disposal Site, please contact:

Envirocare of Utah, Inc.
Suite 116
46 W. Broadway
Salt Lake City, UT 84101-2019
Phone: 801-532-1330

(ATLAS) MOAB MILL

1.0 SITE SUMMARY

1.1 Site Description and Mission

The (Atlas) Moab Mill is the location of a former uranium milling site that operated from 1956 until 1988. The site is located on 162 hectares (400 acres) of land on the northwest shore of the Colorado River in Grand County, Utah, approximately 5 kilometers (3 miles) from the city of Moab. Adjacent to the mill on the north and west are U.S. Highway 191 and Utah Highway 279, respectively. Arches National Park is north of the site across U.S. Highway 191. The Rio Grande Railroad traverses a small section of the property, just west of Highway 279. Milling operations at the site created uranium mill tailings and other process-related wastes, which occupy approximately 53 hectares (130 acres) of the site and are located about 230 meters (750 feet) from the Colorado River.

LONG-TERM STEWARDSHIP HIGHLIGHTS

Major Long-Term Stewardship Activities -yet to be determined
Total Site Area - 162 hectares (400 acres)
Estimated Volume of Residual Contaminants - groundwater unknown; surface water unknown; soil unknown
Long-Term Stewardship Start-End Years - yet to be determined*
Average Annual Long-Term Stewardship Cost FY 2005-2006 - $16,500
Landlord - U.S. Department of Energy, Grand Junction Office
*The long-term stewardship start and end years will depend on the remedial action selected and completion date. Long-term stewardship activities are not expected to begin until after 2006.

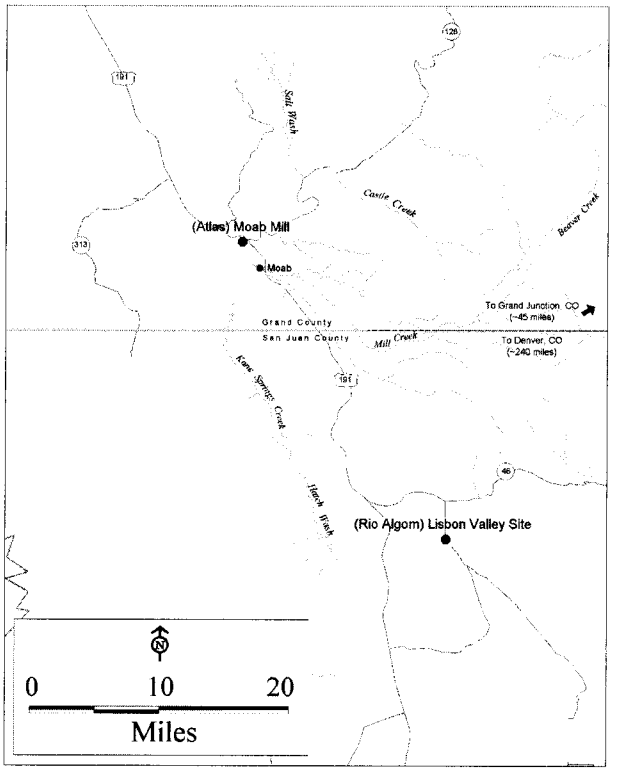
The current mission of the (Atlas) Moab Mill site has been modified by the National Defense Authorization Act (NDAA) for Fiscal Year (FY) 2001. The U.S. Department of Energy (DOE) will be responsible for conducting long-term stewardship activities at the site, if any are necessary.

In the NDAA for FY 2001, the (Atlas) Moab Mill site's remediation schedule and plans were changed. To satisfy the site's remediation procedures in the NDAA for FY 2001, DOE must prepare a remediation plan for the site, in accordance with Title I of the Uranium Mill Tailings Radiation Control Act of 1978 (UMTRCA), that includes considering the relocation of the mill tailings and contaminated media to an offsite disposal cell (most likely a disposal cell constructed specifically to contain the remediated materials from the (Atlas) Moab Mill site) and restoration of the groundwater. As part of the development of this remediation plan, DOE must cooperate with the National Academy of Sciences and thoughtfully consider its recommendations on various remedial alternatives. Also, DOE will develop, in consultation with the Trustee, NRC, and the State of Utah, an efficient and legal means for transferring all responsibilities and title of the (Atlas) Moab Mill site, and all the materials therein, from the Trustee to DOE. This remediation plan must be completed no later than one year after the date of the enactment of the NDAA for FY 2001; and DOE must begin remedial action at the site as soon as practicable after the completion of the plan.

The license for the materials at the (Atlas) Moab Mill site, issued by NRC, will terminate one year after the date of the enactment of the NDAA for FY 2001, unless DOE determines that the license can be terminated earlier. Until the license is terminated, the Trustee, subject to the availability of funds appropriated specifically for the site's remediation or the funds made available by the Trustee from the site's trust, may carry out (1) interim measures to reduce or eliminate the localized high ammonia concentrations in the Colorado River; (2) activities to dewater the mill tailings at the site; and (3) other activities related to the site, subject to the authority of the NRC and in consultation with DOE.

The historical mission of the uranium milling site was to process uranium for sale to the U.S. Government and

other industries. More than half of the uranium produced at the site was used to support the U.S. Government national defense program. The Uranium Reduction Company (URC) built the (Atlas) Moab Mill and began operations in October 1956. Atlas Corporation purchased the site from URC in 1962 and operated the mill until 1984. The majority of the ore processed at the (Atlas) Moab Mill was transported to the mill from the Big Indian Uranium District, approximately 48 kilometers (30 miles) to the southeast. The ore was ground to a sufficiently fine consistency to allow efficient chemical reactions to occur, and was then processed, using either the acid-leach or alkaline-leach process. After milling, the combined waste slurry from both processes was pumped into the tailings impoundment.



(Atlas) Moab Mill

1.2 Site Cleanup and Accomplishments

Contamination at the (Atlas) Moab Mill resulted from the previous uranium milling operations conducted by URC and Atlas Corporation. Approximately 10,500,000 tons of uranium mill tailings are currently located on the site. In addition to the tailings, soil and building debris are contaminated with uranium, radium, and thorium.

In 1988, the Atlas Corporation began decommissioning the site and constructing an interim cover for the tailings disposal area. The former mill was decommissioned and the wastes were consolidated under an interim cover that was completed in 1995. In 1998, the Atlas Corporation declared bankruptcy. As a result of the bankruptcy proceedings, the Moab Uranium Mill Site Transfer Agreement was established, which provided for the transfer of the site's NRC license to a trustee that was to be responsible for completing the site's remediation. In January 2000, PricewaterhouseCoopers was selected as the trustee and agreed to oversee and ensure that remediation of the (Atlas) Moab Mill was completed in accordance with the conditions of the NRC license and the site's transfer agreement. However, as stated above, the Trustee will relinquish all responsibility to DOE within one year of enactment of the NDAA for FY 2001.

Groundwater at the site is contaminated with radioactive materials, including radium and uranium, and nitrogen compounds from the uranium ore processing. The Colorado River is contaminated with localized, high concentrations of ammonia. The initial monitoring program of water resources at and around the site began in 1976, after approximately 20 years of mill operation. The monitoring program was designed to collect surface water samples from the Colorado River and groundwater samples from the alluvial aquifer situated beneath the tailings impoundment. NRC has indicated that remediating contaminated groundwater will require a substantially longer period of time than will be involved in the surface reclamation of the mill tailings.

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

The DOE Grand Junction Office will be responsible for performing long-term stewardship activities at the (Atlas) Moab Mill site, if any are required. The types of long-term stewardship activities that may be needed at the site will not be known until the site's remediation plan is prepared and the remedial action is completed. DOE provides a 24-hour phone line for reporting site concerns.

Site records will be kept in permanent storage at the DOE Grand Junction Office in Colorado. The types of records that will be maintained include site characterization data, remedial action design information, the radiological assessment, long-term monitoring plans, annual inspection reports, and current and historic monitoring data.

2.2 Specific Long-Term Stewardship Activities

Groundwater

The groundwater is expected to require annual monitoring. The specific monitoring requirements will be prescribed in the site's long-term surveillance plan that will be developed after remediation is completed, and if long-term stewardship activities are required.

STAKEHOLDER INVOLVEMENT

DOE will assume the lead role in stakeholder involvement during remedial action as a result of the NDAA for FY 2001. Once remediation is complete, the annual inspection reports for the (Atlas) Moab Mill will be distributed to the local libraries and to any stakeholders requesting them. The reports, once published, will be available on the DOE Grand Junction Office website at www.doegjpo.com.

Surface Water/Sediments

The surface water may require periodic monitoring if it is not completely cleaned up during the site's remedial action. The specific monitoring requirements will be prescribed in the site's long-term surveillance plan that will be developed after remediation is completed, and if long-term stewardship activities are required.

2.3 Regulatory Regime

The long-term stewardship activities, if required, at the (Atlas) Moab Mill will be governed by several requirements in the following regulations: Title I of UMTRCA; the *Atomic Energy Act;* EPA standards, including Title 40 of the *Code of Federal Regulations*, Part 192 Subparts B and C; and the *National Environmental Policy Act,* as amended.

2.4 Assumptions and Uncertainties

The site's remediation strategy has not yet been selected. DOE assumes that the tailings will be removed to an offsite disposal cell. The costs for conducting long-term stewardship activities at an offsite disposal cell will be similar to other UMTRCA Title II, offsite disposal cells.

The (Atlas) Moab Mill site will undergo groundwater restoration activities for a currently undetermined length of time; after which, the site is expected to be eligible for unrestricted use.

3.0 ESTIMATED LONG-TERM STEWARDSHIP COSTS

The cost estimates, identified in the table below, are based on the actual costs of long-term stewardship activities at other similar sites under DOE's management. Actual costs will vary depending upon the groundwater

sampling frequency, number of analyses sampled, and the number of sampling points (e.g., wells). Contingency costs, such as cap replacement, have not been incorporated in the cost estimates.

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	***Amount***	***Year(s)***	***Amount***	***Year(s)***	***Amount***
FY 2000	$0	**FY 2008**	$16,500	**FY 2036-2040**	$81,800
FY 2001	$0	**FY 2009**	$16,500	**FY 2041-2045**	$81,800
FY 2002	$0	**FY 2010**	$16,500	**FY 2046-2050**	$81,800
FY 2003	$0	**FY 2011-2015**	$78,500	**FY 2051-2055**	$81,800
FY 2004	$0	**FY 2016-2020**	$76,400	**FY 2056-2060**	$81,800
FY 2005	$16,500	**FY 2021-2025**	$76,600	**FY 2061-2065**	$81,800
FY 2006	$16,500	**FY 2026-2030**	$81,000	**FY 2066-2070**	$81,800
FY 2007	$16,500	**FY 2031-2035**	$81,800		

4.0 FUTURE USES

Assuming that the contaminated materials are relocated to an offsite disposal cell, title to the (Atlas) Moab Mill site will likely be transferred or sold after remediation activities at the site are completed. The future use of the site will depend on the remedial action that is selected in the site's remediation plan, but DOE anticipates that the site will ultimately be remediated to unrestricted use.

The associated, anticipated disposal cell will be a permanent mill tailings repository under DOE ownership with the necessary use restrictions.

For more information about the (Atlas) Moab Mill site, please contact:

Art Kleinrath, Long-Term Surveillance and Maintenance Program Manager
U.S. Department of Energy, Grand Junction Office
2597 B3/4 Road, Grand Junction, CO 81503
Phone: 970-248-6037
or visit the Internet website at http://www.doegjpo.com

(EFN) WHITE MESA SITE[1]

1.0 SITE SUMMARY

1.1 Site Description and Mission

The (EFN) White Mesa Site is the location of a currently operating uranium milling site. The site is located in San Juan County, Utah, approximately eight kilometers (five miles) south of Blanding. The (EFN) White Mesa site is currently owned and operated by the International Uranium Corporation (formerly owned and operated by Energy Fuels Nuclear, Inc). The site covers approximately 202 hectares (500 acres).

LONG-TERM STEWARDSHIP HIGHLIGHTS

Total Site Area - 202 hectares (500 acres)
Current Landlord - International Uranium Corporation
Expected Future Landlord - U.S. Department of Energy, Grand Junction Office
Reason Not Subject to NDAA Requirements - This site is an UMTRCA Title II site that will not be transferred to DOE until 2025

Once the site is transferred to DOE in 2025, the only site mission will be the long-term surveillance and maintenance of the disposal cell. The exact number of acres that will be transferred to DOE has not yet been determined.

The current and historic mission of the site is to extract uranium oxide concentrate (commonly called yellowcake) from uranium ores found in the region. The (EFN) White Mesa Site uranium milling site was constructed in the late 1970s by Energy Fuels Nuclear, Inc. to process uranium ores from the Colorado Plateau. After two- and-a-half years of operation, the mill was shut down. In May 1997, International Uranium Corporation, the current owner and site operator, purchased the mill assets. The mill operated intermittently throughout the 1980s and 1990s and is currently in operation. From its inception through April 1999, the mill processed a total of 3.8 million tons of uranium ore.

1.2 Site Cleanup and Accomplishments

The International Uranium Corporation will be responsible for conducting all remediation activities at the (EFN) White Mesa site. All contamination at the site will be remediated and disposed of in two onsite disposal cells. Materials and debris associated with the decommissioning of the mill facility will be placed in one of the lined disposal cells. Contaminated soils, crystals, and the synthetic liner from an existing evaporation pond will be consolidated in the other cell, along with offsite soils contaminated by wind-blown mill tailings. When remediation activities are completed, the site will have two disposal cells containing approximately two million cubic meters (2.6 million cubic yards) of uranium mill tailings. The precise size of the disposal cells will not be known until remediation is completed. Once the cells reach capacity, they will be capped with a one-meter (three-foot) layer of soil, followed by a layer of compacted clay and eight-to-20 centimeters (three-to-eight inches) of rock riprap for erosion control. The cells will be designed to limit the infiltration of precipitation,

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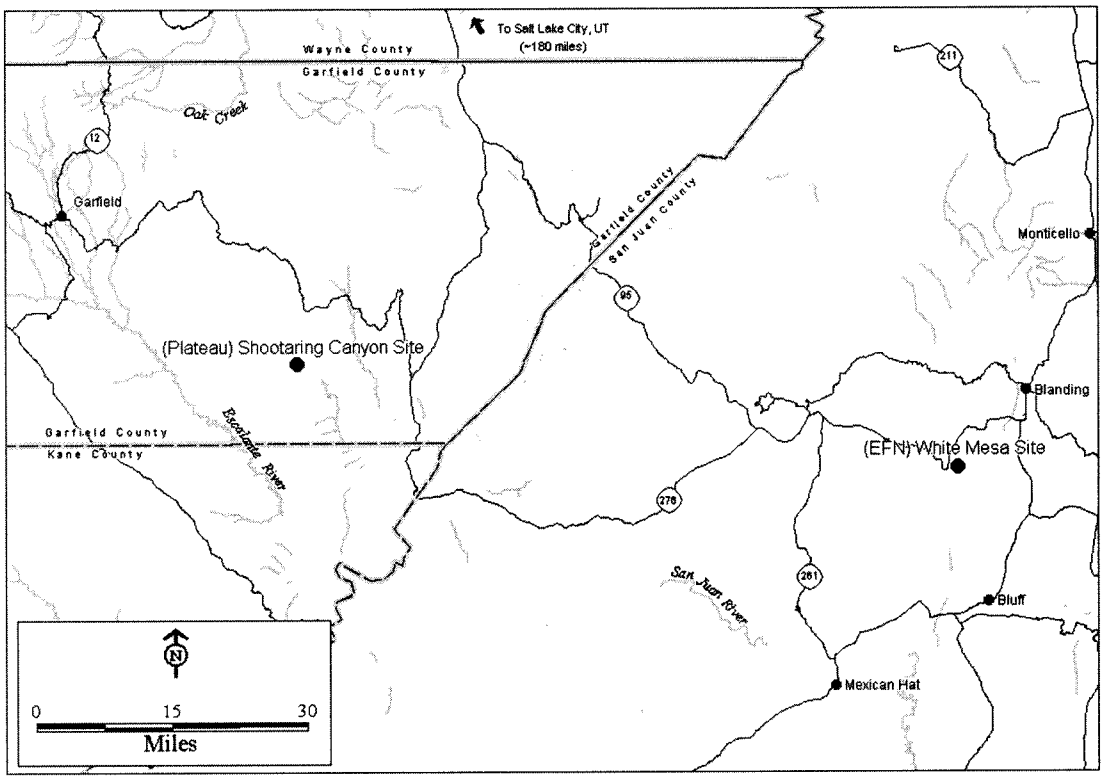
[1]This report is developed in response to a Congressional request in the Fiscal Year (FY) 2000 National Defense Authorization Act (NDAA). As requested by the Act, this report addresses current and anticipated long-term stewardship activities at each site or portion of a site by the end of calendar year 2006 ("Conference Report on S.1059, National Defense Authorization Act for Fiscal Year 2000," *Congressional Record,* August 5, 1999).

Based on current planning, the (EFN) White Mesa Site is not expected to be transferred to the U.S. Department of Energy (DOE) for long-term stewardship until 2025, and for this reason the site is not the primary focus of this report. This brief summary of the site cleanup activities is provided for background information and potential future long-term stewardship activities. (See Section 3.2 of Volume I).

prevent erosion, and control radon gas releases.

No groundwater contamination has been detected by the site's existing groundwater detection monitoring program. Because contamination has not been detected, the U.S. Nuclear Regulatory Commission (NRC) Reclamation Plan for the (EFN) White Mesa Site does not require any corrective measures for groundwater.



(EFN) White Mesa Site

2.0 EXPECTED FUTURE USES AND SITE RESPONSIBILITY

Once the (EFN) White Mesa Site is transferred to DOE in 2025, the DOE Grand Junction Office will be responsible for long-term stewardship activities. The two disposal cells at the site will be similar to other uranium mill tailings disposal cells and will have similar long-term stewardship activities.

Anticipated site-wide long-term stewardship activities include restricting access by fencing and posting warning signs along the site boundary. DOE will repair the fence and replace the signs, as necessary. DOE will staff a 24-hour phone line for reporting site concerns. Drilling and other intrusive activities will be prevented within site boundaries through institutional controls. DOE expects to conduct annual surface inspections to ensure the integrity of the disposal cell covers and other engineered features. Groundwater is likely to be monitored annually as a "best management" practice.

Site records will be placed in permanent storage at the DOE Grand Junction Office in Colorado. The types of records maintained include site characterization data, remedial action design information, the site completion report, long-term monitoring plans, annual inspection reports, and current and historic monitoring data.

For additional information about the (EFN) White Mesa Site, please contact:

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Bill Von Till, Project Manager
Uranium Recovery and Low-Level Waste
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GREEN RIVER SITE

1.0 SITE SUMMARY

1.1 Site Description and Mission

The Green River Site is the location of a former uranium milling site that operated between 1958 and 1961. The site covers approximately 10 hectares (25 acres) and is located in Grand County in the east-central portion of Utah. The site is 1.6 kilometers (one mile) southeast of the City of Green River and 113 kilometers (70 miles) west of the Utah-Colorado border. The U.S. Army's White Sands Missile Range, Utah Launch Complex, uses most of the vacant land south and east of the site. Agriculture is the predominant land use in this sparsely populated area.

LONG-TERM STEWARDSHIP HIGHLIGHTS

Major Long-Term Stewardship Activities - disposal cell monitoring; groundwater monitoring; access restrictions; inspections; maintenance
Total Site Area - 10 hectares (25 acres)
Estimated Volume of Residual Contaminants - engineered unit 292,200 cubic meters (382,000 cubic yards); groundwater 685,200 cubic meters (181 million gallons)
Long-Term Stewardship Start-End Years - engineered unit - 1998-in perpetuity; groundwater - 2009-2018
Average Annual Long-Term Stewardship Cost FY 2000-2006 - $88,300
Landlord - U.S. Department of Energy, Grand Junction Office

The milling operations used to process the uranium ore created approximately 292,200 cubic meters (382,000 cubic yards) of process-related waste and uranium mill tailings. The tailings were originally deposited onsite in a two-meter (seven-foot) thick pile covering four hectares (nine acres). The U.S. Department of Energy (DOE) encapsulated the tailings in an engineered disposal cell in 1989.

The current mission of the Green River Site is monitoring and maintaining the onsite disposal cell. The site is subject to Title I of the *Uranium Mill Tailings Radiation Control Act of 1978* (UMTRCA). As such, DOE is responsible for remediation and long-term stewardship activities of the site. DOE began long-term stewardship activities for the engineered unit in 1998.

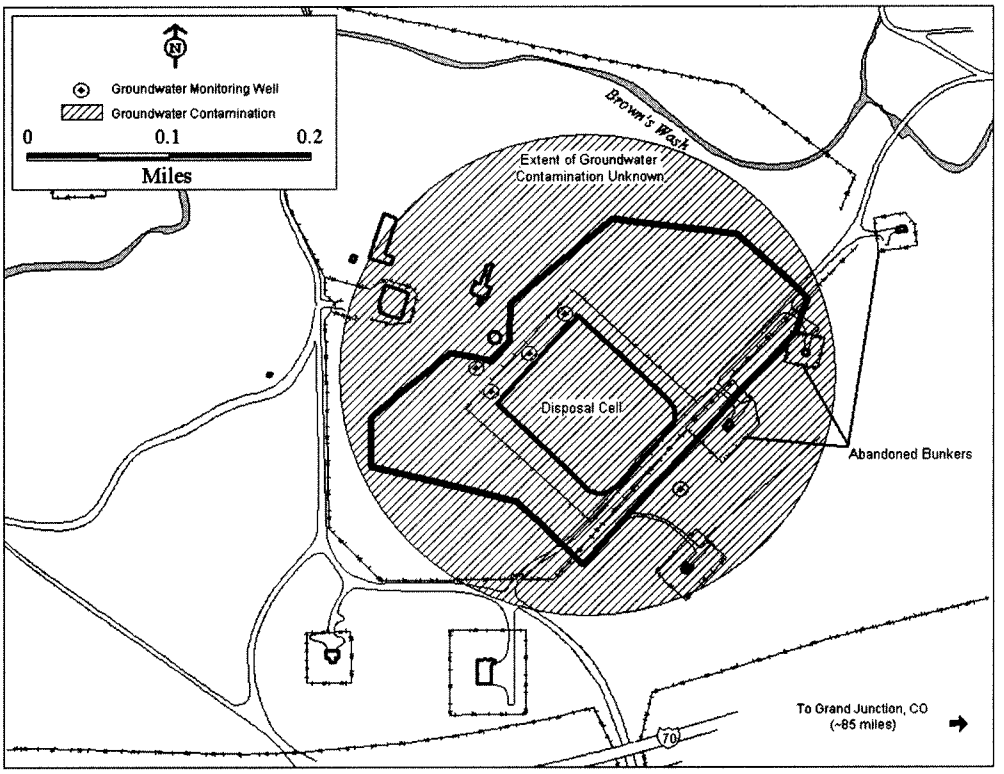
The historic mission of the Green River site was to provide uranium for the U.S. Government's national defense program. Union Carbide built the uranium processing mill in 1958 and operated it until 1961. Later, the mill buildings were used for assembly of missile components for the Utah Launch Complex. The State of Utah acquired ownership of the mill and tailings site in 1988.

1.2 Site Cleanup and Accomplishments

Remediation of the site involved consolidating and stabilizing the residual radioactive material in a disposal cell at the former processing site and remediating 17 vicinity properties. The State of Utah and the U.S. Nuclear Regulatory Commission (NRC) concurred in DOE's decision to consolidate the tailings onsite in an engineered disposal cell.

Radioactive materials from the original pile, the demolished or decontaminated mill buildings, and contaminated vicinity properties were consolidated into a U.S. Environmental Protection Agency (EPA)-compliant disposal cell. The cell was excavated to bedrock and lined with two meters (six feet) of low-permeability soil. The cell measures 137 meters (449 feet) by 162 meters (532 feet) at the base and rises 13 meters (43 feet) above the surrounding land. Most of the contaminated materials are below grade. Approximately 292,200 cubic meters (382,000 cubic yards) of contaminated materials, including uranium, radium, and thorium, were placed in the 2.5-hectare (six-acre) cell (equivalent to 501,000 dry tons of contaminated material with an estimated activity

of 30 curies of radium-226). A clay-rich soil layer placed over the contaminated materials extends to the edge of the cell below grade and serves as a low permeability radon barrier. Above grade, the radon barrier is covered by a layer of rock placed on granular bedding material. The cell design promotes rapid precipitation runoff to minimize leachate. Surface remedial action was completed in September 1989.



Green River Site

Approximately 685,200 cubic meters (181 million gallons) of groundwater in the vicinity of the Green River Site are contaminated with materials generated during uranium ores processing. Uranium processing-related contaminants have been identified in the alluvium and in the upper Cedar Mountain Formation beneath the site. An upward hydraulic gradient prevents these contaminants from migrating into lower strata. Groundwater in these aquifers is not suitable for agricultural or domestic use because of naturally occurring contamination and low water yields. The groundwater is not a current or potential source of drinking water, as defined in Title 40 of the *Code of Federal Regulations*, Part 192. Therefore, no active groundwater remediation is planned. DOE is currently monitoring groundwater to provide additional characterization and to develop a groundwater compliance strategy for regulatory approval.

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

The DOE Grand Junction Office manages the site according to a long-term surveillance plan prepared specifically for the Green River Site. Under provisions of the plan, the Grand Junction Office conducts annual

STAKEHOLDER INVOLVEMENT

Community interaction has been minimal since the surface remedial action was completed. Copies of the annual inspection report for Green River Site and other sites are distributed to the local library and to any stakeholders requesting them. The annual inspection reports are also published on the DOE Grand Junction Office website at www.doegjpo.com..

inspections of the site to evaluate the condition of surface features. DOE also performs site maintenance, such as fence repair and sign replacements, as necessary. A locked security fence surrounds the perimeter of the cell to control access.

The disposal site is owned by the Federal Government, which controls land use within the site boundaries. DOE performs long-term stewardship activities, as required under the NRC general license (10 CFR 40.27), to maintain protectiveness of the remedy and to ensure compliance with the applicable regulations. A chain- link fence with locked gates restricts access to the disposal cell, and warning signs are posted every 152 meters (500 feet) along the site boundary. DOE staffs a 24-hour phone line for reporting site concerns. Drilling and other intrusive activities are prevented within site boundaries through the use of institutional controls.

DOE maintains and updates specific records and reports required to document the long-term stewardship activities at the Green River Site. DOE submits an annual report to NRC that documents the results of the long-term surveillance plan, as required by NRC regulations in Title 10 of the *Code of Federal Regulations* Part 27, Appendix A, Criterion 12. Site records are kept in permanent storage at the DOE Grand Junction Office in Colorado and are available for review by the public. The types of records maintained include site characterization data, remedial action design information, the site completion report, long-term monitoring plans, annual inspection reports, and current and historic monitoring data. Real property records are maintained at the DOE Albuquerque Operations Office in New Mexico.

2.2 Specific Long-Term Stewardship Activities

Engineered units

Long-term stewardship activities for the disposal cell include conducting annual inspections to assess the integrity of the cell cover and other engineered features, and ensuring effectiveness of institutional controls. No significant repairs are anticipated for the disposal cell. The Green River Site disposal cell is designed and constructed to last for 200 to 1,000 years. However, DOE's responsibility for the safety and integrity of the Green River Site will continue in perpetuity. Under the provisions of the long-term stewardship plan, DOE will monitor groundwater on a quarterly basis through at least 2001 to demonstrate the effectiveness of the cell in isolating the encapsulated wastes from the groundwater. After 2001, the groundwater monitoring strategy will be reevaluated. It is expected to continue beyond 2001, but at a reduced frequency.

Groundwater

No groundwater remediation occurred at the Green River Site because of the already high levels of naturally occurring constituents in the groundwater. DOE is currently developing a groundwater compliance strategy for regulatory approval. The monitoring frequency and duration will be determined by the compliance strategy. Current planning assumes that DOE will monitor the groundwater once every five years until 2018.

2.3 Regulatory Regime

In 1998, the Green River Site came under a general license issued by NRC for custody and long-term care of residual radioactive disposal sites (contained in Title 10 of the *Code of Federal Regulations,* Section 40.27). The purpose of the general license is to ensure that such sites will be cared for in a manner that protects human health and safety and the environment. The general license went into effect when NRC agreed that the site conformed to cleanup standards and formally accepted the site's long-term surveillance plan.

Long-term stewardship activities at the Green River Site are governed by several requirements in the following regulations: UMTRCA; the *Atomic Energy Act of 1954,* as amended; EPA Groundwater Protection Standards,

including Subparts A, B, and C of Title 40 of the *Code of Federal Regulations* Part 192; and the *National Environmental Policy Act of 1969,* as amended.

2.4 Assumptions and Uncertainties

Because long-term stewardship activities have been conducted since 1998, the long-term stewardship activities at the site are well known and are not expected to change dramatically.

DOE expects that the disposal cap will not need to be replaced for a minimum of 200 years. Groundwater and disposal cell monitoring will occur in perpetuity.

3.0 ESTIMATED LONG-TERM STEWARDSHIP COSTS

Long-term stewardship costs for the Green River Site are based on historical costs incurred while conducting actual surveillance and maintenance activities. Costs for fiscal years (FY) 2001 through 2006 include prorated costs associated with decommissioning unnecessary monitoring wells at similar sites. Contingency costs, such as cap replacement, have not been incorporated in the cost estimates.

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	***Amount***	***Year(s)***	***Amount***	***Year(s)***	***Amount***
FY 2000	$41,000	**FY 2008**	$29,000	**FY 2036-2040**	$142,400
FY 2001	$105,200	**FY 2009**	$29,000	**FY 2041-2045**	$142,200
FY 2002	$111,400	**FY 2010**	$29,000	**FY 2046-2050**	$142,400
FY 2003	$99,400	**FY 2011-2015**	$129,700	**FY 2051-2055**	$142,200
FY 2004	$112,200	**FY 2016-2020**	$129,600	**FY 2056-2060**	$142,400
FY 2005	$73,900	**FY 2021-2025**	$132,800	**FY 2061-2065**	$142,200
FY 2006	$75,100	**FY 2026-2030**	$141,000	**FY 2066-2070**	$142,400
FY 2007	$29,200	**FY 2031-2035**	$142,200		

4.0 FUTURE USES

The future use of the site will be restricted to long-term monitoring and maintenance of the disposal cell in perpetuity.

For more information about the Green River Site, please contact:

Art Kleinrath, Long-Term Surveillance and Maintenance Program Manager
U.S. Department of Energy, Grand Junction Office
2597 B3/4 Road, Grand Junction, CO 81503
Phone: 970-248-6037
or visit the Internet website at http://www.doegjpo.com

MEXICAN HAT SITE

1.0 SITE SUMMARY

1.1 Site Description and Mission

The Mexican Hat Site is the location of a former uranium processing mill that operated from 1957 until 1965, and a sulfuric acid plant that operated from 1957 to 1970. The site also contains a disposal cell for the uranium mill tailings and other process-related wastes from the former mill at the site and from the Monument Valley Site in Arizona). The Mexican Hat Site is located on Navajo Nation land in San Juan County, Utah, east of U.S. Highway 163. The 48-hectare (119-acre) site lies between the towns of Halchita and Mexican Hat, approximately 13 kilometers (18 miles) southwest of Bluff, Utah, and 16 kilometers (10 miles) north of the Arizona border.

LONG-TERM STEWARDSHIP HIGHLIGHTS

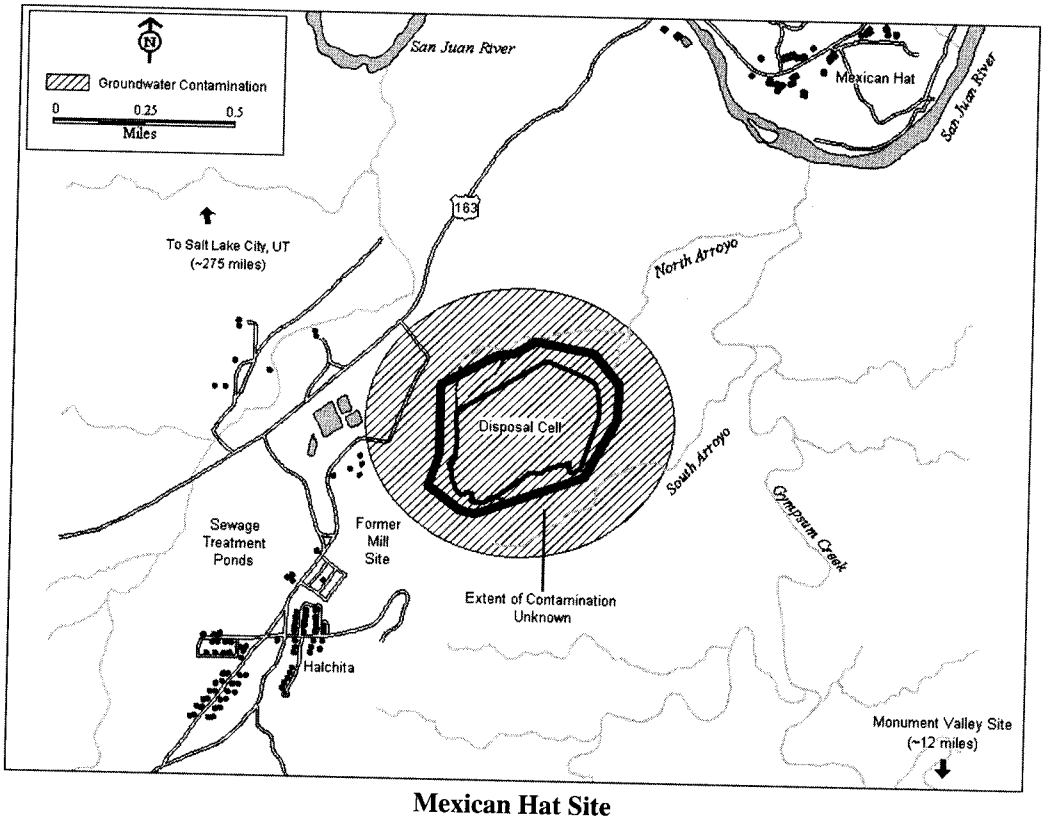
Major Long-Term Stewardship Activities - groundwater monitoring; disposal cell monitoring
Total Site Area - 48 hectares (119 acres)
Estimated Volume of Residual Contaminants - disposal cell 2.66 million cubic meters (3.48 million cubic yards); groundwater 416,400 cubic meters (544,600 cubic yards)
Long-Term Stewardship Start-End Years - disposal cell 1997-in perpetuity; groundwater 1999-2004
Average Annual Long-Term Stewardship Cost FY 2000-2006 - $139,000
Landlord - U.S. Department of Energy, Grand Junction Office; Navajo Nation

Contamination of the site resulted from previous uranium milling and acid production operations. The milling operations created process-related wastes and tailings. Before remedial action was completed, the site consisted of two tailings piles totaling 29 hectares (72 acres). One covered 10 hectares (25 acres) and the other covered 19 hectares (47 acres). The site also contained seven mill buildings and associated debris, a concrete pad, contaminated soil, and wind-blown material. An estimated 2.2 million cubic meters (2.8 million cubic yards) of contaminated material were contained in these two tailings piles and on an additional 101 hectares (250 acres) of adjacent land. The contaminated material at this site and contaminated material from the Monument Valley Site was stabilized in a 29-hectare (72-acre) disposal cell at the Mexican Hat Site. The U.S. Department of Energy (DOE) closed the cell and completed surface remediation of the site in January 1995.

The current mission of the Mexican Hat Site is to perform long-term stewardship activities, including disposal cell monitoring and the groundwater monitoring at the former mill site. The site is subject to Title I of the *Uranium Mill Tailings Radiation Control Act of 1978* (UMTRCA). As such, DOE is responsible for any remediation and long-term stewardship activities. DOE began conducting long-term stewardship activities at the site in 1997.

The historic mission of the Mexican Hat Site was to process uranium for sale to the U.S. Government. The mill at the site was constructed and operated from 1957 to 1963 by Texas-Zinc Minerals Corporation. The Atlas Corporation purchased the mill in 1963 and operated it until it was closed in 1965. When the Atlas lease expired in 1970, control of the site reverted to the Navajo Nation. Much of the ore processed at the Mexican Hat Site came from the White Canyon area of Utah and contained a considerable amount of copper sulfide and other sulfide minerals. During its operation, the uranium mill processed 2.2 million tons of ore and produced 5,700 tons of uranium concentrate.

At the time of the remedial action, the concrete pad for the mill building and several associated buildings and structures (e.g., scale house, office building, and tanks) were left in place. One or two of the smaller buildings appeared to be used for storage, and the Navajo Tribal Utility Authority operated a small electrical substation and sewage system (three lagoons) at the site. Access to the site was not restricted; however, the Navajo Environmental Protection Administration has discouraged any activity at the site since 1978.



Mexican Hat Site

The Mexican Hat Site is also the repository for residual radioactive material from the Monument Valley Site and eleven vicinity properties. The Monument Valley Site's residual radioactive material was transported to the Mexican Hat Site and was placed on top of the residual radioactive material in the disposal cell.

1.2 Site Cleanup and Accomplishments

The source of contamination at the Mexican Hat Site was the residual tailings that remained after the milling process extracted the uranium. DOE completed surface remedial actions in 1995 under the provisions of the *Uranium Mill Tailings Radiation Control Act of 1978* (UMTRCA), in accordance with a remedial action plan approved by the U.S. Nuclear Regulatory Agency (NRC). Remedial action involved consolidation of approximately 2 million cubic meters (2.66 million cubic yards) of residual radioactive material in place at the bottom of what is now the Mexican Hat disposal cell, followed by placement of approximately 703,200 cubic meters (925,200 cubic yards) of residual radioactive material from the Monument Valley Site, for a total of approximately 2.66 million cubic meters (3.48 million cubic yards) of residual radioactive material. Eleven vicinity properties were also remediated concurrent with site remediation activities.

The final disposal cell covers approximately 29 hectares (72 acres). The disposal cell includes a radon cover and rock surface layer to control erosion. In accordance with U.S. Environmental Protection Agency (EPA) standards, the disposal cell was designed to remain effective for 200 to 1,000 years.

Groundwater contamination at the Mexican Hat Site was caused by the discharge of waste water and tailings from uranium milling. Seepage of construction water resulting from consolidation during material compaction may have contributed to the contamination. Approximately 416,400 cubic meters (544,600 cubic yards) of

groundwater are contaminated with nitrate, molybdenum, selenium, uranium, net gross alpha, arsenic, chromium, and radium. Contamination is present in the residual process water within the upper part of the Halgaito Formation. The former uranium mill was the largest source of contamination. The sulfuric acid plant probably contributed little additional contamination when compared to the uranium mill. The approved groundwater compliance strategy for the Mexican Hat Site is to perform no remediation and to continue monitoring the seeps below the disposal cell. Site data indicate that groundwater in the uppermost aquifer (the lower unit of the Halgaito Formation) beneath the site is not suitable for use because of the presence of hydrogen sulfide and hydrocarbons. Contamination introduced from uranium processing is present in the perched, ephemeral groundwater system at a higher stratigraphic level in the Halgaito Formation. Based upon data from intermittent seeps downgradient of the disposal cell, it appears that flow rates may be decreasing, and may cease over time. Monitoring of contaminant concentrations in the seeps will continue as long as water is present.

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

The DOE Grand Junction Office is responsible for performing long-term stewardship activities at the Mexican Hat Site, including maintaining access restrictions and enforcing institutional controls. DOE will also conduct annual inspections of the site to evaluate the condition of surface features, perform site maintenance, as necessary, and monitor the groundwater in the seeps. The seeps will be monitored below the disposal cell for flow rate and contaminant levels to demonstrate the effectiveness of the cell in isolating the encapsulated wastes from the local groundwater system until 2004. No drilling or other intrusive activities are allowed within the property.

The site records for the Mexican Hat Site are kept in permanent storage at DOE's Grand Junction Office Colorado. The types of records kept include the characterization data, remedial action design, completion report, long-term monitoring plan, annual inspection reports, and monitoring data.

2.2 Specific Long-Term Stewardship Activities

Engineered Units

The disposal cell contains 4,400,000 dry tons of contaminated material, with a total activity of 1,800 curies of radium-226. The disposal cell measures 394 meters by 591 meters (1,200 feet by 1,800 feet) at the base and occupies an area of 29 hectares (72 acres) on the 49-hectare (119-acre) site. It abuts a rock outcrop on the south and rises 16 meters (50 feet) above the surrounding land on the other sides. A posted wire fence surrounds the cell. A low-permeability radon barrier, consisting of clayey soil, covers the contaminated materials to prevent precipitation from percolating into the underlying tailings and to reduce radon emissions. The radon barrier is covered by granular bedding material and a layer of rock (riprap) on the top, the side slopes, and the aprons. The cell design promotes rapid runoff of precipitation to minimize leachate. Runoff water flows down the slide slopes into the surrounding rock apron. The site location and design were selected to minimize the potential for erosion from onsite runoff or storm water flow. All surrounding remediated areas were regraded and reseeded with native species. Existing gullies in the vicinity of the cell were turned into trenches by excavating the gullies down to the underlying bedrock. Riprap-protected diversion ditches were

STAKEHOLDER INVOLVEMENT

Frequent meeting with representatives of the Navajo Nation have been held during remediation and since. Tribal members frequently participate in sampling events and annual inspections. Copies of the annual inspection report for this site are distributed to the local library and any stakeholders that request copies. The report is also published on the GJO website at www.doegjpo.com.

installed to channel runoff water away from the cell. The rock cover on the top and side slopes of the disposal cell also prevents erosion. The stock fence prevents unauthorized access to the property. The disposal cell is designed to last for 200 to 1,000 years. However, DOE's responsibility for the safety and integrity of the Mexican Hat Site will last indefinitely. DOE has a permanent agreement with the Navajo Nation for access to the site.

Groundwater

Monitoring of springs and seeps will be conducted from 1999 to 2004.

2.3 Regulatory Regime

In 1997, the Mexican Hat Site came under a general license issued by NRC for custody and long-term care of residual radioactive disposal sites (contained at Title 10 of the *Code of Federal Regulations,* Section 40.27). The purpose of the general license is to ensure that such sites will be cared for in a manner that protects human health and safety and the environment. The general license went into effect when NRC concurred that the site conformed to cleanup standards and formally accepted the site-specific long-term surveillance plan.

Long-term stewardship activities of the Mexican Hat Site are governed by several requirements in the following regulations: UMTRCA; the *Atomic Energy Act of 1954,* as amended; EPA Groundwater Protection Standards, including Subparts A, B, and C of Title 40 of the *Code of Federal Regulations* Part 192; a cooperative agreement between DOE and the State of Utah; a cooperative agreement between DOE and the Navajo Nation; and the *National Environmental Policy Act of 1969,* as amended.

2.4 Assumptions and Uncertainties

DOE assumes that groundwater compliance monitoring will be required in perpetuity. DOE assumes that the site is institutionally and physically stable. Because DOE is already conducting long-term stewardship activities at the site, activities are well known and are not expected to change dramatically. Caps are expected to last for a minimum of 200 years.

3.0 Estimated Long-Term Stewardship Costs

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	*Amount*	*Year(s)*	*Amount*	*Year(s)*	*Amount*
FY 2000	$118,300	**FY 2008**	$47,700	**FY 2036-2040**	$222,800
FY 2001	$155,700	**FY 2009**	$47,300	**FY 2041-2045**	$229,400
FY 2002	$164,500	**FY 2010**	$47,400	**FY 2046-2050**	$222,900
FY 2003	$147,400	**FY 2011-2015**	$209,100	**FY 2051-2055**	$229,400
FY 2004	$165,500	**FY 2016-2020**	$214,100	**FY 2056-2060**	$222,800
FY 2005	$111,100	**FY 2021-2025**	$220,700	**FY 2061-2065**	$229,400
FY 2006	$112,900	**FY 2026-2030**	$220,400	**FY 2066-2070**	$222,900
FY 2007	$47,700	**FY 2031-2035**	$222,800		

The following table shows the estimated long-term stewardship costs for the Mexican Hat Site. Fiscal Years (FY) 2000 through 2006 include costs for well decommissioning. Cost estimates reflect the current site agreements and monitoring frequencies. Because DOE is already conducting long-term stewardship activities at the site, cost estimates are based on the actual cost of those activities.

4.0 FUTURE USES

The Mexican Hat Site and the adjacent property is owned by the Navajo Nation, which controls land use within site boundaries. However, the long-term surveillance of the disposal cell is the responsibility of DOE through a Custodial Access Agreement between the Navajo Nation and the Federal Government. Provisions of the Custodial Access Agreement grant DOE permanent access to the disposal cell and include restrictions, as necessary, to protect public health and safety, and the environment. Under the provisions of this agreement, public access to the disposal cell is restricted indefinitely.

For more information about the Mexican Hat Site, please contact:

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or visit the Internet website at http://www.doegjpo.com

MONTICELLO MILL SITE AND VICINITY PROPERTIES

1.0 SITE SUMMARY

1.1 Site Description and Mission

The Monticello Mill Site is the location of the former Monticello uranium and vanadium ore-processing mill, which operated from 1942 to 1960. The Monticello Mill Site and Vicinity Properties occupy approximately 2,300-hectares (5,700-acres) of land near and within the City of Monticello in San Juan County, Utah. The Monticello Mill Site is located on a 44.5-hectare (110-acre) tract of land on the southeast edge of Monticello, along Montezuma Creek. Processing of the ores generated mill tailings (a sandlike radioactive waste product), which were stored in four tailings piles occupying almost 50 percent of the mill site. Contamination at the mill site consisted of uranium and vanadium mill tailings; radium, thorium, and uranium in soils; groundwater; and construction debris. Due to wind and water erosion, the mill tailings spread to 34 peripheral properties near and downstream from the mill site. In addition, the mill tailings were used for construction purposes throughout the City of Monticello and, therefore, contaminated 424 vicinity properties.

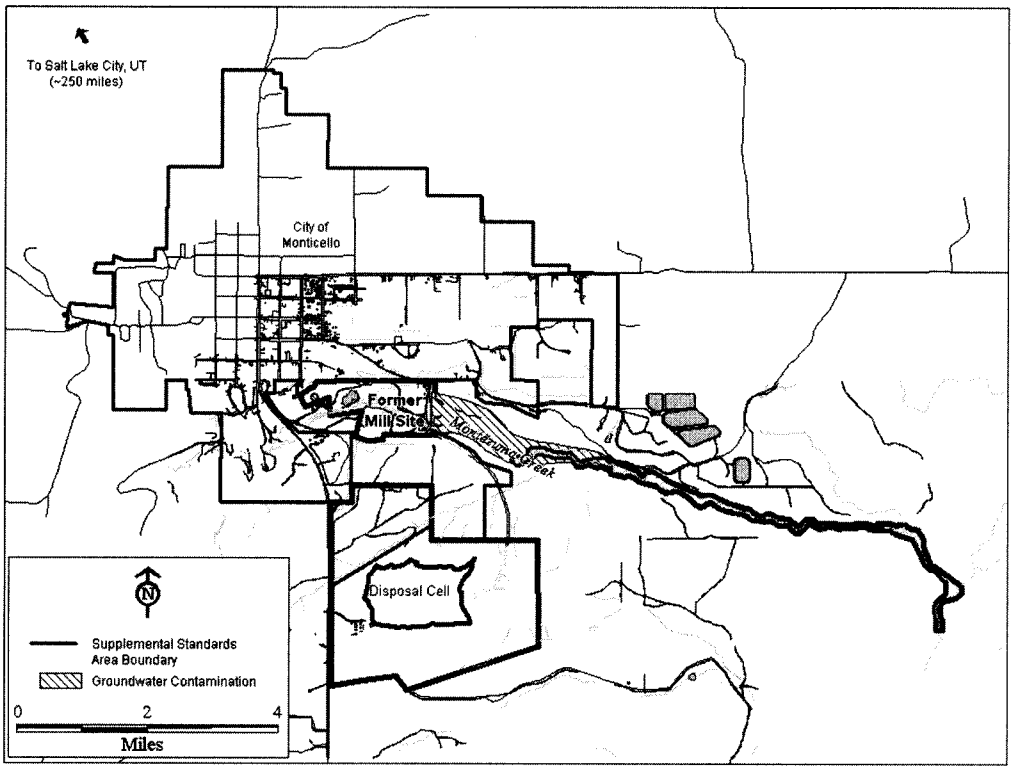
LONG-TERM STEWARDSHIP HIGHLIGHTS

Major Long-Term Stewardship Activities - disposal cell monitoring; institutional control enforcement; supplemental standards area monitoring; groundwater monitoring
Total Site Area - 2,300 hectares (5,700 acres)
**Estimated Volume of Residual Contaminants* - soil unknown; groundwater 379,000 cubic meters (495,000 cubic yards); engineered units 2 million cubic meters (2.6 million cubic yards)
Portions in Long-Term Stewardship as of 2006 - 3
Average Annual Long-Term Stewardship Cost FY 2000-2006 - $286,000
Landlord - U.S. Department of Energy, Grand Junction Office
*The estimated volume indicates only the known amounts of residual contaminants. For certain portions discussed for this site, exact volume is not known at this point. For specific discussions, please see Section 3.0.

The Monticello Mill Site and Vicinity Properties were placed on the U.S. Environmental Protection Agency's (EPA) National Priorities List (listed as the Monticello Mill Tailings Site and Monticello Vicinity Properties Site). The National Priorities List is EPA's list of top-priority sites for cleanup under the *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA).

The U.S. Department of Energy (DOE) began remediation activities at the mill site in 1983 and anticipates completion of these activities by 2000. DOE completed remediation activities at the 34 peripheral properties and the 424 vicinity properties in 1998. However, some of the properties were remediated to supplemental EPA standards and will not be released for unrestricted use. Currently, two million cubic meters (2.6 million cubic yards) of mill tailings and other contaminated material from the mill site, peripheral properties, and vicinity properties have been relocated to a 148-hectare (365-acre) DOE-owned site and stabilized in a 38-hectare (95-acre) disposal cell.

The current mission of the Monticello Mill Site and Vicinity Properties is to perform long-term stewardship activities, including monitoring and maintaining the disposal cell, monitoring supplemental standards areas, enforcing institutional controls, and, possibly, remediating the groundwater. DOE's Grand Junction Office conducts and funds these activities. The historic mission of the Monticello mill site was to provide uranium and vanadium ores for the Federal Government. The original Monticello mill was built in 1941 to provide an additional supply of vanadium during World War II. The plant was later modified to mill uranium ore. Vanadium and uranium were milled intermittently until January 1, 1960, when the mill was permanently closed. Part of the land was transferred for a period of time to the Bureau of Land Management, but, otherwise, the site remained under the control of the U.S. Atomic Energy Commission, a predecessor agency to DOE.



Monticello Mill Site and Vicinity Properties

1.2 Site Cleanup and Accomplishments

When the mill was closed, approximately 1.7 million cubic meters (2.3 million cubic yards) of low-level radioactive mill tailings, contaminated soil, and other miscellaneous debris remained onsite. Remediation consisted of excavating mill tailings and other contaminated materials, and hauling them south of the mill site to a permanent disposal cell on DOE-owned property. The mill site was mostly backfilled, using clean material from the site, and revegetated. Mill site soils have been remediated to regulatory cleanup levels, and part of the mill site and peripheral properties containing surface contamination have been proposed for deletion from the National Priorities List. However, the remediation will not be complete until the groundwater meets the negotiated cleanup levels. Surface areas were remediated to standards established in Title 40 of the *Code of Federal Regulations*, Part 192, and DOE Order 5400.5.

In addition to the mill site, 34 peripheral properties and 424 vicinity properties were contaminated with residual uranium mill tailings, which typically contain toxic heavy metals, and radioactive thorium and radium. Remediation activities consisted of excavating the mill tailings and other contaminated materials from the peripheral and vicinity properties and relocating the materials to the permanent disposal cell on DOE-owned land. Surface areas were remediated to meet the radium-226 standards established in Title 40 of the *Code of Federal Regulations*, Part 192, and DOE Order 5400.5. Some areas within the peripheral and vicinity properties were remediated to supplemental standards, as defined in Title 40 of the *Code of Federal Regulations* Part 192.22, because remediation would be unjustifiably expensive or would result in environmental damage, and the contamination poses no present or future risk. Long-term stewardship activities will be performed in these areas to ensure continued protection of human health and the environment.

Surface water and groundwater were also contaminated by the Monticello mill site and are being addressed as a separate issue. A remedial strategy for this area has not been determined and is not expected until 2005. The interim remedial strategy consists of institutional controls, millsite dewatering and treatment, monitoring, and installation and evaluation of a permeable reactive treatment wall. Activities associated with this interim action began in May 1999 and will continue for four to five years after mill site restoration is completed. At the end of that time, sufficient information is expected to have been collected on the ground and surface water conditions at the site to select a final remedy.

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Site-Wide Long-Term Stewardship Activities

DOE is required to conduct long-term surveillance and maintenance activities at the disposal site and in the supplemental standards areas. In addition, long-term stewardship activities may also be necessary for groundwater areas. DOE will assume these responsibilities at the site following remediation. DOE will conduct annual inspections of the site to evaluate the condition of surface features; perform site maintenance, as necessary; and ensure that institutional controls remain effective. In addition to long-term surveillance and maintenance of the permanent repository (i.e., the disposal cell and adjacent area), DOE will be responsible for post-remediation CERCLA inspection of the repository, supplemental standards areas, and any National Priorities List deletion activities conducted after 2001 (e.g., groundwater remediation). The site-specific long-term surveillance plan, which is not yet complete (except for the supplemental standards areas), will fully define long-term stewardship duration, activities, and final land use restrictions.

DOE, EPA, and the State of Utah are determining the final land-use restrictions that will be incorporated into the Monticello long-term surveillance plan for the disposal site, supplemental standards areas, and affected groundwater areas. With the possible exception of groundwater remediation, all surface remedial activities at the mill site, vicinity properties, and peripheral properties are complete. For the mill site and downgradient peripheral properties, groundwater use restrictions will be necessary until the water quality reaches acceptable levels. Deed restrictions, Memoranda of Understanding, restrictive easements, and other legal instruments are used to prevent exposure to contaminated groundwater or to soil areas to which supplemental EPA standards have been applied.

> ***STAKEHOLDER INVOLVEMENT***
>
> Community interaction has been and will continue to be extensive. The Monticello Site Specific Advisory Board was established to give Monticello residents a forum for participating in DOE decisions about Monticello environmental restoration activities. A full-time DOE employee, residing in Monticello, will meet with City of Monticello personnel frequently and will be on call 24 hours a day.

DOE maintains and updates the specific records and reports required to document long-term stewardship activities at the Monticello disposal site, supplemental standards areas, and affected groundwater areas. DOE submits an annual report that documents the results of the long-term stewardship activities. Site records are kept in permanent storage at the DOE Grand Junction Office in Colorado, and real property records are retained at the DOE Albuquerque Operations Office in New Mexico. The types of records maintained include site characterization data, remedial action design information, the site completion report, long-term monitoring plans, annual inspection reports, and current and historic monitoring data. Additionally, DOE will prepare CERCLA five-year reviews for submittal to EPA and the Utah Department of Environmental Quality.

2.2 Assumptions and Uncertainties

Surface remediation of the former mill site was completed in 2000, with the exception of re-establishing statutory wetlands. Surface areas that meet the radium-226 standards will be released for unrestricted use to the City of Monticello. Remediation of the groundwater has not been completed. DOE assumes that groundwater compliance will be achieved through natural flushing and that active remediation will not be required. DOE anticipates conducting long-term groundwater monitoring activities indefinitely, or until cleanup levels are achieved. Affected groundwater areas are associated with a restrictive easement applied to the supplemental standards area in the Montezuma Creek corridor. In addition, DOE assumes that groundwater monitoring for the disposal cell will continue indefinitely or until the engineered unit demonstrates infiltration control. The disposal cell cover is not expected to be replaced for a minimum of 200 years.

2.3 Estimated Site-Wide Long-Term Stewardship Costs

Long-term stewardship costs for the Monticello disposal site, supplemental standards areas, and anticipated costs for Monticello surface and groundwater, identified in the table below, are based on historic costs incurred while conducting actual surveillance and maintenance activities at similar sites. Contingency costs, such as disposal cap replacement, have not been incorporated in the cost estimate. Cost estimates reflect the current site agreements and monitoring frequencies. For purposes of this report, long-term stewardship costs are shown until fiscal year (FY) 2070; however, it is anticipated that long-term stewardship activities will be required in perpetuity.

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	***Amount***	***Year(s)***	***Amount***	***Year(s)***	***Amount***
FY 2000	$0	**FY 2008**	$510,000	**FY 2036-2040**	$2,600,000
FY 2001	$0	**FY 2009**	$510,000	**FY 2041-2045**	$2,600,000
FY 2002	$230,000	**FY 2010**	$510,000	**FY 2046-2050**	$2,600,000
FY 2003	$230,000	**FY 2011-2015**	$2,600,000	**FY 2051-2055**	$2,600,000
FY 2004	$230,000	**FY 2016-2020**	$2,600,000	**FY 2056-2060**	$2,600,000
FY 2005	$230,000	**FY 2021-2025**	$2,600,000	**FY 2061-2065**	$2,600,000
FY 2006	$510,000	**FY 2026-2030**	$2,600,000	**FY 2066-2070**	$2,600,000
FY 2007	$510,000	**FY 2031-2035**	$2,600,000		

3.0 PORTION OVERVIEW

The Monticello Mill Site and Vicinity Properties consists of three portions that will require long-term stewardship activities as of 2006. For purposes of this report, a "portion" is defined as a geographically contiguous and distinct area (which may involve residually contaminated facilities, engineered units, soil, groundwater, and/or surface water/sediment) for which cleanup, disposal, or stabilization will have been completed and long-term stewardship activities will be required as of 2006.

The site consists of three portions: (1) the Disposal Site, (2) the Supplemental Standards Areas, and (3) the Groundwater Areas. Each portion is listed in the table below, with accompanying discussion of cleanup and long-term stewardship activities in Sections 3.1 through 3.3.

Long-Term Stewardship Information		
Portion	***Long-Term Stewardship Start Year***	***Long-Term Stewardship End Year***
Disposal Site	2001	In perpetuity
Supplemental Standards Areas	2001	In perpetuity
Groundwater Areas	2006	In perpetuity

3.1 Disposal Site Portion

DISPOSAL SITE PORTION HIGHLIGHTS

Major Long-Term Stewardship Activities - disposal cell and evaporation pond monitoring
Portion Size - 147.7 hectares (365 acres)
Estimated Volume of Residual Contaminants - disposal cell 2 million cubic meters (2.6 million cubic yards)
Long-Term Stewardship Start-End Years - 2001-in perpetuity
Average Annual Long-Term Stewardship Costs FY 2000-2006 - $230,000 (includes Supplemental Areas Portion)

DOE constructed a 38-hectare (95-acre) disposal cell (i.e, repository) on 148-hectares (365-acres) of DOE-owned land east of U.S. Highway 191 and approximately two kilometers (one mile) south of the former mill site. Two million cubic meters (2.6 million cubic yards) of mill tailings and other contaminated material from the mill site and peripheral and vicinity properties are isolated in the disposal cell. An evaporation pond, located just east of the repository, is retained to collect drainage from the tailings for an expected five to 20 years. Also at the repository site is a temporary storage area for tailings removed after cell closure from public utilities, rights-of-way, and other supplemental standards areas. DOE maintains the storage facility to manage contaminated material until it can be transported to the Cheney Disposal Cell or another approved facility for permanent disposal.

The disposal cell incorporates leak detection and leachate collection systems and an associated evaporation pond. A wire fence with a locked gate surrounds the Monticello disposal site to prevent unauthorized access. Warning signs are posted on the site perimeter. In addition, DOE staffs a 24-hour phone line for reporting any site concerns. No drilling or other intrusive activities are allowed on the property unless authorized by DOE.

The disposal cell is compliant with the *Resource Conservation and Recovery Act* (RCRA). However, DOE does not have a RCRA permit for the disposal cell. Several requirements in the following regulations govern long-term stewardship activities of the Monticello disposal site: CERCLA Title 40 of the *Code of Federal Regulations,* Part 300; the *Atomic Energy Act of 1954,* as amended; EPA groundwater protection standards, including Subparts B and C of Title 40 of the *Code of Federal Regulations,* Part 192; a cooperative agreement between DOE and the State of Utah; and the *National Environmental Policy Act of 1969,* as amended.

3.1.1 Engineered Units

The disposal cell cover is a multilayered earthen (clean topsoil, vegetation, and rock) and geomembrane (plastic) design, which meets EPA standards for longevity, radon control, and groundwater protection. In accordance with EPA standards, the cover is designed to remain effective for 200 to 1,000 years. Placement of contaminated material in the repository was completed in 1999. Following emplacement of the cover components and revegetation, the repository cell will be the responsibility of DOE's Grand Junction Office for long-term surveillance and maintenance in perpetuity.

The evaporation pond collects leachate (water with leached contaminants) from the mill tailings. Contaminated solids will remain after the water evaporates, and the remaining sludge will likely go to the Cheney Disposal Cell. A wildlife fence was installed around the pond to protect the liner from damage by deer and other wildlife. No discharge from the pond to the environment is expected to occur, as this is a triple-lined pond with leak-detection capability.

Engineered Units Long-Term Stewardship Activities

The disposal cell will require long-term surveillance and maintenance to ensure continued protection of human health and the environment. Long-term stewardship activities for the disposal cell will include annual surface inspections, maintenance of institutional controls, and minor maintenance of as-built features, as needed. Annual inspections will be conducted to detect progressive change caused by slow-acting natural processes and to identify potential problems before extensive maintenance, repairs, or corrective actions are needed. DOE does not plan to conduct significant maintenance of the disposal cell. However, DOE will perform minor maintenance (e.g., fix fence) or repair, as needed, or determined from site inspections. It is estimated that it will take two or three years for the vegetation to become established. To protect the vegetation, a wildlife fence around the area will restrict grazing by deer and cattle for a minimum of five years. Groundwater monitoring is not required at the disposal site because the cell has an automated state-of-the-art leak detection system and a leachate collection system installed in the bottom double liner. However, DOE will address any potential contamination of groundwater beneath the disposal cell if threshold leakage rates are exceeded.

Long-term stewardship activities for the evaporation pond will include monitoring, fence repair, and sign replacements, as needed. Initially, the evaporation pond will require frequent visits, perhaps monthly. After a few years, the monitoring frequency will decrease substantially. The evaporation pond will be maintained until it is no longer needed, at which time it will be removed. In 2009, DOE anticipates decontaminating and decommissioning the pond.

3.1.2 Estimated Long-Term Stewardship Costs for Disposal Site

The long-term stewardship costs, identified in the table below, include both the Disposal Site Portion and the Supplemental Standards Areas Portion. Approximately 50 percent of the costs are for monitoring activities at the disposal site, and approximately 50 percent are for monitoring and maintenance of the supplemental standards areas. The long-term stewardship costs are based on historic costs incurred while conducting actual surveillance and maintenance activities at similar sites. Contingency costs, such as disposal cap replacement, have not been incorporated in the cost estimate. For purposes of this report, long-term stewardship costs are shown until FY 2070; however, it is anticipated that long-term stewardship activities will be required in perpetuity.

Long-Term Stewardship Costs (Constant Year 2000 Dollars)							
FY 2000 - FY 2010	***FY 2011 - FY 2020***	***FY 2021 - FY 2030***	***FY 2031 - FY 2040***	***FY 2041 - FY 2050***	***FY 2051 - FY 2060***	***FY 2061 - FY 2070***	***Estimated Total***
$2,070,000	$2,400,000	$2,400,000	$2,400,000	$2,400,000	$2,400,000	$2,400,000	$16,470,000

3.2 Supplemental Standards Areas Portion

The Supplemental Standards Areas Portion consists of peripheral and vicinity properties which were cleaned to EPA supplemental standards, as defined in Title 40 of the *Code of Federal Regulations* Part 192.22. Peripheral and vicinity properties are considered one portion because the properties share similar uranium and vanadium mill tailings contamination, remediation standards, and long-term stewardship activities.

Thirty-four peripheral properties and 424 vicinity properties were remediated. However, some areas were remediated to EPA supplemental standards, as defined in Title 40 of the *Code of Federal Regulations* Part 192.22, rather than to EPA numerical standards. Supplemental standards may be applied when the activities required to cleanup the property would be cost-prohibitive relative to the health benefits or would cause excessive environmental damage, and the material to be left poses no present or future health risks. Supplemental standards were applied to four peripheral properties adjacent to Montezuma Creek and three DOE-owned properties south of Montezuma Creek. Of the vicinity properties, supplemental standards, as defined in Title 40 of the *Code of Federal Regulations* Part 192.22, were applied to one private property, portions of the city street and utility easements, and state highway rights-of-way within the City of Monticello. Appropriate institutional controls (i.e., restrictions on land access and usage) and long-term monitoring have been implemented for these properties.

SUPPLEMENTAL STANDARDS AREAS PORTION HIGHLIGHTS

Major Long-Term Stewardship Activities - institutional controls
Portion Size - 911 hectares (2,250 acres)
Estimated Volume of Residual Contaminants - soil unknown
Long-Term Stewardship Start-End Years - 2001-in perpetuity
Average Annual Long-Term Stewardship Costs FY 2000-2006 -$230,000 (includes Disposal Site Portion)

Permanent surveillance features on the government-owned Supplemental Standards Areas include the use of fences and signs. On privately-owned Supplemental Standards Areas, there are no permanent surveillance features.

In September 1999, the site-specific long-term surveillance plan for the Supplemental Standards Areas was approved. Long-term stewardship activities of the supplemental standards areas are governed by several requirements in the following regulations: CERCLA Title 40 of the *Code of Federal Regulations,* Part 300; the *Atomic Energy Act of 1954,* as amended; EPA groundwater protection standards, including Subparts B and C of Title 40 of the *Code of Federal Regulations,* Part 192; a cooperative agreement between DOE and the State of Utah; and the *National Environmental Policy Act of 1969,* as amended.

3.2.1 Soil

Thirty-four peripheral properties with wind-blown and waterborne contamination comprise approximately 240 hectares (600 acres) of land adjacent to the mill site. The remedy involved excavating approximately 230,000 cubic meters (300,000 cubic yards) of soil containing tailings and byproduct materials from mill processing areas and moving the soil to the repository. After the tailings and contaminated soils were remediated to EPA standards, the disturbed areas were graded and revegetated. Remedial activities were completed in 1998, and the properties were released for unrestricted use, except for those areas where the supplemental standards, as defined in Title 40 of the *Code of Federal Regulations* Part 192.22, applied. The supplemental standards on these properties will reduce damage to riparian habitat and wetlands and to stands of pinon juniper and scrub oak on the sloping hillsides south of the millsite.

Throughout the operating period, mill tailings from the Monticello mill were used in the City of Monticello for construction purposes. Mill tailings were used in foundations, masonry, sidewalks, patios, and fill material. Vicinity properties were also contaminated by wind-blown tailings from the mill site. The main contaminants of concern are radium-226 and the associated radon gas. Remedial action consisted of removing radioactively contaminated material from the 424 residential and commercial properties identified and replacing it with clean material. Removed materials were temporarily relocated to the former mill site and were then transported along with mill site tailings to the permanent disposal cell south of the mill site. Remediation of the last property was completed in December 1998. In September 1999, EPA approved the cleanup and, as of February 28, 2000, the Monticello Vicinity Properties site has been deleted from the National Priorities List. The properties have been

released for unrestricted use, except for those where supplemental standards were applied, as defined in Title 40 of the *Code of Federal Regulations* Part 192.22.

Soil Long-Term Stewardship Activities

DOE is responsible for long-term surveillance and maintenance of areas where the supplemental limits have been applied. DOE will perform CERCLA five-year reviews for the Supplemental Standards Areas because these areas cannot be released for unrestricted use. Where mill tailings have been left in place, a DOE authorized technician will scan any excavations prior to disposal of soils. No residential development will be allowed in these areas. The total affected area is approximately 900 hectares (2,250 acres). Operating plans and procedures for these properties have been approved by EPA and the Utah Department of Environmental Quality. The properties include the following:

- The city streets and utilities area, where contamination might exist, consists of the rights-of-way owned by the City of Monticello. The total affected area is 659 hectares (1,628 acres). Long-term stewardship activities will consist of periodic inspections and radiological support for excavation activities. DOE will dispose of any contaminated material found during excavation. The long-term stewardship activities are defined in a Memorandum of Understanding between DOE and the City of Monticello.

- The Highways 191 and 666 rights-of-way area, where contamination might exist, consists of rights-of-way owned by the Utah Department of Transportation. The total affected area is 24 hectares (58 acres). Long-term stewardship activities will consist of periodic inspections, reporting, and radiological support for excavation activities. The Utah Department of Transportation may return contaminated material to an excavation site; otherwise, DOE will dispose of the contaminated material. The long-term stewardship activities are defined in a Memorandum of Understanding between DOE and the Utah Department of Transportation Quality.

- The Pinyon/Juniper Property is partly government-owned and partly privately-owned. The government area consists of 17 hectares (42 acres), where radium-226 concentrations in soil exceed EPA standards. Supplemental standards were approved because remediation would cause environmental harm, and the contamination does not pose a current or future risk to public health or the environment. These areas were located on five DOE-owned parcels totaling 110 hectares (271 acres). The parcels have been transferred to the City of Monticello. They are addressed by deed restrictions and a Memorandum of Understanding that restricts future land use to public recreation, prohibits extended occupation (camping), prohibits installation of wells in regions with contaminated groundwater, and prohibits removal of material from areas where minor radium-226 contamination was left in place. Long-term stewardship activities will consist of periodic inspections and reporting. In addition, signs and fencing will be maintained around the properties. The privately-owned Pinyon/Juniper Property area consists of a one-hectare (two-acre) parcel, where contaminated soil was left in place to avoid damage to a mature forest. Long-term stewardship activities will consist of periodic inspections and reporting, radiological support for excavation activities, and periodic assessment of institutional controls. DOE will dispose of the contaminated material removed during excavation. The long-term stewardship activities are defined in a deed restriction between DOE and the owner.

3.2.2 Estimated Long-Term Stewardship Costs for Supplemental Standards Areas

Refer to Section 3.1.2 for the long-term stewardship costs for the Supplemental Standards Areas Portion.

3.3 Groundwater Areas Portion

The Groundwater Areas Portion consists of ground and surface water contaminated by the former millsite. The ground and surface water are considered one portion because similar uranium and vanadium mill tailings contamination is present, and similar remediation strategies will be employed.

GROUNDWATER AREAS PORTION HIGHLIGHTS

Major Long-Term Stewardship Activities - institutional controls
Portion Size - 133.5 hectares (330 acres)
Estimated Volume of Residual Contaminants - groundwater 379,000 cubic meters (495,000 cubic yards)
Long-Term Stewardship Start-End Years - 2006-in perpetuity
Average Annual Long-Term Stewardship Costs FY 2006 - $280,000

The mill site and adjoining areas within the Montezuma Creek valley are underlain by two groundwater-bearing units (aquifers). The upper unit is called the alluvial aquifer; the surface of the alluvial aquifer (water table) is generally encountered between one and three meters (two and ten feet) below the ground surface. Mill tailings have contaminated this alluvial aquifer, which discharges to Montezuma Creek in several areas east of the mill site. The sandstone aquifer beneath the alluvial aquifer is not contaminated. This lower aquifer is separated from the upper alluvial aquifer at and directly east of the mill site by layers of sandstone and shale that restrict the downward movement of water.

Several requirements in the following regulations govern the long-term stewardship activities of the Groundwater Areas Portion: CERCLA Title 40 of the *Code of Federal Regulations,* Part 300; the *Atomic Energy Act of 1954,* as amended; EPA groundwater protection standards, including Subparts B and C of Title 40 of the *Code of Federal Regulations,* Part 192; a cooperative agreement between DOE and the State of Utah; and the *National Environmental Policy Act of 1969,* as amended.

3.3.1 Groundwater

Former milling operations at the Monticello site caused groundwater, surface water, and stream-deposited contaminants in Montezuma Creek Canyon. Specifically, the identified contaminants of concern in the ground and surface water include arsenic, manganese, molybdenum, selenium, uranium, vanadium, radium-226, lead-210, and gross alpha. Approximately 379,000 cubic meters (495,000 cubic yards) of groundwater are contaminated with materials from processing ores to recover vanadium and uranium. The groundwater plume is approximately 130 hectares (330 acres) within the alluvial aquifer, which extends beyond the mill site. DOE will remediate the contaminated sediments and surface water in Montezuma Creek Canyon to acceptable risk-based standards negotiated with the EPA and the State of Utah.

DOE is also responsible for remediation of contaminated groundwater downgradient of and beneath the site. However, ground and surface water conditions at the mill site changed because of tailings excavation activities. These changing conditions made it impractical to proceed with selecting a final cleanup remedy for groundwater and surface water. Instead, an interim remedial strategy was selected that consisted of institutional controls, mill site dewatering and treatment, monitoring, and installation and evaluation of a permeable reactive treatment wall. Activities associated with this interim action began in May 1999. Groundwater is monitored through the use of wells, and surface water is monitored by taking "grab" samples in Montezuma Creek. Monitoring will be conducted until the negotiated remediation levels are met. These interim activities will continue for four to five years after mill site restoration is completed. At the end of that time, sufficient information is expected to have been collected on the ground and surface water conditions at the site to select a final remedy. The final remedy is currently planned for the year 2005.

Groundwater Long-Term Stewardship Activities

DOE is responsible for ensuring that institutional controls effectively restrict the use of contaminated groundwater while groundwater remediation is in progress. Granting access to water rights will be prohibited, and a moratorium will be placed on drilling new water wells in the contaminated alluvial aquifer. These controls will be administered through the Utah State Engineer's Office. On May 1999, the State of Utah issued a Groundwater Management Policy which states that new applications to appropriate water for domestic use from the contaminated alluvial groundwater will not be approved. The policy does not affect existing water rights, nor does it affect applications to drill wells into the deeper, uncontaminated lower aquifer. In addition, groundwater use restrictions have been added to the deeds for some affected properties. Long-term stewardship activities will also consist of monitoring and periodic inspections and reporting.

3.3.2 Estimated Long-Term Stewardship Costs for Groundwater Areas

The long-term stewardship costs, identified in the table below, are based on anticipated groundwater monitoring as conducted at similar sites. The cost estimates reflect the current site agreements and monitoring frequencies. Contingency costs, such as groundwater monitoring well replacements, have not been incorporated in the cost estimates. For purposes of this report, long-term stewardship costs are shown until FY 2070; however, it is anticipated that long-term stewardship activities will be required in perpetuity.

Long-Term Stewardship Costs (Constant Year 2000 Dollars)							
FY 2000 - FY 2010	***FY 2011 - FY 2020***	***FY 2021 - FY 2030***	***FY 2031 - FY 2040***	***FY 2041 - FY 2050***	***FY 2051 - FY 2060***	***FY 2061 - FY 2070***	***Estimated Total***
$1,400,000	$2,800,000	$2,800,000	$2,800,000	$2,800,000	$2,800,000	$2,800,000	$18,200,000

4.0 FUTURE USES

DOE, EPA, and the State of Utah have determined final land use restrictions for areas where supplemental standards, as defined in Title 40 of the *Code of Federal Regulations* Part 192.22, have been applied. No residential development will be allowed in the supplemental standards areas. The Monticello mill site, plus portions of the peripheral properties, will be deeded to the City of Monticello for recreational use. DOE will retain ownership of the Monticello disposal site in perpetuity. Anticipated future use of the ground and surface water will be agricultural.

For more information about the Monticello Mill Site and Vicinity Properties, please contact:

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Phone: 970-248-6037
or visit the Internet website at http://www.doegjpo.com

(PLATEAU) SHOOTARING CANYON SITE[1]

1.0 SITE SUMMARY

1.1 Site Description and Mission

> ***LONG-TERM STEWARDSHIP HIGHLIGHTS***
>
> *Total Site Area* - unknown
> *Current Landlord* - U.S. Energy Corporation through its subsidiary, Plateau Resources Limited
> *Expected Future Landlord* - U.S. Department of Energy, Grand Junction Office
> *Reason Not Subject to NDAA Requirements* - This site is an UMTRCA Title II site that will not be transferred to the Department of Energy until after 2015

The (Plateau) Shootaring Canyon site (also known as Shootaring Canyon) is the location of a former uranium milling site that operated for two months in 1982. The site is located in Shootaring Canyon on the Colorado Plateau near the town of Ticaboo, Utah, about 18 kilometers (11 miles) north of Lake Powell. The U.S. Energy Corporation privately owns the site through its subsidiary Plateau Resources Limited. Currently, the (Plateau) Shootaring Canyon Site mill is on standby status (not in operation). As a result of past operations, the site contains a small amount of uranium mill tailings, a sand-like waste product containing radioactive materials and other contaminants, and radium, thorium, and uranium in soils.

The (Plateau) Shootaring Canyon Site is subject to Title II of the *Uranium Mill Tailings Radiation Control Act of 1978* (UMTRCA). UMTRCA Title II sites are privately owned and operated sites that were licensed when UMTRCA was passed, or thereafter. The majority of the mining and milling conducted at these sites was for private sale, but a portion was sold to the U.S. Government. Under UMTRCA Title II, DOE is responsible for long-term stewardship activities, but the site owner, U.S. Energy Corporation, is responsible for remediation.

The (Plateau) Shootaring Canyon Site is awaiting approval of its remediation strategy. U.S. Energy Corporation, through its subsidiary Plateau Resources Limited, has requested that the U.S. Nuclear Regulatory Commission (NRC) amend its uranium mill operation license. The license amendment would approve the site's reclamation plan and allow U.S. Energy Corporation to begin remediation of the (Plateau) Shootaring Canyon Site. Once the site's license amendment is approved, its mission will be to remediate the site.

The historic mission of the (Plateau) Shootaring Canyon Site was to provide uranium for commercial markets. Between 1981 and 1982, Plateau Resources Limited built the site's mill -- the last uranium mill built in the United States. The mill only operated for two months to make sure the system worked before it closed when the price of uranium dropped suddenly in 1982. Since 1982, the mill has been maintained in a standby condition. The U.S. Energy Corporation purchased the mill when it acquired Plateau Resources Limited and a nearby mine in 1993, and slowly refurbished and updated the equipment in anticipation of higher uranium prices in the future. The mill, however, never resumed operations.

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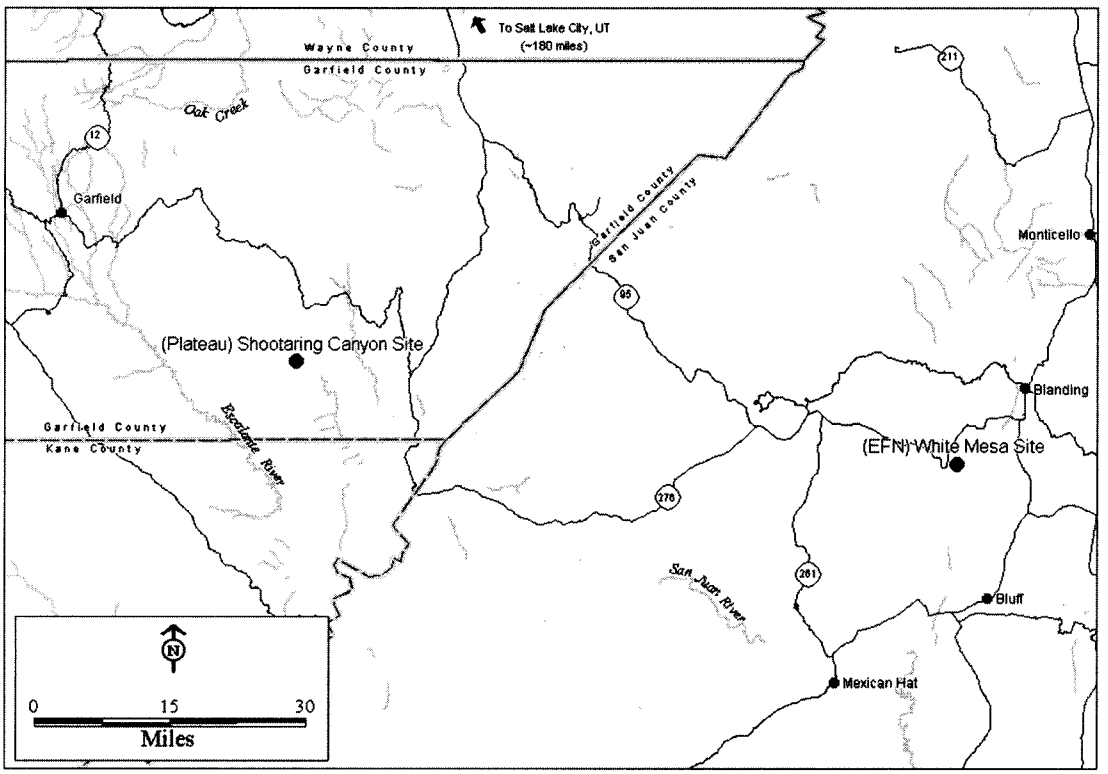
[1]This report is developed in response to a Congressional request in the Fiscal Year (FY) 2000 National Defense Authorization Act (NDAA). As requested by the Act, this report addresses current and anticipated long-term stewardship activities at each site or portion of a site by the end of calendar year 2006 ("Conference Report on S.1059, National Defense Authorization Act for Fiscal Year 2000," *Congressional Record,* August 5, 1999).

Based on current planning, the (Plateau) Shootaring Canyon Site is not expected to be transferred to the U.S. Department of Energy (DOE) for long-term stewardship until 2015, and for this reason the site is not the primary focus of this report. This brief summary of the site cleanup activities is provided for background information and potential future long-term stewardship activities. (See Section 3.2 of Volume I).



Plateau Shootaring Canyon Site

1.2 Site Cleanup and Accomplishments

The proposed decommissioning and reclamation activities include removing mill structures and regrading disturbed areas to blend with the surroundings; constructing a disposal cell and then disposing of process-related wastes, contaminated soils and concrete in the cell; covering and stabilizing the tailings impoundment area; replacing stockpiled topsoil in selected areas for plant growth; and revegetating disturbed areas. The volume of contaminated materials that will be contained in the disposal cell and the size of the disposal cell will not be known until remediation is completed.

An environmental and effluent monitoring program is currently in place to monitor effluent releases and determine if applicable regulatory limits are exceeded. Radiological effluents from site operations have been below the regulatory limits and are expected to remain so after site remediation is completed. Because the (Plateau) Shootaring Canyon mill barely operated, there is likely to be no groundwater contamination. No groundwater remediation is expected to be necessary. Any facility built after 1978 is required to have a *Resource Conservation Recovery Act (RCRA)*-style, double-lined, tailings impoundment.

The U.S. Energy Corporation is expected to remediate the site. At some future date, the site will be transferred to the DOE Grand Junction Office for custody and long-term care. To transfer the (Plateau) Shootaring Canyon Site to DOE, the U.S. Energy Corporation must conduct NRC-approved reclamation of any and all onsite radioactive waste, and make a one-time payment to the U.S. Treasury fully funding monitoring and ongoing maintenance activities under Title II of UMTRCA.

2.0 POTENTIAL LONG-TERM STEWARDSHIP ACTIVITIES

The DOE Grand Junction Office will be responsible for long-term monitoring and maintenance activities at the (Plateau) Shootaring Canyon Site. DOE estimates that its future long-term stewardship activities at the site will cost approximately $24,000 per year. The disposal cell will be similar to other uranium mill tailings disposal cells and will require similar long-term stewardship activities.

Anticipated site-wide long-term stewardship activities include restricting access by fencing and posting warning signs along the site boundary. DOE will repair the fence and replace signs, as necessary. DOE will staff a 24-hour phone line for reporting any site concerns. Drilling and other intrusive activities within site boundaries will be prevented through institutional controls.

Site records will be kept in permanent storage at the DOE Grand Junction Office in Colorado. The types of records maintained include site characterization data, remedial action design information, the site completion report, long-term monitoring plans, annual inspection reports, and current and historic monitoring data.

3.0 EXPECTED FUTURE USES AND SITE RESPONSIBILITY

The U.S. Energy Corporation is currently responsible for all activities at the (Plateau) Shootaring Canyon Site. After remediation is complete, the site is expected to be transferred to DOE in 2015 to perform long-term stewardship activities.

For additional information about the (Plateau) Shootaring Canyon Site, please contact:

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(RIO ALGOM) LISBON VALLEY SITE[1]

1.0 SITE SUMMARY

1.1 Site Description and Mission

> ***LONG-TERM STEWARDSHIP HIGHLIGHTS***
>
> *Total Site Area* - 130 hectares (330 acres)
> *Current Landlord* - Rio Algom through its subsidiary, Rio Algom Mining Corporation
> *Expected Long-Term Stewardship Start Year* - 2010
> *Expected Future Landlord* - U.S. Department of Energy, Grand Junction Office
> *Reason Not Subject to NDAA Requirements* - This site is an UMTRCA Title II site that will not be transferred to the U.S. Department of Energy until 2010

The (Rio Algom) Lisbon Valley Site (also known as the Lisbon Valley Uranium Mill) is located in rural southeast Utah, south of the city of Moab. The uranium milling site was operated by Rio Algom's wholly-owned subsidiary, Rio Algom Mining Corporation, from 1972 through 1988. Currently, Rio Algom owns the site. The site is approximately 130 hectares (330 acres), and contains two evaporation ponds and an 823-meter (2,700-foot) deep mine. The site is contaminated with byproduct material that resulted from processing uranium ores. The byproduct material consists primarily of mill tailings and radioactive soil and rock that remained after the uranium ore was processed. The mill has been dismantled, and there is one active disposal cell at the site, which is expected to be permanently closed and capped by December 31, 2000. A new disposal cell has yet to be constructed to hold the contaminated materials remediated from the two evaporation ponds.

The (Rio Algom) Lisbon Valley Site is subject to Title II of the *Uranium Mill Tailings Radiation Control Act of 1978* (UMTRCA). UMTRCA Title II sites are privately owned and operated sites that were licensed when the Act was passed. The majority of the uranium produced at these sites was for private sale, but a portion was sold to the U.S. Government. Under UMTRCA Title II, DOE is responsible for long-term stewardship activities, but the site's owner, Rio Algom, is responsible for remediation.

The current mission of the (Rio Algom) Lisbon Valley Site is to complete decommissioning activities and remediation of contaminated areas. The (Rio Algom) Lisbon Valley Site is expected to be transferred to DOE in 2010. The number of acres that will be transferred has not been determined. Once the site is transferred to DOE, the only site mission will be long-term monitoring and maintenance of the two disposal cells. The historic mission of the site was to process uranium ore. The Rio Algom Mining Company began operations at the Lisbon Valley uranium milling site in 1972 and closed the mill in 1988 when the price of uranium dropped.

1.2 Site Cleanup and Accomplishments

The site contains approximately four million tons (3.6 million metric tons) of uranium mill tailings. All identified contaminated materials will be disposed in two engineered disposal cells (one for the evaporation ponds and the

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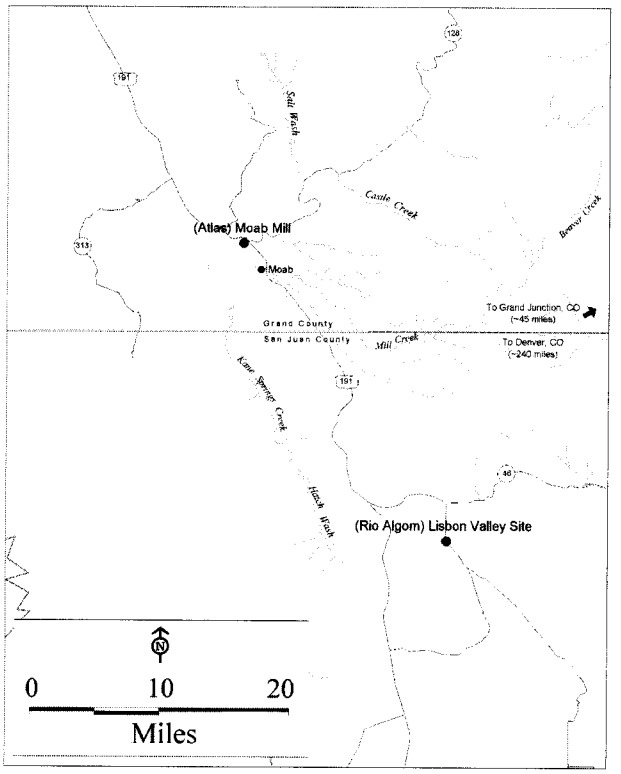
[1]This report is developed in response to a Congressional request in the Fiscal Year (FY) 2000 National Defense Authorization Act (NDAA). As requested by the Act, this report addresses current and anticipated long-term stewardship activities at each site or portion of a site by the end of calendar year 2006 ("Conference Report on S.1059, National Defense Authorization Act for Fiscal Year 2000," *Congressional Record,* August 5, 1999).

Based on current planning, the (Rio Algom) Lisbon Valley Site is not expected to be transferred to the U.S. Department of Energy (DOE) for long-term stewardship until 2010, and for this reason the site is not the primary focus of this report. This brief summary of the site cleanup activities is provided for background information and potential future long-term stewardship activities. (See Section 3.2 of Volume I).

other for the mill tailings and other contaminated materials) that comply with U.S. Environmental Protection Agency (EPA) standards.

The Rio Algom Mining Corporation requested an amendment to its NRC license that will revise one of its site-reclamation milestones (*Federal Register*, February 4, 2000). If this amendment is approved, then the completion deadline for the final radon barrier on the tailings disposal cell (which does not include contaminated sludge from the evaporation ponds) will be December 31, 2000. A larger disposal cell is expected to contain approximately 3,900,000 tons (3,538,000 metric tons) of tailings and other associated contaminated materials. This disposal cell is currently covered with a temporary soil and clay cover. The final radon barrier on the second disposal cell will be completed by 2014, under the proposed license amendment, since the evaporation ponds are still in use. Once the ponds are no longer in use, significant time will be required for the water to evaporate from the ponds so that the sludge can be collected and disposed of in the second disposal cell.



(Rio Algom) Lisbon Valley Site

The groundwater is contaminated with seepage from the tailings disposal and storage area. This seepage is being pumped to the evaporation ponds. The licensee, Rio Algom Mining Corporation, must submit a groundwater corrective action plan to the U.S. Nuclear Regulatory Commission (NRC) (the site regulator) by June 2000. Alternate concentration limits (ACLs), cleanup standards based on site-specific considerations, for uranium have been proposed to NRC. For the alternate concentrations to be approved, evidence must be provided that the ACLs will not adversely impact human health or the environment. Active remediation must be complete before the site can be transferred to DOE to perform long-term stewardship activities (expected in 2010).

2.0 POTENTIAL LONG-TERM STEWARDSHIP ACTIVITIES

The potential long-term stewardship activities will predominantly involve groundwater monitoring, surveillance and maintenance of the disposal cells, and implementing institutional controls.

3.0 EXPECTED FUTURE USES AND RESPONSIBILITY

Once the (Rio Algom) Lisbon Valley Site is transferred to DOE in 2010, DOE's Grand Junction Office will be responsible for long-term stewardship activities at the site. The precise size of the two disposal cells will not be known until remediation is completed. The disposal cells will have a low-permeability radon barrier with an erosion control layer. Erosion control will be provided for all potentially vulnerable features, and the site will be graded to provide positive drainage. Disturbed areas will be revegetated. The disposal cells will be similar to other uranium mill tailings disposal cells and will have similar long-term stewardship activities.

Anticipated site-wide long-term stewardship activities include restricting access by fencing and posting warning signs along the site boundary. DOE will repair the fence and replace signs, as necessary. DOE will staff a 24-hour phone line for reporting any site concerns. Drilling and other intrusive activities on the site will be prevented through institutional controls.

Groundwater at the site is known to be contaminated as a result of the site's historical uranium processing activities. The extent of groundwater contamination that will be present at the time of site transfer cannot be reasonably estimated; however, future remediation by DOE is not required. DOE assumes that groundwater monitoring will be required on a periodic basis to verify compliance with ACLs (i.e., if the groundwater readings are in compliance with ACLs, then the disposal cells are performing as designed). Precise monitoring requirements will be prescribed in the site-specific long-term surveillance plan. This surveillance plan will be developed and approved by NRC at the time of site transfer.

Site records will be kept in permanent storage at the DOE Grand Junction Office in Colorado. The types of records maintained will include site characterization data, remedial action design information, the site completion report, long-term monitoring plans, annual inspection reports, and current and historic monitoring data.

For additional information about the (Rio Algom) Lisbon Valley Site, please contact:

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SALT LAKE CITY MILL

1.0 SITE SUMMARY

1.1 Site Description and Mission

> ***LONG-TERM STEWARDSHIP HIGHLIGHTS***
>
> *Major Long-Term Stewardship Activities* - groundwater monitoring; land use restrictions; record keeping
> *Total Site Area* - 52 hectares (128 acres)
> *Estimated Volume of Residual Contaminants* - groundwater 1.3 million cubic meters (1.7 million cubic yards)
> *Long-Term Stewardship Start-End Years* - 1989-2004
> *Average Annual Long-Term Stewardship Cost FY 2004-2006* - $25,000
> *Landlord* - U.S. Department of Energy, Grand Junction Office

The Salt Lake City Mill is the location of a former mill that processed uranium and vanadium from 1951 to 1968. The 52-hectare (128-acre) site is located about four miles south-southwest of the center of Salt Lake City, Utah. The Salt Lake City Mill is in an urban area, bounded by a sewage treatment plant on the north, a railroad on the east, and city streets on the south and west. The Jordan River is 457 meters (1,500 feet) west of the site, and Mill Creek, a perennial stream, flows along the site's northern boundary. In addition, an irrigation ditch (South Vitro Ditch) traverses the site, and a small wetland is just east of the site. An unconfined aquifer approximately 14 meters (45 feet) thick lies underneath the Salt Lake City Mill and is composed of sand, clay, and silt. This aquifer is recharged by precipitation and leakage from a lower confined aquifer. Groundwater flow is toward the northwest and discharges into Mill Creek and the Jordan River.

The site is governed by Title I of the *Uranium Mill Tailings Radiation Control Act of 1978* (UMTRCA). The site is owned by the Central Valley Wastewater Treatment District; however, the U.S. Department of Energy (DOE) is responsible for performing all long-term stewardship activities associated with the site. There is no ongoing mission at the site except monitoring groundwater, enforcing land use restrictions, and maintaining permanent records. The site began long-term stewardship activities in 1989.

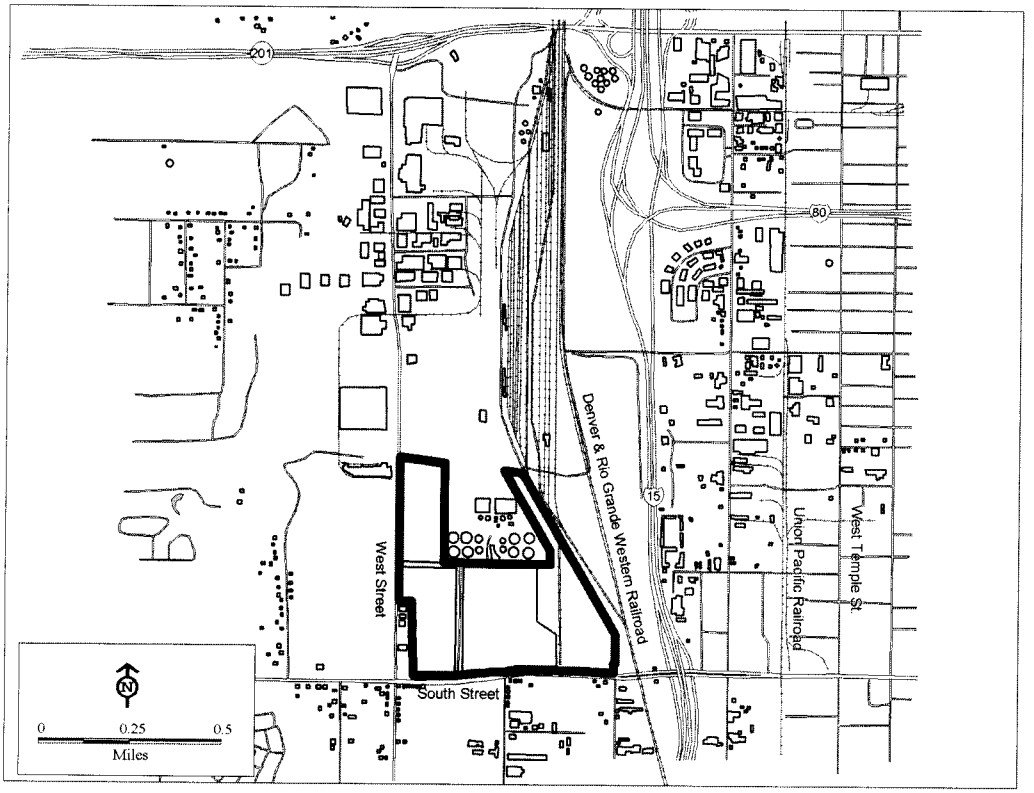
Historically, uranium and vanadium were milled at the site. The ore-processing mill, ore storage, and transportation facilities were located on 3.2 hectares (8 acres) on the eastern portion of the site and operated between 1951 and 1968. The milling operations created process-related waste and mill tailings. Tailings at one time occupied the remaining 48.6 hectares (120 acres) with piles up to 4.8 meters (16 feet) high. The facility was dismantled in 1970; however, reclamation of the site was not initiated until 1989.

1.2 Site Cleanup and Accomplishments

Reclamation of the Salt Lake City Mill was initiated by the State of Utah, under the direction of DOE, in 1984 and was completed in 1989. Approximately 2.1 million cubic meters (2.8 million cubic yards) of residual radioactive materials were removed from the Salt Lake City Mill and were disposed of in an engineered disposal cell at the South Clive Disposal site built by DOE, in the western part of the state. The mill structures were demolished, and the soils were remediated to U.S. Environmental Protection Agency (EPA) standards (Title 40 of the *Code of Federal Regulations*, Part 192).

Approximately 1.3 million cubic meters (1.7 million cubic yards) of groundwater in the alluvial aquifer at the Salt Lake City Mill are contaminated. Groundwater monitoring has been conducted at the site since the 1980s. Surface water samples indicate that the site-related contaminated groundwater has not adversely affected surface water quality. Limited sediment sampling indicates that the South Vitro Ditch may have high levels of molybdenum, but the remaining samples show no adverse effects from site-related contamination. Background

groundwater has a total dissolved solids content ranging from 300 to 550 milligrams per liter and sulfate levels ranging from 2.0 to 6.0 milligrams per liter. Arsenic has exceeded the maximum concentration limit in most background groundwater samples. A contaminant plume exists beneath the site, and molybdenum, net gross alpha, and uranium have exceeded the maximum concentration limits in some onsite and downgradient monitoring wells at least twice since 1990.



Salt Lake City Mill

There is no evidence that contaminants derived from uranium processing have entered the lower confined aquifer beneath the site, as a result of the upward gradient between the lower confined and unconfined aquifers. Because of its poor quality and minimal well yield, the upper aquifer has very limited potential use for domestic or agricultural purposes. Residents of Salt Lake City obtain water from a municipal supply system that is upgradient of the processing site. The City of South Salt Lake is planning to install a water supply well within the site boundary that will draw water from an uncontaminated aquifer below the site.

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

The DOE Grand Junction Office became responsible for long-term stewardship activities at the Salt Lake City Mill in 1989. These activities at the site are expected to continue until 2004. DOE's Grand Junction Office conducts annual groundwater monitoring and enforces land use restrictions, including prevention of drilling or other intrusive activities on the property. Access to the site is restricted by the Wastewater Treatment District, whose facility occupies most of the property. Site records are maintained in permanent storage at DOE's Grand Junction Office. The types of records maintained include characterization data, remedial action design

information, the site completion report, the groundwater compliance plan, and groundwater monitoring results.

2.2 Specific Long-Term Stewardship Activities

Groundwater

DOE will conduct groundwater-related long-term stewardship activities in accordance with the U.S. Nuclear Regulatory Commission (NRC)-approved Groundwater Compliance Action Plan. The proposed compliance strategy is to use supplemental standards, as defined in Title 40 of the *Code of Federal Regulations* Part 192.22, because the groundwater in the affected aquifer is naturally of poor quality. Active groundwater remediation will not be required. Groundwater monitoring will continue annually through until 2004, at which time DOE will evaluate the need for continued monitoring. Groundwater institutional controls will be enforced for as long as necessary.

STAKEHOLDER INVOLVEMENT

Community interaction has been minimal since the remedial action was completed. Copies of the annual inspection report are distributed to the local library and any stakeholders that requests copies. The report is also published on the DOE Grand Junction Office website at www.doegjpo.com.

2.3 Regulatory Regime

The *Uranium Mill Tailings Radiation Control Act of 1978* (UMTRCA) authorized DOE to care for the uranium mill tailings sites under a general license issued by NRC for the long-term care of residual radioactive material disposal cells. However, for the actual processing site where the residual radioactive materials were relocated off the site, such as is the case with Salt Lake City Mill, NRC will not license the site. Compliance with EPA ground water standards will require NRC concurrence.

The long-term stewardship activities of the site are governed by several requirements in the following regulations: UMTRCA; the *Atomic Energy Act of 1954,* as amended; EPA Groundwater Protection Standards, including Subparts B and C of Title 40 of the *Code of Federal Regulations,* Part 192; a cooperative agreement between DOE and the State of Utah; and the *National Environmental Policy Act of 1969*, as amended.

2.4 Assumptions and Uncertainties

Because DOE is already conducting long-term stewardship activities at the Salt Lake City Mill, these activities are well known and not expected to change dramatically. Long-term stewardship activities are based on actual, historical activities that have occurred at the site. It is unknown if groundwater monitoring will be required after 2004.

3.0 Estimated Long-Term Stewardship Costs

Long-term stewardship costs for the Salt Lake City Mill are based on the historic costs incurred while conducting actual surveillance and maintenance activities and other long-term stewardship activities. Costs in FY 2000 are associated primarily with abandoning unneeded monitor wells. From FY 2001 to 2004, costs include annual groundwater monitoring. After 2004, DOE will reevaluate the need for continued monitoring.

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	*Amount*	*Year(s)*	*Amount*	*Year(s)*	*Amount*
FY 2000	$83,800	**FY 2008**	$0	**FY 2036-2040**	$0
FY 2001	$10,300	**FY 2009**	$0	**FY 2041-2045**	$0
FY 2002	$10,200	**FY 2010**	$0	**FY 2046-2050**	$0
FY 2003	$10,300	**FY 2011-2015**	$0	**FY 2051-2055**	$0
FY 2004	$10,300	**FY 2016-2020**	$0	**FY 2056-2060**	$0
FY 2005	$0	**FY 2021-2025**	$0	**FY 2061-2065**	$0
FY 2006	$0	**FY 2026-2030**	$0	**FY 2066-2070**	$0
FY 2007	$0	**FY 2031-2035**	$0		$0

4.0 FUTURE USES

The 52 hectares (128 acres) of the former Salt Lake City Mill are now used for a golf driving range and a sewage treatment facility. The future use of this site is restricted to industrial use, and no drilling or other subsurface uses are permitted.

For more information about the Salt Lake City Mill, please contact:

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SOUTH CLIVE DISPOSAL CELL

1.0 SITE SUMMARY

1.1 Site Description and Mission

The South Clive Disposal Cell is the location of a disposal cell built by U.S. Department of Energy (DOE) to retain mill tailings and other process related wastes from former mill operations at the Salt Lake City Mill. The disposal site is located approximately 137 kilometers (85 miles) west of Salt Lake City and 4 kilometers (2.5 miles) south of U.S. Interstate 80 in Tooele County, Utah. The 40-hectare (99-acre) site lies in a topographically flat area along the eastern edge of the Great Salt Lake Desert, which extends approximately 97 kilometers (60 miles) from the Nevada/Utah border. East of the site, the Cedar Mountains rise to elevations of approximately 2,340 meters (7,700 feet) above sea level. The proximity of this mountain range causes surface drainage to flow toward the site. The site is adjacent to the Envirocare of Utah, Inc. facility, a commercial low-level radioactive materials disposal operation. The surrounding area is sparsely populated, and the nearest residences are at least 24 kilometers (15 miles) from the site. Roads in the area are used for recreation and for access to military firing ranges south of the site. Vegetation in the area is sparse and is typical of semi-arid low shrub land.

LONG-TERM STEWARDSHIP HIGHLIGHTS

Major Long-Term Stewardship Activities -disposal cell monitoring
Total Site Area - 40 hectares (99 acres)
Estimated Volume of Residual Contaminants - disposal cell 2.1 million cubic meters (2.8 million cubic yards)
Long-Term Stewardship Start-End Years - 1997-in perpetuity
Average Annual Long-Term Stewardship Cost FY 2000-2006 - $32,342
Landlord - U.S. Department of Energy, Grand Junction Office

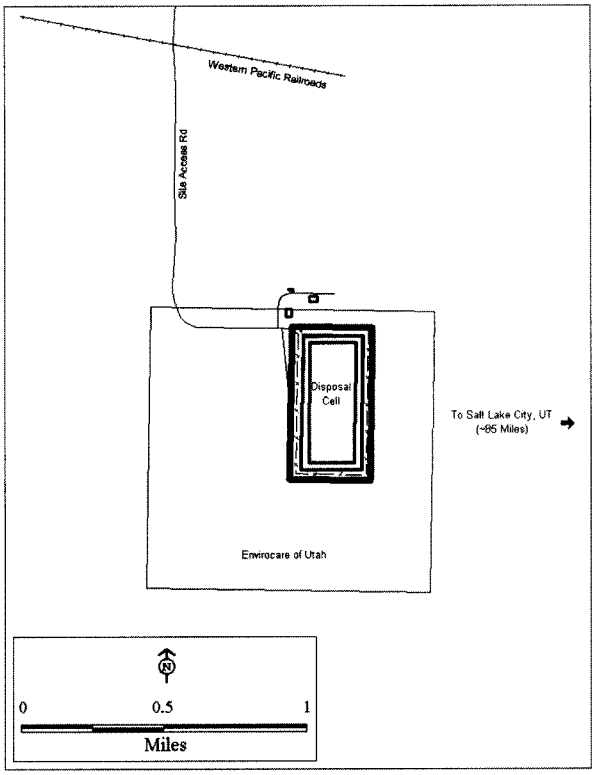
The disposal cell is subject to Title I of the *Uranium Mill Tailings Radiation Control Act of 1978* (UMTRCA). As such, DOE is responsible for any long-term stewardship activities. DOE is the current owner of the South Clive Disposal Cell and is responsible for conducting all long-term stewardship activities. There is no ongoing mission at the site except monitoring and maintenance of a disposal cell that was used to dispose of residual radioactive materials from the Salt Lake City Mill. The DOE Grand Junction Office expects to conduct only routine maintenance activities for the South Clive Disposal Cell.

In the late 1980s, approximately 2.1 million cubic meters (2.8 million cubic yards) of residual radioactive materials were removed from the Salt Lake City Mill, transported 137 kilometers (85 miles) to the South Clive Disposal Cell, and stabilized in the site's disposal cell. Remedial action was conducted by the State of Utah under the direction of the DOE Uranium Mill Tailings Remedial Action Surface Project in Albuquerque, New Mexico. The completed disposal cell occupies approximately 22 hectares (54 acres) of the 40-hectare (99-acre) rectangular site. The disposal cell is surrounded by a toe drain, a maintenance road, and a perimeter diversion channel. The site is enclosed by a locked gate and fence, and the perimeter is marked with warning signs, boundary markers, and survey monuments.

1.2 Site Cleanup and Accomplishments

Approximately 1.2 million cubic meters (1.6 million cubic yards) of radioactively contaminated material and 650,000 cubic meters (850,000 cubic yards) of other contaminated material were at the Salt Lake City Mill when it was remediated. A total of approximately 2.1 million cubic meters (2.8 million cubic yards) of mill tailings and residual radioactive materials were transported from the Salt Lake City Mill for disposal at the South Clive Disposal Cell.

Remedial action at the Salt Lake City Mill consisted of excavating residual radioactive materials and relocating these materials to a disposal cell constructed at the South Clive Disposal Cell. The disposal cell was constructed in accordance with requirements of Title 40 of *Code of Federal Regulations*, Part 192. The unlined disposal cell is covered with a 2.1-meter (7-foot) layer of silty clay that acts as a low-permeability radon barrier. The top and side slopes of the disposal cell are covered with a 0.4-meter (1.5-foot) rock barrier and a 15.24-centimeter (6-inch) thick sand layer to resist erosion and root intrusion. In accordance with U.S. Environmental Protection Agency (EPA) standards, the cover is designed to remain effective for 200 to 1,000 years. The construction completion report for the South Clive Disposal Cell was submitted to the U.S. Nuclear Regulatory Commission (NRC) in 1996. In 1997, the disposal cell was accepted under the NRC general license and DOE began conducting long-term stewardship activities.



South Clive Disposal Cell

Based on background groundwater monitoring conducted at the South Clive Disposal Cell, the groundwater is classified as "limited use" because total dissolved solids exceed 10,000 milligrams per liter. Groundwater on the site is neither a current nor potential source of drinking or irrigation water. The EPA has determined that the South Clive Disposal Cell qualifies for supplemental groundwater standards [under Title 40 of the *Code of Federal Regulation*, Part 192.21(g)] and, therefore, groundwater monitoring at this site is not required. Groundwater wells on the South Clive Disposal Cell property were transferred to Envirocare of Utah, Inc., when the site license was issued to DOE.

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

Under the provisions of the site-specific long-term surveillance plan, the DOE Grand Junction Office conducts annual inspections of the site to evaluate the condition of surface features, performs site maintenance as necessary, maintains institutional controls, and monitors the disposal cell. Annual inspections of the disposal site are conducted to detect progressive change caused by slow-acting natural processes and to identify potential problems before the need for extensive maintenance, repairs, or corrective action. Groundwater monitoring is not required because the groundwater has been classified as "limited use."

The permanent surveillance features at the South Clive Disposal Cell include survey and boundary monuments, site markers, and entrance and perimeter signs. In addition, DOE staffs a 24-hour phone line for reporting any site concerns. Unauthorized access to the property is prevented by the locked security fence. No drilling or other intrusive activities are allowed on the property unless authorized by DOE.

DOE maintains and updates the specific records and reports required to document the long-term stewardship activities at the South Clive Disposal Cell. DOE submits an annual report to the NRC that documents the results of the annual inspection, as required by NRC regulations. Site records are maintained in permanent storage at the DOE Grand Junction Office in Colorado. The types of records maintained include site characterization data, remedial action design information, the completion report, long-term monitoring plans, annual inspection reports, and current and historic monitoring data. Real property records are maintained at the DOE Albuquerque Operations Office in New Mexico.

STAKEHOLDER INVOLVEMENT

Community interaction has been minimal since the remedial action was completed. Copies of the annual inspection report for the South Clive Disposal Cell and other sites are distributed to the local library and any stakeholders that requests copies. The report is also published on the DOE Grand Junction Office website at www.doegjpo.com.

2.2 Specific Long-Term Stewardship Activities

Engineered Units

The South Clive Disposal Cell measures approximately 340 meters by 643 meters (1,115 feet by 2,110 feet) and occupies 22 hectares (54 acres) of the 40-hectare (99-acre) site. The cell extends approximately 2.7 meters (9 feet) below grade and rises 10.6 meters (35 feet) above the surrounding terrain. The disposal cell contains approximately 2.1 million cubic meters (2.8 million cubic yards) of mill tailings and other radioactive materials such as soils contaminated with uranium, radium, and thorium and construction debris. The cover of the South Clive Disposal Cell consists of three layers. The low-permeability radon barrier is a densely compacted, silty clay layer designed to prevent release of radon and infiltration of precipitation. The radon barrier is protected by a sand filter layer, over which a rock layer was placed to protect against wind and water erosion, plant root intrusion, and burrowing animals. The disposal cell cover promotes rapid runoff of precipitation to minimize leachate. The cell is unlined; however, the excavation subgrade was scarified and compacted before fill placement. Rock-lined drainage ditches around the base of the disposal cell intercept runoff and direct the flow into the natural drainage west of the site. The ditches have gentle slopes and the capacity to carry the runoff from a 100-year, one-hour storm event. A maintenance road and a perimeter diversion channel surround the cell.

The DOE Grand Junction Office manages the site according to the site-specific long-term surveillance plan for the South Clive Disposal Cell. Under provisions of the plan, the DOE Grand Junction Office conducts annual site inspections to evaluate the condition of surface features and performs additional maintenance, as necessary. The disposal cell at South Clive is designed and constructed to last for 200 to 1,000 years.

2.3 Regulatory Regime

In 1997, the South Clive Disposal Cell came under a general license issued by NRC for custody and long-term care of residual radioactive disposal sites (contained at Title 10 of the *Code of Federal Regulations,* Section 40.27). The purpose of the general license is to ensure that such sites will be cared for in a manner that protects human health and safety and the environment. The general license went into effect when NRC concurred that the site conformed to cleanup standards and formally accepted the site-specific long-term surveillance plan.

Long-term stewardship activities of the South Clive Disposal Cell are governed by several requirements in the following regulations: UMTRCA; the *Atomic Energy Act of 1954*, as amended; Title 40, *Code of Federal Regulations*, Part 192; a cooperative agreement between DOE and the State of Utah; and the *National Environmental Policy Act of 1969*, as amended.

2.4 Assumptions and Uncertainties

Because the site has been monitored since 1992, the long-term stewardship activities at the site are well known and are not expected to change dramatically.

3.0 Estimated Long-Term Stewardship Costs

Long-term stewardship costs for the South Clive Disposal Cell are based on historic costs incurred while conducting actual surveillance and maintenance activities at this site. Annual costs for long-term stewardship between fiscal year (FY) 2001 and FY 2006 reflect distributed costs for program-wide decommissioning of unnecessary monitoring wells.

Site Long-Term Stewardship Cost by Fiscal Year (Constant Year 2000 Dollars)					
Year(s)	***Amount***	***Year(s)***	***Amount***	***Year(s)***	***Amount***
FY 2000	$13,700	**FY 2008**	$10,700	**FY 2036-2040**	$56,000
FY 2001	$38,800	**FY 2009**	$10,700	**FY 2041-2045**	$56,000
FY 2002	$41,100	**FY 2010**	$10,700	**FY 2046-2050**	$56,000
FY 2003	$36,600	**FY 2011-2015**	$51,100	**FY 2051-2055**	$56,000
FY 2004	$41,300	**FY 2016-2020**	$51,100	**FY 2056-2060**	$56,000
FY 2005	$27,200	**FY 2021-2025**	$52,400	**FY 2061-2065**	$56,000
FY 2006	$27,700	**FY 2026-2030**	$55,500	**FY 2066-2070**	$56,000
FY 2007	$10,800	**FY 2031-2035**	$56,000		

4.0 Future Uses

Future use of the site will be limited to monitoring and maintaining the disposal cell and monitoring the groundwater. Public access to the site will be restricted in perpetuity.

For more information about the South Clive Disposal Cell, please contact:

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or visit the Internet website at http://www.doegjpo.com

Washington

(Dawn) Ford Site

(WNI) Sherwood Site

Hanford

Long-Term Stewardship Site Highlights

(Dawn) Ford Site (page 3)

Total Site Area - Currently 202 hectares (500 acres); 81 hectares (200 acres) are expected to be transferred to DOE
Current Landlord - Dawn Mining Company
Expected Future Landlord - U.S. Department of Energy, Grand Junction Office

Hanford (page 7)

Major Activities - institutional controls; maintenance; surveillance and monitoring
Site Size - 152,000 hectares (375,000 acres)
Estimated Average Annual Cost FY 2000-2006 - $55,000

(WNI) Sherwood Site (page 65)

Major Activities - disposal cell monitoring; groundwater monitoring
Site Size - 154 hectares (380 acres)
Start-End Years - 2000/in perpetuity
Estimated Average Annual Cost FY 2000-2006 - $38,700

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(WNI) Sherwood Site 65

(DAWN) FORD SITE[1]

1.0 SITE SUMMARY

1.1 Site Description and Mission

The (Dawn) Ford Site (also known as the Ford Mill site) is the location of a former uranium milling site that operated from 1956 until 1981. The site is located in Ford, Washington, on the eastern border of the Spokane Indian Reservation in Stevens County. Dawn Mining Company owns and operated the 202-hectare (500 acres) mill site. The site contains four disposal cells used to dispose of the uranium mill tailings and radioactive soil and rock that remained after uranium ore was processed. Three of the disposal cells are closed.

LONG-TERM STEWARDSHIP HIGHLIGHTS

Total Site Area - Currently 202 hectares (500 acres); 81 hectares (200 acres) are expected to be transferred to DOE
Current Landlord - Dawn Mining Company
Expected Future Landlord - U.S. Department of Energy, Grand Junction Office
Reason Not Subject to NDAA Requirements - This site is an UMTRCA Title II site that will not be transferred to the U.S. Department of Energy until 2019

The (Dawn) Ford Site is subject to Title II of the *Uranium Mill Tailings Radiation Control Act of 1978* (UMTRCA). UMTRCA Title II sites are privately owned and operated sites that were under active license when UMTRCA was passed, or were licensed thereafter. The majority of the mining and milling conducted at these sites was for private sale, but a portion of the uranium was sold to the U.S. Government. Under UMTRCA, the U.S. Department of Energy (DOE) is responsible for performing long-term stewardship activities at the site, but is not responsible for the site's remediation.

The (Dawn) Ford Site is expected to be transferred to DOE in 2019. The number of acres that will be transferred to DOE has not yet been formalized but is expected to be approximately 81 hectares (200 acres). Once the site is transferred to DOE, the only activities will be long-term monitoring of the disposal cell.

The historic mission of the site was to process uranium ore from the Midnite Mine, located on the Spokane Indian Reservation, approximately 25 miles west of the mill. The (Dawn) Ford Site processed uranium ore into yellow cake for the U.S. Atomic Energy Commission (a predecessor agency to DOE) and disposed of the mill tailings and other process-related wastes onsite. Dawn Mining Company was originally licensed by the Atomic Energy Commission to process uranium for weapons production, but the oversight authority for the milling operations was transferred to the State of Washington in 1969. The mill was shut down in 1982 due to litigation pending against the Midnite Mine, which provided the source uranium for the milling operations.

1.2 Site Cleanup and Accomplishments

The remediation approach for the (Dawn) Ford Site is to stabilize the uranium mill tailings and process-related

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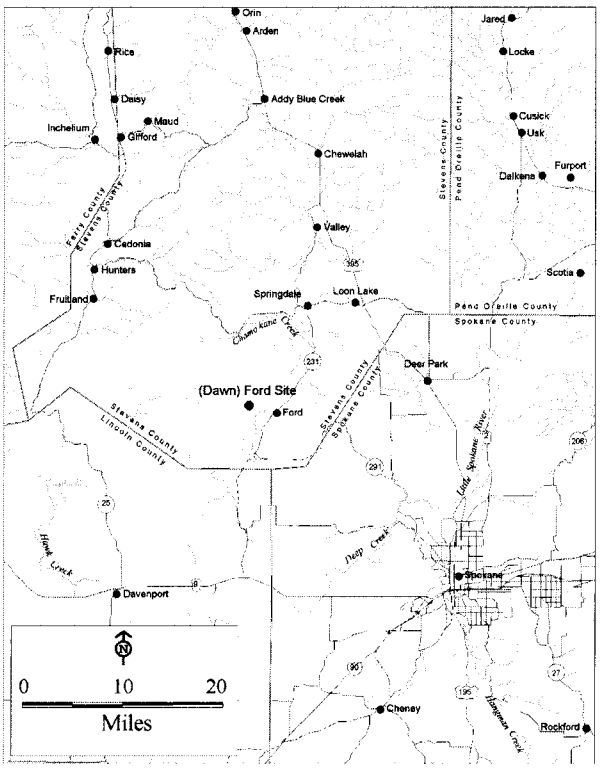
[1]This report is developed in response to a Congressional request in the Fiscal Year (FY) 2000 National Defense Authorization Act (NDAA). As requested by the Act, this report addresses current and anticipated long-term stewardship activities at each site or portion of a site by the end of calendar year 2006 ("Conference Report on S.1059, National Defense Authorization Act for Fiscal Year 2000," *Congressional Record,* August 5, 1999).

Based on current planning, the (Dawn) Ford Site is not expected to be transferred to the U.S. Department of Energy (DOE) for long-term stewardship until 2019, and for this reason the site is not the primary focus of this report. This brief summary of the site cleanup activities is provided for background information and potential future long-term stewardship activities. (See section 3.2 of Volume I).

wastes in place. Three of the four disposal cells have been closed. Demolition of the mill buildings and evaporation of water in the ponds, is yet to be completed. Also, the groundwater restoration strategy has not been finalized.

2.0 EXPECTED FUTURE USES AND SITE RESPONSIBILITY

When remediation activities are complete, the site will have four onsite disposal cells containing approximately 1.8 million cubic meters (2.3 million cubic yards) of uranium mill tailings and contaminated material. The precise volume of material will not be known until remediation is completed. The disposal cells will have a low-permeability radon barrier with an erosion control layer. Erosion control will be provided for all potentially vulnerable features, and the site will be graded to provide positive drainage. Disturbed areas will be revegetated. The disposal cells will be similar to other uranium mill tailings disposal cells and will require similar long-term stewardship activities. Once the site is transferred to DOE in 2019, DOE will be responsible for long-term stewardship activities at the site.



(Dawn) Ford Site

Anticipated site-wide long-term stewardship activities include restricting access by fencing and posting warning signs along the site boundary. DOE will repair the fence and replace signs, as necessary. DOE will staff a 24-hour phone line for reporting site concerns. Drilling and other intrusive activities will be prevented within site boundaries through institutional controls.

Groundwater at the site is known to be contaminated as a result of uranium processing activities. The extent of groundwater contamination that will be present at the time of site transfer cannot be reasonably estimated at this time. DOE assumes that groundwater will require monitoring on a periodic basis. The precise monitoring requirements will be prescribed in the long-term surveillance plan that will be developed and approved by the U.S. Nuclear Regulatory Commission at the time of site transfer.

Site records will be placed in permanent storage at the DOE Grand Junction Office in Colorado. The types of records maintained include site characterization data, remedial action design information, the site completion report, long-term monitoring plans, annual inspection reports, and current and historic monitoring data.

For additional information about the (Dawn) Ford Site, please contact:

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HANFORD[1]

1.0 SITE SUMMARY

The need for new long-term site management processes is being evaluated by the U.S. Department of Energy (DOE) Hanford Site because of the end of the historical weapon production operations and the prospect for significant hazards to remain at the site long after remediation. The site history, an overview of the current remediation activities, and brief descriptions of regulatory requirements and remediation accomplishments are provided in this chapter to present a perspective for the discussion on long-term stewardship in Section 2.0.

LONG-TERM STEWARDSHIP HIGHLIGHTS

Major Long-Term Stewardship Activities - institutional controls, maintenance, surveillance and monitoring
Total Site Area - 152,000 hectares (375,000 acres)
Estimated Volume of Residual Contaminants - to be determined
Portions in Long-Term Stewardship as of 2000 - 4
Average Annual Long-Term Stewardship Cost FY 2000-2006 - $55,000
Landlord - U.S. Department of Energy; U.S. Forest Service; Bureau of Land Management; State of Washington; Port of Benton

1.1 Description and Mission

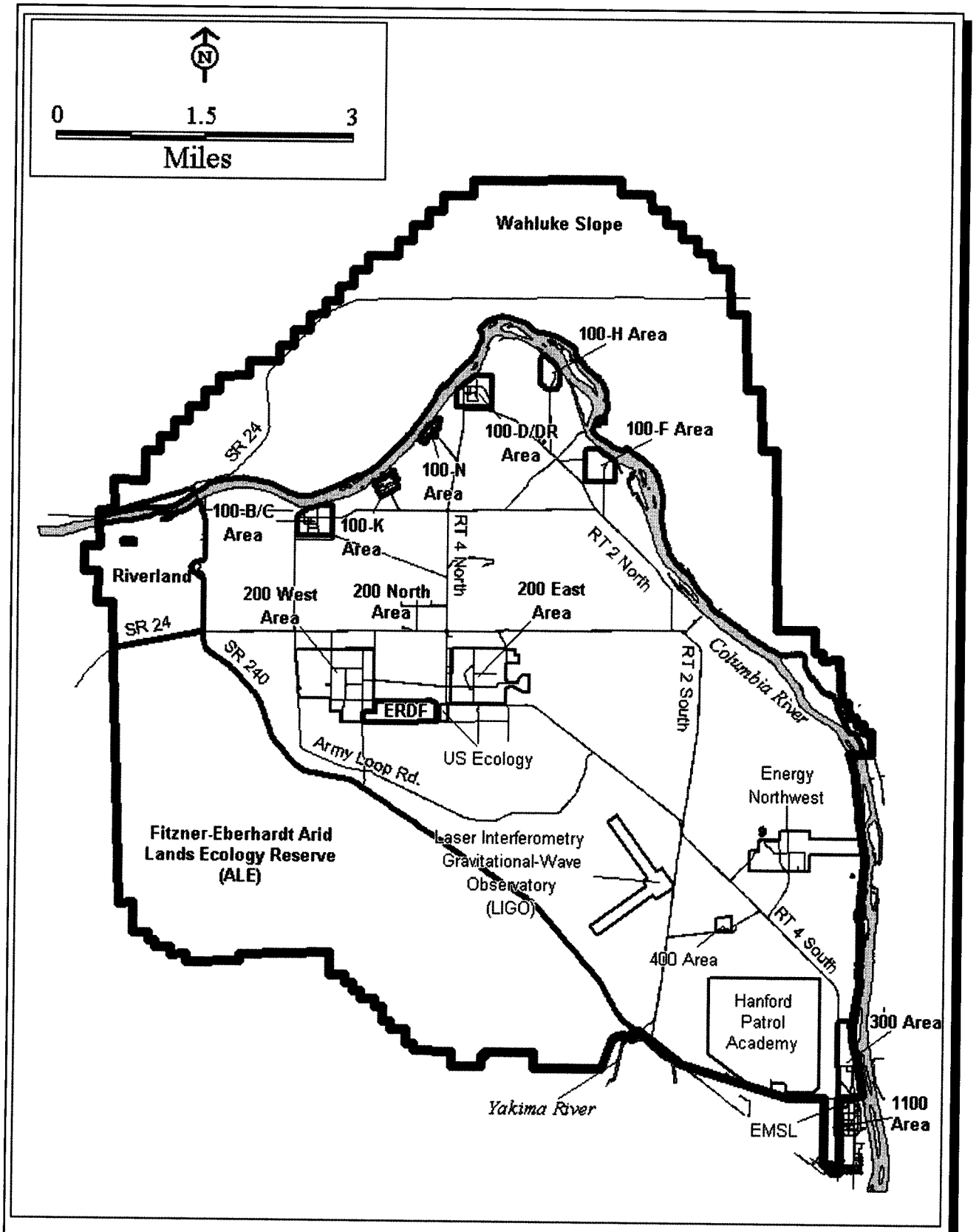
Hanford was established by the Federal government in 1943 (then called Hanford Engineering Works) for plutonium production, chemical processing, and research and development to support the nation's wartime effort to produce plutonium for the world's first nuclear weapons. Hanford's boundary encloses 1,517 square kilometers (586 square miles) in the southeastern portion of the State of Washington. The Columbia River runs through the northern portion of the site and forms Hanford's eastern boundary. The City of Richland is located at the southern border of the site, and the cities of Kennewick and Pasco are located less than 24 kilometers (15 miles) southeast of the site. Hanford is divided into "Areas," which are numbered (e.g., 300 Area, 200East Area) as shown on the following map.[2] The designation of the "600 Area" refers to all lands not specifically designated by another name.

The U.S. Army Corps of Engineers selected the site near the towns of White Bluffs and Hanford because of the remote location, good climate, and most important, the abundant supply of hydroelectric power and clean water from the Columbia River. The production of plutonium at Hanford involved three steps: 1) fuel fabrication – uranium was made into fuel elements in the 300 Area of the site; 2) fuel irradiation – fuel elements were irradiated in nuclear reactors in the 100 Area, converting small amounts of the uranium fuel to plutonium; and 3) chemical processing – the irradiated fuel elements, or "slugs," were chemically processed to extract the plutonium in the 200 Area facilities. The fabrication of the fuel elements that fed the plutonium production reactors was accomplished in the nuclear facilities of the 300 Area, which housed numerous large nuclear facilities used for research and development and one test reactor.

By the 1950s, a total of eight plutonium production reactors had been built in the 100 Area (the B, C, D, DR, F, H, K-East, and K-West Reactors). N Reactor (located in the 100N Area) became operational in 1963 and was used for both plutonium production and steam generation. During the production period, while waiting for

[1]In June 2000, amid the preparation of this Report, Columbia river land, the Wahluke Slope, the Arid Lands Reserve and portions of land north of the 300 Area were designated by the Administration as a National Monument. The impact of the Monument designation on planning, land management and cleanup has not been fully assessed, and therefore, not fully reflected in this Report.

[2]For convenience, and in this Report only, a 200 North Area is specified; this is a "portion" as defined in this Report and is not a recognized Area at Hanford.


N
0
1.5
3
Miles
Wahluke Slope
100-H Area
100-D/DR Area
100-F Area
100-N Area
100-B/C Area
100-K Area
SR 24
RT 4 North
RT 2 North
Riverland
200 West Area
200 North Area
200 East Area
SR 24
SR 240
RT 2 South
Columbia River
ERDF
US Ecology
Army Loop Rd.
Energy Northwest
Fitzner-Eberhardt Arid Lands Ecology Reserve (ALE)
Laser Interferometry Gravitational-Wave Observatory (LIGO)
RT 4 South
400 Area
Hanford Patrol Academy
300 Area
Yakima River
EMSL
1100 Area

Hanford

chemical separation in the 200 Area, the irradiated fuel rods were stored in large basins filled with water at the back end of each reactor. Later, during shutdown of N Reactor, N Reactor fuel rods were transferred to the K-East and K-West Basins and were stored there while fuel treatment issues were resolved. These rods are scheduled for transfer to dry storage following stabilization. In addition to the nine production reactors, two test reactors were built for use in fuel materials testing, isotope production, and power research. The Plutonium Research Test Reactor is located in the 300 Area, and the much larger Fast Flux Test Facility reactor is in the 400 Area.

The fabricated fuel was irradiated in the plutonium production reactors, and chemical separation of the plutonium in the fuel slugs was conducted in the 200 Area by one of three different methods. Hanford's T-Plant, B-Plant and U-Plant all used the bismuth phosphate separation technology, with final extraction at 224-T Building, 231-Z Building and the Plutonium Finishing Plant. Hanford's REDOX Plant (S-Plant) used organic solution and aqueous phase separation technology, with plutonium and uranium recovery conducted at the 231-Z Building and U- Plant, respectively. The U-Plant was converted for a new separation technology, UO_3, used mainly for the recovery of uranium. The product from the UO_3 facility was sent to the Plutonium Finishing Plant for final extraction. Hanford's C Plant (Strontium Semiworks) was a semi-scale test facility. Separation of strontium and cesium from waste streams was performed in the B Plant. The aqueous wastes from these operations were sent to cribs, ponds, or trenches for disposal via soil infiltration or evaporation. The chemical wastes and slurries were sent to Hanford's 177 large underground storage tanks for disposal. Solid wastes were disposed in trenches and caissons at Hanford.

Beginning in 1964, DOE sharply curtailed plutonium production in response to the nation's changing defense needs. By 1971, eight of the nine production reactors had been shut down and by 1972, all related fuel separation facilities had ceased operations. In the early 1980s, DOE briefly restarted the REDOX Plant and UO_3 Plant; however, these plants are now permanently shut down.

As a result of the reduction of plutonium production activities, the resources and capabilities of Hanford were refocused toward developing nonmilitary applications of nuclear energy. In the late 1970s, the Energy Research and Development Administration, a predecessor agency to DOE, emphasized energy research programs, including solar, geothermal, and advanced systems; fossil energy; national security; conservation; energy policy analysis; and resource assessment. Through the 1980s, the Fast Flux Test Facility was used for large-scale nuclear fuels and reactors materials testing in support of nuclear energy research.

In 1989, the defense-related plutonium production mission at Hanford was replaced by the environmental management mission. The current and future mission of Hanford is to manage the facilities and inventories of special materials, remediate the environmental contamination caused by decades of activities related to the production of plutonium, and support national research efforts in environmental and other sciences. In addition to the reactors and nuclear facilities, Hanford has more than 500 DOE-owned structures. These structures support past and present operations and vary greatly in their use, their size, and their level of radiological and chemical contamination.

1.2 Cleanup and Accomplishments

By 1989, when Hanford's mission had changed to that of environmental restoration, production activities had resulted in the discharge of contaminated liquids into the soil, groundwater, and the Columbia River; the disposal of solid waste throughout the area; and the accumulation of two-thirds of the nation's stored weapons-related radioactive waste.

Hanford's cleanup deals with three types of waste, as described below:

The first type of waste includes high-level, low-level, transuranic, mixed, and hazardous wastes. High-level waste is defined as wastes from the reprocessing of spent nuclear fuel, usually highly radioactive and containing fission products. Transuranic waste is defined as radioactive wastes contaminated with uranium-233 or transuranic elements having half-lives over 20 years. Low-level waste is defined as any radioactive wastes that are not high-level or transuranic, regardless of their level of radioactivity. High-level, low-level, and transuranic wastes are, in some way, contained and require treatment and/or final disposal. Transuranic waste is currently stored awaiting shipment to the Waste Isolation Pilot Plant (WIPP) in New Mexico. Shipments to WIPP began in the summer of 2000. The low-level wastes are buried at onsite low-level waste disposal facilities. The mixed waste and hazardous waste make up much of this first type of waste and are regulated under the *Resource Conservation and Recovery Act* (RCRA). Under RCRA, most mixed and hazardous wastes cannot be buried and other approved treatment options must be used. Treatment will be determined through established regulatory processes.

The second type of waste is material (radioactive or hazardous) that has escaped or was placed into the environment. This waste is hard to recover and is now located in Hanford's soils, unconsolidated geologic material, groundwater, plants and animals, and within the Columbia River's aqueous, biota, and sediment systems. In 1989, Hanford was placed on the U.S. Environmental Protection Agency's (EPA) National Priorities List under the *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA). Since that time, DOE has been committed to remediation and waste management to decrease potential risks to Hanford's work force, the public, and the environment. Disposal and treatment of wastes that have escaped into the environment are handled under CERCLA or RCRA, depending on the regulatory lead under the provisions of the Tri-Party Agreement.

The third type of waste consists of building materials that became contaminated during the production era. This phase includes waste materials inside pipes, slab tanks, sumps, filters, and the building materials themselves (contaminated concrete, electrical equipment and wiring, steel gratings). Decommissioning and decontamination of these facilities will remove most of this contamination, which will be treated as CERCLA, RCRA, or low-level waste.

MAJOR ENVIRONMENTAL RESTORATION ACTIVITY MILESTONES

TASK	COMPLETION DATE Fiscal Year
Site-wide	
Submit Columbia River Impact Assessment	1996 (done)
100 Area	
N-Reactor Deactivation	1997 (done)
Pre-Record of Decision	1998 (done)
Remedial Action	2016
Decommissioning	2038
200 Area	
Environmental Restoration Disposal Facility Operational	1996 (done)
Non-tank Areas Site Investigation	2024
Remedial Action	2038
Decommissioning	2048
300 Area	
Pre-Record of Decision Site Investigation	1997 (done)
Remedial Action	2038
Decommissioning	2045
400 Area	
Remedial Action	2038
Decommissioning	2047

Comprehensive and verifiable inventories of Hanford's waste volumes are currently being developed or upgraded. Location and volume of the first type of waste are generally well known. However, the sampling and analysis of these wastes is expensive and involves radiation and chemical exposure risks to workers. For example, for high-level waste tanks, obtaining a single sample may cost as much as $750,000, and much of the work involves application of full ALARA (as low as reasonably achievable) controls for worker protection. Generating inventories for the second type of waste involves environmental sampling and analysis, followed by prediction of the total mass and type of the contaminants in the environment. Computer models accomplish these predictions and a comprehensive estimate for all contaminated environmental media is being conducted. Many of the buildings at Hanford have been closed and sealed. Re-entry into these buildings requires months of

preparation and involves potential radiological and hazardous chemical exposures for workers, again requiring ALARA controls for worker protection. In addition to worker exposure, generating inventories of contamination in pipe works and sumps requires extensive nonstandard sampling and analysis that is expensive. Part of the decontamination and decommissioning activities at Hanford includes investigation, evaluation, and application of innovative and transferable technologies for reducing the time, cost, and risks associated with facility contamination characterization and removal.

The origination of wastes and contamination at Hanford, and their nature and extent, are described further below.

Hanford processed more than 100,000 metric tons (110,000 tons) of irradiated uranium and generated several hundred thousand metric tons of chemical and radioactive waste. Much of the waste is contained in the 177 large storage tanks in the 200 Area. Environmental contamination is found in surface and subsurface soils. In addition, liquids (principally liquid low-level radioactive waste effluents) were discharged into the soils and have contaminated 25 to 35% of the groundwater under Hanford. This groundwater contamination includes 12 known contaminants (tritium, carbon tetrachloride, chromium VI, nitrates, cobalt-60, strontium-90, cesium-137, technetium-99, iodine-129, plutonium-239, uranium-235, and uranium-238). Monitoring and data evaluation continue for the sub-surface at Hanford so that characterization of the nature and extent of the groundwater contamination is continually updated. These monitoring data are also used to continually improve predictions for contaminant migration.

Prior to 1970, solid wastes contaminated with hazardous chemicals or plutonium or containing transuranic or low-level wastes were disposed in burial trenches. After 1970, most of the plutonium-contaminated wastes were placed into partially lined underground vaults or surface trenches designed for easier retrieval. Hanford also has sites in which packaged, low-level radioactive and hazardous wastes are buried. These packages include drums, boxes, and bags. Solid radioactive wastes were also disposed of in caissons (60 or 90-cm (2 or 3-foot) diameter and 6 to 35- meter (20 to 120-foot) long metal or concrete pipes buried vertically in the ground).

The chemical processing of irradiated fuels generated the largest volume of Hanford's waste. The process wastewaters were divided into high-level radioactive alkaline slurries containing heavy metals, organic and inorganic salts; uranium, plutonium, and mixed fission products stored in underground waste tanks; and low-level waste streams, such as cooling water, condensates, and other similar waste discharged to the ground. Most of the high-level waste remains in the underground storage tanks and will be removed from the tanks and treated in the proposed Waste Processing and Immobilization Facility. Contamination resulting from discharge to the ground remains in the soil and groundwater at Hanford and is being treated and removed where possible by excavation and pump-and-treat operations.

Contaminated facilities located in the 100, 200, 300, 400, and 600 Areas consist of shut-down production and test reactors, chemical separation and processing plants, waste-handling facilities, and various support structures. Many of these facilities are contaminated with radioactive and hazardous materials because of the various processes associated with fuel fabrication, fuel irradiation, and chemical processing, as described previously. DOE is decontaminating and decommissioning all existing contaminated buildings across the site. This effort requires disposition of more than 300 buildings currently in the surplus facility inventory, as well as more than 500 other buildings that will require decommissioning in the future.

Environmental restoration activities are well underway at Hanford. Initial emphasis was on stabilizing sites with contamination posing near-term, more severe health risks, while concurrently seeking to characterize the extent of contamination in other areas. To date, DOE has successfully completed all required measures to contain surface contamination in a stable form, while continuing its monitoring and maintenance activities until it can remediate these sites. In addition, all known contaminated areas, groundwater plumes, and surplus buildings have received at least preliminary characterization, and the levels of contamination for many sites and plumes have

been thoroughly defined.

As DOE has stabilized and characterized high-risk sites, it has shifted the emphasis of its environmental restoration activities to designing and implementing remediation approaches. DOE's current remediation strategy for these areas involves removing most surface contamination from the region along the Columbia River and near the City of Richland. DOE is moving contaminated waste materials to the Central Plateau (or 200 Area) for disposal in the Environmental Restoration Disposal Facility, which is the site's disposal facility for waste materials removed during site remediation and building decommissioning. This waste (the bulk of which is low-level mixed waste), as well as other contamination within the Central Plateau, is contained and controlled in place. Sanitary waste is disposed of in the City of Richland landfill. Hazardous waste is sent to commercial facilities.

Remediation plans for specific areas of Hanford are discussed below.

1.2.1 100 Area

The 100 Area encompasses 6,800 hectares (17,000 acres), which is divided into six main, non-contiguous, operating areas (B/C, D, F, H, K and N Areas), separated by buffer zones (open spaces). These operating areas contain Hanford's nine production reactors, more than 200 inactive support buildings, 36 former solid waste burial sites, and more than 200 identified sites with surface or subsurface contamination. Eight of the reactors were shut down by 1971; the final reactor was shut down in 1987. At present, only a few facilities are being used to support the storage of spent nuclear fuel in the K Reactor basins (until a new dry storage facility is available in the Fall of 2000) and to support environmental restoration activities throughout the area.

All of the production reactors, except the N Reactor, were "single-pass" reactors. Water was pumped from the Columbia River, through the reactor tubes to cool the uranium fuel, and then out of the reactor through large pipelines back into the river. Between the reactors and the river, the cooling water (effluent) was held in large tanks (retention basins) for short periods to allow the short-lived radionuclides, picked up in the reactors, to decay and for thermal cooling of the water. Lower concentrations of longer-lived isotopes from these units remained in the cooling water and were discharged directly into the Columbia River where the concentrations declined further due to dilution. There is evidence of radionuclides trapped in the sediments of the Columbia River downstream of Hanford; however, there is no indication of direct impacts to human heath due to these production-era releases, and much of contamination passed out of the Columbia River into the Pacific Ocean.

Contaminants were also introduced into the environment when some of the basins and pipelines overflowed or leaked, releasing contaminants into the soil. Over the years, large quantities of sludge that settled out in the basins were pumped out into disposal trenches near each basin. Each area had sites where solid wastes generated during routine reactor operations (contaminated rags, filters, clothing, equipment, disposable supplies, etc.) were buried. In each of the operating areas, some of the contaminants introduced into the soil have migrated to the groundwater, which is relatively close to the surface in the 100 Area (less than 50 feet). Transport of these contaminants toward the Columbia River is currently slowed with pump-and-treat systems.

Remediation of surface and subsurface soils in the 100 Area is being completed in phases. Remediation in the 100-B/C Area was initiated in late 1995 and will progress until all other areas are completed in 2016. During this period, DOE is excavating and removing contaminated soil and debris, filling excavated sites, and restoring natural vegetation to the remediated areas. The waste will be transported and disposed directly in the Environmental Restoration Disposal Facility on the Central Plateau. As the soil is being excavated, samples are taken periodically and analyzed to determine the concentration of contaminants being removed. When complete, 100 Area remediation operations will have excavated and replaced an estimated three million cubic meters (four million cubic yards) of contaminated soils; analyzed more than 20,000 soil samples; and restored 256 hectares

(640 acres) of previously controlled surface area for other uses.

The level of contamination in the groundwater is currently monitored twice a year through a system of approximately 400 wells that are sampled and analyzed. In some cases, contaminated groundwater plumes are intercepted through a network of extraction wells and treated and returned to the ground. For the contaminants in the 100 Area, groundwater treatment includes ion exchange to remove strontium-90 and use of innovative in-situ technology for stabilization of chromium contamination. The tritium in the 100 Area groundwater cannot be removed using today's technology; therefore, water contaminated with tritium is reinjected up and away from the river shoreline after other contaminants are removed (giving tritium time to decay). Groundwater treatment systems will operate until 2002, with monitoring continuing through 2018. Unless regulations change dramatically, the continuing sampling and analysis will require extensive resources in the long-term. The groundwater treatment systems are evaluated periodically to determine their effectiveness. Based on the results of these evaluations and in conjunction with regulators and stakeholders, plans for the duration of operations of groundwater treatment systems are continually updated. Groundwater is not expected to meet current drinking water standards, so the use of groundwater will be restricted through institutional controls.

Building decommissioning and other remedial activities in the 100 Area will generate approximately 3.3 million cubic meters (4.3 million cubic yards) of low-level waste. DOE does not expect any of this waste to require treatment before disposal. The waste is being transported and directly disposed of in the Environmental Restoration Disposal Facility on the Central Plateau. The intact reactor blocks will be disposed of in a separate, specially constructed reactor block disposal area.

1.2.2 200 Area (Central Plateau)

The 200 Area (also known has the Central Plateau) is divided into two main operating areas (east and west) where plutonium was extracted from irradiated reactor fuel in massive chemical processing facilities. Irradiated reactor fuel was transported by rail from the 100 Area reactors to chemical separation plants, where the fuel cladding was removed, and the fuel dissolved into a chemical slurry. Plutonium and uranium were separated from this slurry, purified, and concentrated in various stages, then packaged for shipment to other stages of weapons production. These large buildings have up to 7,400 square meters (80,000 square feet) of floor space and are surrounded by 100s of contaminated ancillary buildings that supported the chemical separations processes.

The 200 Area encompasses 2,400 hectares (6,000 acres) and contains six chemical processing plants, more than 250 support and research buildings, all of Hanford's 177 high-level waste storage tanks, most of Hanford's waste disposal sites, as well as one million square meters (265 acres) of contaminated surface soil.

During the operation of the processing plants, low-level waste was discharged directly to the soil through cribs, ditches, ponds, drain fields and wells. The direct disposal of waste to the soils was considered safe because the soils were thought to filter and trap a large portion of the radioactive contaminant in the top layers. More than 1.3 trillion liters (350 billion gallons) of liquid, ranging from cooling waters to supernatant from single shell tanks, have been discharged to the ground in the 200 Area. Not all radioactive contaminants were absorbed by the upper soil layers. Instead, they migrated to the subsurface and groundwater, along with chemical solvents (e.g., trichloroethylene, carbon tetrachloride) used by the processing plants. At least 24% of the groundwater under Hanford is known to be contaminated by radioactive materials and hazardous chemicals. Nine contaminants exist at levels exceeding current national drinking water standards.

Other waste was piped to storage tanks, where it was to be retained until a final treatment option could be devised. Approximately 350 million liters (93 million gallons) of waste were pumped into 149 single-shell tanks between 1944 and 1980. The tanks and the piping systems associated with these single-shell tanks have leaked

at various times, releasing as much as 3.8 million liters (one million gallons) of high-level waste into the 200 Area soil. The Waste Management program at Hanford is responsible for managing and decommissioning the tank farms, as well as remediating contaminated soils within the tank farm boundaries.

The 200 Area was also the location for managing waste generated during processing. Contaminated items such as clothing, tools, filters, construction material, laboratory ware, and failed process equipment were disposed in the 200 Area in trenches, typically measuring 275 by 6 by 6 meters (900 by 20 by 20 feet). A total of more than 400,000 cubic meters (523,000 cubic yards) of radioactive solid waste has been buried within the 200 Area, including approximately 140,000 cubic meters (183,000 cubic yards) of unsegregated transuranic waste.

Government agencies and most stakeholders generally agree that restoring the entire 200 Area to a pristine condition is not a practical or technically feasible objective. Rather, DOE assumes that much of the Central Plateau may be used exclusively to manage contaminated media and dispose of waste materials. However, the 200 Area remediation is still a major effort, with extensive actions needed to control and contain contamination, minimize long-term maintenance operations, and ensure safe disposal of waste materials. Remediation efforts, as well as the accompanying decontamination and dismantling activities, will be completed by 2046. Since many facilities and waste management operations continue to be active, extensive remedial actions will not begin in the 200 Area until after 2006. However, a groundwater-monitoring program has been in place for several years. Many areas containing surface radiological contamination have been stabilized and, in 1994, systems began treating groundwater contaminated with carbon tetrachloride and radionuclides. DOE has also deployed a number of vapor extraction systems to remove carbon tetrachloride from the soil, reducing the threat of additional groundwater contamination.

In contrast to the excavation and disposal strategy employed in the 100 Area, DOE plans to leave contaminated soil and solid waste disposal sites in the 200 Area in place. However, it will take measures to control and contain sites in ways that will greatly reduce public health risks and the threat of further contamination of groundwater. Soil sites contaminated by hazardous chemicals and/or radioactive isotopes will be contained in place through the extensive use of engineered barriers placed over the area of contamination. Barrier design will vary depending on the level of contamination present, but caps dramatically reduce the amount of surface moisture seeping downward through the contaminated area, essentially eliminating further spread of contaminants and limiting the intrusion of plants and animals into the waste site. In some instances, vertical barriers may be constructed along the perimeter of contaminated sites to prevent contamination from spreading laterally through the soil. DOE may remove soils and waste from a small number of sites that cannot be suitably contained and dispose of them in the Environmental Restoration Disposal Facility.

DOE will also apply caps and barriers to currently closed solid waste burial grounds. As remediation continues and other solid waste burial trenches are filled and closed, DOE will install caps and barriers for these trenches. By the time this remediation is complete in 2038, DOE will have installed approximately six million square meters (seven million square yards) of caps within the 200 Area.

As DOE remediates other areas across Hanford, much of the waste will be brought to the 200 Area. Low-level wastes are to be disposed of in the Environmental Restoration Disposal Facility. Low-level mixed waste will be stored in the 200 Area in recoverable trenches until treatment options are determined and approved through established regulatory processes. Transuranic wastes and high-level wastes will be stabilized and packaged for transfer to WIPP and to the proposed high-level waste repository, respectively, for disposal. The 200Area also permanently stores 90 (inventory as of Spring 2000) de-fueled U.S. Navy reactor vessels in a shallow trench that must remain uncovered in accordance with agreement requirements for satellite surveillance.

In 1968, the B Plant was modified to remove cesium and strontium from the high-level waste tank contents. The cesium and strontium were purified and placed into capsules that were stored or leased for industrial uses.

However, some of the capsules deteriorated over time and all leased capsules were returned to Hanford by 1996. Currently, all of these capsules are stored at the Waste Encapsulation and Storage Facility (WESF) at Hanford awaiting final disposal. The current baseline plan is to dispose of these by vitrification, though no decision has been made. The cesium and strontium capsules are a significant portion of Hanford's total curie inventory, and current plans are to vitrify the contents in the Hanford Waste Treatment and Immobilization Plant.

Hanford's groundwater monitoring activities are ongoing and will continue until the extent of contamination is well understood and beyond to provide periodic data for updating transport predictions and evaluating treatment efficacy. DOE expects that groundwater will be pumped to the surface in some areas of the 200 Area and treated to control the spread of plumes of contamination and to reduce contamination in areas of high concentration. DOE is currently evaluating various systems to treat this pumped groundwater and has already placed some systems into service to remove carbon tetrachloride and other organic contaminants from the groundwater, reducing the concentration and dispersion of these mobile contaminants.

Schedule for Decommissioning Buildings in the 200 Area

Facility Complex	*Number of Buildings*	*Decommissioning Initiated*	*Decommissioning Complete*
U Plant Complex	30	Ongoing	2038
Reduction-Oxidation Plant Complex	45	Ongoing	2040
Plutonium-Uranium Extraction Plant Complex	100	2039	2043
B Plant Complex	88	2035	2048
T Plant Complex	20	2044	2048
Plutonium Finishing Plant Complex	150	2035	2048
Support Services	61	2025	2048

1.2.3 300 Area

The 300 Area is a 46-hectare (115-acre) industrial area just north of the city of Richland and adjacent to the Columbia River. The facilities in this area have been used for fabrication of reactor fuel assemblies, reactor research and development, metalworking, chemical process development, and research and development sponsored by DOE. Many of the buildings in the 300 Area are still used for research and development; others are currently being cleaned out and refurbished for new uses; and others are being prepared for decommissioning. In addition, the 300 Area houses several office buildings and support facilities (fire stations, security headquarters, water treatment plant, etc.).

Much of the contamination found within the 300 Area is similar to that found in many industrial areas in the United States; that is, it includes solvents and petrochemicals. However, during fuel fabrication and materials processing research, radioactive materials were introduced via pipeline leaks, spills, airborne releases from shops, burial of process waste, and release of liquids into ponds. The bulk of the contamination is concentrated in buildings and in approximately 20 hectares (50 acres) of soil within the main industrial area. Contaminants such as nitrates, heavy metals, trichloroethylene, and uranium are also present in groundwater beneath the 300 Area.

The remedial action plan for the 300 Area is designed to remove contaminants from surface and subsurface soils to levels compatible with continued industrial use. Soil in the 300 Area contaminated with low-level radionuclides or hazardous chemicals will be disposed of at the Environmental Restoration Disposal Facility.

Transuranic soil and buried waste (276 cubic meters, 360 cubic yards) will be retrieved and properly disposed at the WIPP in New Mexico. Currently, the 300 Area Accelerated Closure Project is being evaluated. If initiated and accomplished, this project will make facilities and land available earlier than planned.

Groundwater monitoring in the 300 Area indicates contaminant levels are decreasing, and contamination is not expected to pose any threat to public health or to the Columbia River in this area. A Record of Decision was issued for the groundwater associated with the 300 Area in 1996, which addressed specific contaminants (uranium, TCE, and DCE) only. Remedial action associated with other constituents (e.g., tritium) have not been addressed.

Schedule for Decommissioning Buildings in the 300 Area

Facility Complex	*Number of Buildings*	*Decommissioning Initiated*	*Decommissioning Complete*
Production Reactor Fuel Fabrication	17	2039	2045
Laboratories Complex	4	2039	2045
Support Services	70	2039	2045

1.2.4 400 Area

The Fast Flux Test Facility (FFTF), which is currently in hot standby, and several state-of-the-art laboratory facilities are located in the 400 Area. In 1999, the Secretary of Energy ordered that a programmatic Environmental Impact Statement (EIS) be conducted to evaluate the future missions for the FFTF. The draft *Programmatic EIS for Accomplishing Expanded Civilian Nuclear Energy Research and Development and Isotope Production Missions in the United States, Including the Role of the Fast Flux Test Facility* has been issued for public review and is expected to lead to a Record of Decision in late calendar year 2000. Until the EIS is complete and a Record of Decision is issued, the future use of the Fast Flux Test Facility is unknown.

The 400 Area is small and has very little contamination, most of which resulted from a few solid waste sites, sanitary systems, and four small process ponds. Characterization of contamination in this area is complete, and remediation designs have been developed. DOE currently plans to complete remediation of the 400 Area in 2046.

Remediation activities in the 400 Area involve excavating approximately 2,300 cubic meters (3,000 cubic yards) of contaminated soil and debris from several waste burial pits, liquid disposal ponds, and spill areas. The contaminated soil and debris removed from the 400 Area will be disposed of in the Environmental Restoration Disposal Facility.

1.2.5 Other Hanford Areas

Only a fraction of the Hanford Site was developed for production and research facilities (the 100, 200, 300, and 400 Areas). The remainder (the 1100 and 600 Areas, the Wahluke Slope, and the Arid Lands Ecology Reserve) provided buffer space around the operating areas or housed support operations. These open spaces were lightly developed, with the exception of a small zone near the City of Richland used for support operations such as offices, bus garages, warehouses, and shops.

All buffer lands are being remediated to a condition suitable for public use. The relatively minor contamination is being removed from surface and subsurface soils, and any contaminated buildings and structures will be removed. Remediation of the 1100 Area, the North Slope, and the Arid Lands Ecology Reserve (ALE) has

already been completed. The Wahluke Slope and ALE recently were designated part of the Hanford Reach National Monument, to be managed by U.S. Fish and Wildlife Service. Contaminated sites known to exist within the 600 Area have been characterized and incorporated into remediation work plans developed for the adjoining 100, 200, and 300 Areas. In addition, contaminated structures in the 600 Area have been removed. Remaining buildings are not contaminated, are still in use, and will ultimately be handled by the current landlord program. A Record of Decision for the 1100 Area, North Slope, and ALE was issued in 1993 for remediation, which contained a No Further Action Required determination for the groundwater. Remediation of the southern section of these areas was completed in 1995. The contaminated soil and debris from the remediation of buffer areas were shipped off the Hanford Site during 1993 and 1994 to a commercial vendor for disposal. Any waste material removed from the 600 Area will be disposed of in the Environmental Restoration Disposal Facility. The 1100 Area was transferred to the Port of Benton in 1998.

The only decommissioning required involved several small structures that formerly housed Nike missiles. These structures have been completely decontaminated and filled.

1.2.6 Environmental Restoration Disposal Facility

The Environmental Restoration Disposal Facility is located between the 200-East and the 200-West Areas. This facility provides trench disposal capacity for low-level and hazardous waste (primarily contaminated soil) to accommodate remedial actions over the next 30 to 40 years. Construction of the first phase of the Environmental Restoration Disposal Facility started in 1995 and operations began in 1996. DOE selected the location for this disposal facility because it is geologically stable, located outside of the 100–year flood plain, distant (more than 11 kilometers, or seven miles) from the Columbia River, far (73 meters, or 240 feet) from the water table, and adjacent to lands the public will not use in the foreseeable future.

ENVIRONMENTAL RESTORATION DISPOSAL FACILITY RECORD OF DECISION

The Environmental Restoration Disposal Facility is a large disposal trench operated by the Environmental Restoration program and authorized to accept CERCLA waste from remediation activities. Innovations include large-scale "just in time" trench design, commercialized operations, downsized facility requirements, and improved planning and proactive coordination among programs and agencies. The project received a Record of Decision in January 1995, making it the first project of its kind to be approved. DOE expects further design enhancements and construction efficiencies will reduce the estimated life-cycle cost of this facility by more than $100 million.

To ensure the safe isolation of waste deposited at this facility, the facility is engineered to prevent rainwater and snowmelt from entering the contaminated soil and spreading contamination. A double liner that complies with requirements of RCRA was installed beneath the contaminated material, and there is an effluent collection system between the liners to collect any liquids. As portions of the facility are filled, a cover is constructed over the top of the waste. The top cover is designed to conduct water away from the contaminated soil and prevent the spread of contaminants.

1.2.7 Other Remedial Actions

Management of environmental pathways to contaminated waste sites is important to protecting Hanford workers and the surrounding community. Uncontrolled wind-blown dust and vegetation (primarily tumbleweeds) can potentially spread surface contamination. Each year, more than 400 waste sites are inspected. Hanford also performs routine radiological surveys throughout the 1517-square kilometer (586–square mile) site, removes deep-rooted vegetation, maintains other vegetation controls on 1,840 hectares (4,600 acres), controls remaining areas of surface contamination, and maintains barricades of hazardous areas to meet safety criteria.

Long-term monitoring and surveillance of the Hanford Site is conducted to demonstrate compliance with

regulations, confirm adherence to environmental protection policies, support DOE decisions, and provide public information. The Surface Environmental Surveillance Project is a multimedia environmental monitoring effort to measure the concentration of radionuclides and chemicals in environmental media and assess the integrated effects of these materials on the environment and the public. The project collects samples of air, surface water, sediments, soil, natural vegetation, agricultural products, fish, and wildlife. In addition, the project measures ambient external radiation. The current surveillance project measures releases from DOE facilities, unplanned releases, and releases from non-DOE operations on and near the site. Surveillance results are reported annually in the Hanford Site Environmental Report and it is anticipated that this activity, with continual advancement in monitoring practices and techniques, will be the basis for long-term stewardship surveillance and monitoring activities at Hanford.

1.3 Regulatory Regime at Hanford

During the production era, the waste produced at Hanford was managed in a manner that complied with existing standards; however, throughout much of the history of plutonium production at Hanford, there were few laws regulating waste management and environmental protection. In the 1970s and 1980s, new environmental laws were enacted regulating waste management, storage, disposal, and pollution emissions to the air and water. Because of national security concerns, nuclear production facilities like Hanford were self-regulated. Under the provisions of the *Atomic Energy Act*, DOE was authorized to establish standards to protect health or minimize dangers to life or property for activities under DOE's jurisdiction. In the 1980's, much of DOE's authority to self-regulate facilities was eliminated, and other agencies became responsible for regulating many aspects of DOE's activities.

TRI-PARTY AGREEMENT

In 1989, DOE, the U.S. Environmental Protection Agency, and the Washington State Department of Ecology entered into the Tri-Party Agreement, a formal agreement to reach compliance for major waste streams managed at the Hanford Site. The agreement currently provides a schedule for site activities and focuses on backlog waste that must be addressed by the Waste Management program. As part of the Tri-Party Agreement process, milestones are continually renegotiated and new milestones added as the Hanford remediation project warrants. Tri-Party Agreement milestone completion rate is the measurement used by many stakeholders to assess DOE's remediation success.

The *Clean Air Act* originally was passed in 1970 and has been amended several times, including extensive amendments in 1977 and 1990. This law requires DOE to meet national air quality standards, ensure hazardous air emissions from existing and new sources are controlled to the extent practical, and obtain an operating permit for all major emission sources. The *Clean Water Act* and the *Safe Drinking Water Act* regulate discharges to surface water, set national drinking water standards, and regulate emissions of hazardous constituents to surface and groundwater.

In 1986, regulators from EPA, the Department of Ecology, and DOE's Richland Operations Office began to examine how best to bring Hanford into compliance with RCRA and CERCLA. The regulators and DOE agreed to develop one compliance agreement that set agreed-upon milestones for cleaning up past disposal sites under CERCLA and bringing operating facilities into compliance with RCRA. Negotiations concluded in late 1988, and the Tri-Party Agreement was signed by the three entities on January 15, 1989. The Tri-Party Agreement is the primary framework for CERCLA and RCRA regulation of Hanford, including the tank farms. Although RCRA provides no regulatory framework for the disposal of radioactive waste, the Tri-Party Agreement does govern the disposal of radioactive wastes, and DOE reports progress on these activities via the Tri-Party Agreement reporting procedures. The Tri-Party Agreement is a negotiated agreement, and all parties have agreed to extend its coverage beyond the normal CERCLA and RCRA regulatory boundaries. The Tri-Party Agreement governs by setting remediation and cleanup milestones that are legally enforceable, and DOE reports quarterly on the progress made toward these milestones.

In response to the continued accumulation of spent nuclear fuel, high-level radioactive waste, other hazardous waste, and growing public awareness and concern for public health and safety, Congress has passed numerous laws, including the *Nuclear Waste Policy Act of 1982,* as amended (NWPA). The purpose of these laws was to establish a national policy and programs that would provide reasonable assurance that the public and the environment would be adequately protected from the hazards posed by these wastes. The NWPA authorized Federal agencies to develop geologic repositories for disposing of high-level radioactive waste and spent nuclear fuel from commercial reactors. In 1987, Congress amended the Nuclear Waste Policy Act to focus potential geologic repository development activity at one site, the Yucca Mountain Site in Nevada. EPA is authorized to establish generally applicable standards for a repository at Yucca Mountain, while NRC is authorized to regulate and license, if justified, a repository at Yucca Mountain.

In addition to applicable laws and regulations, DOE has established a set of policies to guide DOE activities. In 1988, DOE issued DOE Order 5820.2A, which stated DOE's policy to process and dispose of high-level waste in a potential geologic repository. For planning purposes, DOE assumes that some or all of the defense high-level waste that satisfies the repository acceptance criteria could be placed in the first potential geologic repository developed under the NWPA. By law, the first repository is limited to a total capacity of 70,000 metric tons (77,000 tons) of spent nuclear fuel or high-level waste, or a quantity of solidified high-level waste resulting from the reprocessing of such a quantity of spent fuel prior to operating a second repository. The allocated capacity for defense high-level waste in the first repository is 7,000 metric tons (7,700 tons). DOE must ensure that the high-level waste and spent nuclear fuel at Hanford meet the waste acceptance criteria for the proposed repository at Yucca Mountain.

DOE has also developed the *Hanford Comprehensive Land Use Plan Environmental Impact Statement* (EIS) to facilitate decision-making about the site's uses and facilities for at least the next 50 years. The Record of Decision was signed and adopted DOE's preferred alternative that seeks to balance DOE's continuing land-use needs with the desire to preserve important ecological and cultural values of the site, and allow for economic development in the area. There are three primary elements to Hanford's Comprehensive Land Use Plan EIS:

- Land-use maps that depict the planned future uses for Hanford;
- Nine land-use designations that define the permissible uses for areas of the site; and
- Policies and procedures for planning and implementing the review and approval of future land uses.

1.4 Accomplishments and Commitments

Long-term stewardship activities are already being performed for significant portions of Hanford. Moving the bulk of remaining waste sites and facilities into long-term stewardship is a major long-term objective for the Hanford Site -- for it is indeed a measure of the success of remediating the site for alternative uses. There are many intermediate steps to this objective, not the least of which is remediating the site within technological and budgetary constraints and the regulatory environment within which the site functions. Considerable preparation is required even before decontamination and decommissioning can occur. Because of the complexity of the Hanford Site and the types of contamination and wastes, much of the effort through the late 1990s and through 2006 has been, and will continue to be, devoted to these remediation efforts as the initial stages of long-term resource management. In the long-term, Hanford activities will focus on removing facilities and contamination within the constraints mentioned above and, where not practical, will focus on stabilizing or managing the wastes in perpetuity until new treatment technologies can be developed and deployed. For example, the Central Plateau will be managed in perpetuity as a waste operations center, and the subsurface will be subject to continual surveillance and monitoring, with management methods updated to meet contemporary practices. In the 100 Area, access will be limited near entombed reactors until and potentially following final disposition.

It is important to note that not all waste sites or portions of the site will require long-term stewardship. There

are accomplishments at Hanford that do not meet the reporting criteria of this report. In some cases, waste sites and facilities can be decontaminated, decommissioned, demolished and/or removed to the point where no further "traditional" long-term stewardship activities will be required, such as surveillance and monitoring. This part of the report summarizes accomplishments at Hanford so that a proper perspective is placed on the cleanup activities at the site.

Several of the completed activities at the site are worth noting specifically. In 1998, final deactivation of the B Plant was completed. The project was completed four years ahead of schedule at $100 million savings over earlier cost estimates, thus avoiding tens of millions of dollars in maintenance costs. Planning for preservation of the B Reactor as a museum is underway. The C Reactor was placed in Interim Safe Storage, a condition requiring minimum expenditure of resources. The reactor will be maintained for up to 75 years until a final disposition for the reactors on the river is implemented. Twenty-three ancillary buildings were removed at the C Reactor along with contaminated waste, and a corrosion-resistant steel roof was installed over the reactor building. The most serious high heat waste tank issues have been resolved with pumping and sluicing work on Tanks SY-101 and C-106. The Waste Receiving and Processing Facility (WRAP) began operation as the final step at Hanford for recovering and preparing non-mixed transuranic waste for offsite burial at WIPP. Plans are for 55 cubic meters (72 cubic yards) of waste to be shipped from WRAP to WIPP in both 2000 and 2001, and the amount is expected to increase to approximately 375 cubic meters (490 cubic yards) for 2002. The first shipment was sent to WIPP in July 2000. Deactivation of the N Reactor was completed and included deactivation of 85 facilities and cleaning out the N Fuel Basin. This is a critical early step in the process of preparing the N Reactor Area for long-term stewardship activities.

In addition to activities in many of the historical production areas of the site, the Richland Operations Office made progress in transferring Hanford Site land to other land managers and opening new facilities for research and training. The 1100 Area was cleaned, released by regulators, and has been transferred to the Port of Benton for local economic development. The transfer included land, buildings, and railroad track and rolling stock. The North Slope and the ALE were cleaned of asbestos and chemical contamination and removed from the National Priorities List. Both are now managed by the U.S. Fish and Wildlife Service as part of the Hanford Reach National Monument. Completion of cleanup in these two areas made 50% of Hanford Site land available for other uses. The William R. Wiley Environmental Molecular Sciences Laboratory (EMSL) was opened to researchers in areas including atmospheric chemistry, health effects, bioremediation, geosciences, and computational modeling. EMSL is the newest national scientific user facility and an important resource for long-term economic and environmental management of Hanford. Another asset to Hanford that is a component of long-term resource planning is the HAMMER facility. HAMMER provides training and education to enhance skills and knowledge of workers and emergency responders.

The tables below identifies some of the additional accomplishments to date at the Hanford Site that reflect the progression toward eventual long-term stewardship of the site and the progress that is anticipated by 2006. These tables are not inclusive but highlight the diverse nature of the challenges and progress at Hanford.

Hanford Site Progress to Date	
Accomplishment	***Date***
Hanford Tank Waste Retrieval and Treatment	
• Installed upgraded tank ventilation system for tank farms	1998
• Completed Cross-Site Transfer Line replacement to move waste from 200W to 200E, critical in the staging process for the vitrification plant	1998
• Complete 30% of preparation for construction of vitrification plant	2000
• Complete characterization of all tanks	1999
K Basins – Removal and Onsite Storage of Spent Nuclear Fuel	
• Completed installation of the Integrated Water Treatment System at K West Basin	1999
• Completed installation of the Fuel Retrieval System at K West Basin	1999
• Completed the Cold Vacuum Drying Facility	1999
• Completed the Canister Storage Building	2000
Groundwater/ Vadose Zone Integration Project	
• Pump and Treat facilities processed three billion liters (792 million gallons) of groundwater	1999
• Decommissioned 28 nonessential monitoring wells	1998
• Restarted Vapor Extraction at 200-ZP-2, removed over 2,220+ kilograms (4900+ pounds) of carbon tetrachloride	1999
Environmental Restoration and Storage and Disposal Facility (ERDF)	
• Excavated more than 1,800,000 metric tons (two billion tons) of contaminated soil/waste material from near Columbia River (100B/C, 100D, 300 Areas) and disposed in ERDF	1999
• Expanded ERDF with construction of cells 3 and 4 - ready to accept waste	1999
Decontamination and Decommissioning (D&D) and Transition of Facilities	
• Reduced footprint of DR and F Reactors by 40% in preparation for interim safe storage of reactors	1999
• Started D&D of Plutonium Concentration Facility (233-S)	1998
• Closed four, 100 Area electrical substations	1998
• Closed WWII-era coal- and oil-fired steam plants in 200 and 300 Areas	1998
• 700 square meters (7500 sq. ft.) of laboratory space was leased to the Tri-Cities branch of the Washington State University	1998
Waste Management and Disposal	
• Cleaned up 85 waste sites to either "release" or long-term stewardship status	1999
Anticipated Accomplishments for Hanford Site by 2006	
Hanford Tank Waste Retrieval and Treatment	
• Start tank waste immobilization	2002
• Complete interim stabilization of single shell tanks	2003
• Start waste removal on 10 single-shelled tanks	2006
K Basins – Removal and Onsite Storage of Spent Nuclear Fuel	
• Initiate K West Basin spent nuclear fuels removal2000	
• Complete removal of all K East Basin spent nuclear fuel	2004
• Initiate full scale K East Basin sludge removal	2002
• Complete sludge removal from K Basins	2004
Environmental Restoration and Storage Facility (ERDF)	
• Dispose of 2.5 million cubic meters (3.3 million cubic yards) of soil in ERDF	2006
D&D and Transition of Facilities (Major Challenges)	
• Complete deactivation of SP-100 GES Test Facility, Bldg. 309	2002
• Complete deactivation of Post Irradiation Test Lab., Bldg. 327 (326 buckets TRU removed by 1998)	2004
• Complete deactivation of Chemical Engineering Lab., Bldg. 324 (750,00 curies of cesium-137 removed by 1998)	2004
• Begin plutonium stabilization at the Plutonium Finishing Plant (PFP)	2000
• Complete stabilization at Plutonium Finishing Plant	2002
• Complete D&D of Reactors on the River Facilities for 76 of ~178 facilities	2006
• Complete deactivation of 24 of 34 facilities in 300 Area	2006
• Complete decommissioning and conversion to alternate use for 73 buildings in 300 Area	2006
Waste Management and Disposal	
• Remove spent nuclear fuel from T Plant Canyon	2001
• Complete cleanup of 450 waste sites in 100-200-300-1100 Areas	2006
• Ship 25% of transuranic waste to Waste Isolation Pilot Plant or dispose onsite	2006

2.0 Site-Wide Long-Term Stewardship

Long term site management processes are being evaluated at Hanford that will address, in an integrated way, issues of reductions in site operations infrastructure, residual hazards after remediation, requirements for protection of site natural and cultural resources, the need to attract new missions for economic stability, and increased access to the site by the public. Hanford calls its long-term site management processes "Long-Term Resource Management" (LTRM). LTRM incorporates long-term stewardship activities described in this report.

A key aspect of the Hanford long-term site management approach is time. Current planning, environmental, safety, and land use documents define stewardship and resource management activities under current missions and with current knowledge of site hazards. However, the long-term role of the Hanford Site is uncertain, site knowledge is incomplete, and different environmental conditions could exist in the future. Long-term site management at Hanford seeks to balance these uncertainties by enabling the best use of the site at the present time without an irrevocable use of resources that could preclude future flexibility to respond to change.

Discussion of long-term site management processes and activities is in its infancy at Hanford. A specific description of each portion of Hanford that will require long-term stewardship by 2006 is introduced in this section and detailed in Section 3.0. However, because of the focus of this report on long-term stewardship activities by 2006, it presents an incomplete picture of the eventual cost and responsibilities of long-term site management. For example, the cost estimate of $287,000 per year for the next few years is about 0.1% of the eventual stewardship cost at the end of the remediation program. Also, the portions of the site described in this report include only a fraction of the residual hazard. Future expansions of long-term stewardship activities will include management of closed waste disposal sites, entombed reactors, high-level waste tanks, spent nuclear fuel, surplus plutonium, additional environmental restoration sites, ongoing effluent treatment facilities, and waste storage facilities.

The remainder of this section must also be considered from the long-term perspective in that the activities discussed are focused on specific facilities and locations. From a site-level perspective, Hanford's approach is to incorporate a strong connection between long-term site management and science and technology. This connection will be part of how the site will manage cost, accomplish the three major objectives, and respond to change.

2.1 Long-Term Stewardship Activities

DOE is expected to act as the steward in perpetuity for all areas of the site retained by the Federal government. The site will restrict access to areas used for radioactive waste disposal, including buffer zones, for as long as necessary to ensure protection. Remote sensory technologies will be implemented to minimize entries into hazardous facilities. The site will maintain contaminated soil sites by controlling vegetation growth and removing contaminated vegetation and will conduct routine surveys and monitoring to ensure that areas remain properly vegetated. The Effluent and Environmental Monitoring Program will continue to monitor air and liquid effluent and surface contamination, and the Landlord Project will be responsible for maintaining and upgrading the necessary site infrastructure. Semi-annual monitoring of groundwater will continue for at least 30 years after closure of the last facilities. Major facility repairs will be conducted every five years and roofs will be replaced every 20 years. The site will determine institutional controls and surveillance and maintenance requirements for specific areas as remediation is completed and waste sites are certified as complete under either CERCLA or RCRA. An Institutional Control Plan will be developed (as required by EPA policy) to ensure the effectiveness and reliability of institutional controls. The Institutional Control Plan can include: development and approval of site-specific Institutional Control Plans (normally written after a Record of Decision requires one or more land use controls); identification of the program and point-of-contact responsible for monitoring, maintaining and enforcing Institutional Control Plans; provisions for funding land use controls in budget allocation requests;

quarterly onsite monitoring for compliance with Institutional Control Plans; and 60-day notifications to EPA and State regulators before "major changes in land use" are approved.

A specific description of each portion of Hanford that will require long-term stewardship in 2006 is provided in Section 3.0. The description of each portion includes a summary of the cleanup and accomplishments that will occur in that portion and the resulting long-term stewardship activities that will be required to protect human health and the environment. It should be noted that, although these portions represent significant accomplishments in remediation and will transition to long-term stewardship by DOE, they do not encompass all long-term stewardship activities that will be required at Hanford. Some of the most challenging remediation tasks will not be completed until beyond the 2006 timeframe specified for this report but will ultimately require long-term stewardship. The major Hanford site remediation projects that will be ongoing beyond 2006, but are likely to require long-term stewardship, include the following:

- Cocoon or Otherwise Disposition B, C, D, DR, F, H, KE, KW and N Reactor Blocks
- Remediate Waste in 149 Single-Shell High-Level Waste Tanks
- Retrieve and Immobilize Waste in 28 Double-Shell High-Level Waste Tanks
- Clean up K-Basins and Retrieve and Package for Storage Associated Spent Nuclear Fuel
- Stabilize Fuel and Disposition Plutonium Finishing Plant
- Complete Remaining Environmental Restoration
- Clean Out and D&D Plutonium Uranium Extraction (PUREX)facility/Uranium Trioxide Plant Disposal Facility Cells
- Manage and Disposition Other Spent Nuclear Fuel in Storage
- Manage and Close Low-Level Waste Burial Grounds
- Operate, Close and D&D 200 Area Effluent Treatment Facility
- Operate and Close Commercial Low-Level Waste Landfill
- Operate, Close and D&D Solid Waste Retrieval Complex
- Operate, Close and D&D Enhanced Radioactive and Mixed Waste Storage Facility
- Operate, Close and D&D Central Waste Support Complex
- Operate and Close Naval Reactor Disposal Trench
- Remediate 618/10&11 Burial Grounds
- Monitor and/or Treat Groundwater

Institutional controls for the site will vary depending on the area. For reactors in the river geographic area, (Portions 100B/C, 100D, 100F, 100H, 100K, 100N, and 100 Other) institutional controls will be implemented to protect ecological, cultural, and Native American resources. For facilities in interim safe storage, the site will conduct repairs as needed to maintain facilities in a safe condition pending final decontamination and decommissioning. Interim surveillance and maintenance will be required for at least 75 years while reactors are awaiting final disposition. During this interim phase, the reactor doors will be welded shut. Every five years, the doors will be opened, and personnel will check the stability of the building, the roof, conduct a radiological survey, and then re-weld the doors.

For the Central Plateau geographic area (Portions Environmental Restoration Disposal Facility, 100 Other, 200 North), the site will restrict access to radioactive waste disposal areas and buffer zones through the use of signs and fences for as long as necessary to ensure protection. Capped soil areas within the fence line will require periodic long-term surveillance and maintenance.

The tank farms, closed burial grounds, Mixed Low-Level Waste (MLLW) trenches, and the Environmental Restoration Disposal Facility will require CERCLA post-closure inspection and monitoring for a minimum of 30 years. The site anticipates the use of deed restrictions, fences, active surveillance, and other entry control and will monitor the high-level waste canisters and spent nuclear fuel stored in the Canister Storage Building in

accordance with DOE requirements pending ultimate disposition in offsite facilities. Plutonium and other special nuclear material stored in the Plutonium Finishing Plant will also require active long-term stewardship activities pending final disposition.

No institutional controls are required for the Wahluke Slope or ALE. Public access is limited by the U.S. Fish and Wildlife Service for protection of sensitive areas and species under the National Monument designation. For the remainder of Hanford, areas not cleaned to unrestricted use will likely use a full spectrum of institutional controls. These could include entry control, signs and fences, active long-term surveillance, and deed restrictions. For land released for use to governmental agencies, institutional controls are further coordinated through their administrative methods. An example of this is the conservation plans used by the U.S. Department of Fish and Wildlife Service.

STAKEHOLDER INVOLVEMENT

Public participation is open, ongoing, two-way communication (both formal and informal) between DOE-RL and its stakeholders, the regulators, and Tribal governments, as required by various laws and regulations governing Hanford cleanup (CERCLA Secs. 117 and 113(k), the National Contingency Plan, EPA guidance on public participation and administrative records, and the public participation requirements of RCRA and Ch. 70.105 RCW); and the Hanford Federal Facility Agreement and Consent Order (TPA); and shall be implemented to meet the public participation requirements applicable to RCRA permits under 40 CFR Part 124 and RCRA Sec. 7004.

Tribal Governments have a unique government-to-government relationship with the United States government, as set forth in the Constitution of the United States, treaties, statutes, and court decisions. Therefore, rather than seeking tribal participation through public forums, DOE-RL consults directly with Tribal Governments prior to taking the actions that may affect their rights and interests, as outlined in the DOE American Indian Policy.

The public involvement process for implementing the Comprehensive Land-Use Plan includes input from the site Planning Advisory Board, which consists of representatives from Tribal Governments; U.S. Bureau of Land Management; U.S. Bureau of Reclamation; U.S. Fish and Wildlife Service; Benton, Franklin, Grant, and Adams Counties; and the City of Richland.

Public involvement regarding the Hanford Site includes: seeking and considering public input; informing the public in an understandable and timely manner of key decisions, progress of activities, emerging technologies, and opportunities for economic diversity; clearly defining access points for public involvement; and consistently incorporating public participation processes into program operations, planning activities, and decision-making processes. DOE-RL managers and contractors operate as an integrated team in planning local and regional public participation programs by combining resources, sharing information, and coordinating activities. Activities are coordinated between contractors to minimize costs and provide the most effective public participation program. DOE-RL managers work with Headquarters' (DOE-HQ) counterparts and the OEA to ensure appropriate DOE-HQ and field coordination.

Record-Keeping

There are currently no requirements or standardized practices that specifically address the management of information to be used in support of long-term stewardship activities. However, each party to the Tri-Party Agreement (TPA) is required to preserve for a minimum of ten (10) years after termination of the TPA all of the records in its or its contractors possession related to sampling, analysis, investigations, and monitoring conducted in accordance with the TPA. DOE is required to maintain information on waste sites that are not clean-closed under CERCLA and RCRA. The current administrative record for the waste sites is held at Bechtel Hanford, Inc. (BHI) in the form of three databases: the Hanford Environmental Information System (HEIS), Waste Information Data System (WIDS), and the Geographic Information System (GIS). The BHI document control

system "Docs Open" maintains the administrative record for documents. As required by the Surface Environmental Surveillance Project, sample data (including historical data from Hanford Engineer Works operations) is stored in the HEIS database, and chain-of-custody forms and other sample collection documentation are stored in the Federal Records Center in Seattle. Long-term stewardship records will likely be maintained in similar databases and records retention facilities, and remediation project records will likely be managed per the requirements of the land-owning agency.

2.2 Assumptions and Uncertainties

DOE assumes the following in planning its long-term stewardship activities for the Hanford Site:

- Hanford will implement long-term stewardship activities as part of the broader long-term site management process that includes natural resource management and completion of new site missions.
- Products of Science and technology activities at Hanford, over time, will contribute to cost-effective and safe management of the site.
- DOE, as a Federal agency, has a Trust responsibility to protect Tribal interests.
- DOE has a responsibility to consult with and recognize the interests of the cooperating agencies. DOE intends to consult with the U.S. Fish and Wildlife Service, as required by documents supporting the creation of the Hanford Reach National Monument. DOE has a role as co-manager with the U.S. Fish and Wildlife Service for the Hanford Reach National Monument per the President's memorandum to the Secretary of Energy that accompanied the Monument designation in June 2000.
- DOE will support economic transition and potential industrial development by the City of Richland or the Port of Benton by encouraging the use of existing utility infrastructure on the Hanford Site.
- Other entities will ask for Hanford's resources and lands.
- The public will continue to support protection of cultural and natural resources on the site, especially within the National Monument.
- Mining of onsite geologic materials will be needed to construct surface barriers and support site infrastructure, as required by Hanford Site remediation activities and ongoing missions.
- Remediation of the site will continue, and, where necessary, the institutional controls currently in place will continue to be required at some level for at least the next 50 years. Institutional controls are transferable and can be shared with other governmental agencies.
- Plutonium production reactor blocks will remain in the 100 Area throughout the 50-year planning period and will be considered a pre-existing, nonconforming use.
- Vadose zone contamination will persist in the All Other Areas, Central Plateau, and 100 Area. Contaminated groundwater will remain unremediated in the All Other Areas, Central Plateau, and 100 Area.
- The public will support preservation of the Manhattan Project's historical legacy and creation of a B Reactor Museum.
- The public will support access to the Columbia River for recreational activities and public restrictions consistent with the protection of cultural and biological resources.
- Areas will be set aside specifically for R&D projects.
- Sufficient area will be retained to support current and expected DOE facility safety requirements.
- An adequate land base and utility infrastructure will be maintained to support possible industrial development associated with future DOE missions.

2.3 Estimated Site-Wide Long-Term Stewardship Costs

Estimated costs for long-term stewardship of the Hanford Site are identified in the table below. The costs for the years FY 2000 through FY 2045 consist of long-term surveillance and maintenance costs from Project Baseline Summary ER-07 and TW-04 (revised from, but as discussed in the 1998 *Accelerating Cleanup: Paths*

to Closure). The costs for the years FY 2046 through FY 2070 represent a best estimate of all long-term stewardship costs; are based on an independent, rough order-of-magnitude estimate; and include post-closure surveillance and monitoring, site and environmental monitoring, and infrastructure support.

There is a significant difference in costs between 2045 and subsequent years. Prior to 2046, infrastructure and other apportioned costs are absorbed by ongoing activities. For example, roads are needed to transport wastes. No attempt has been made to pro-rate costs such as infrastructure or management costs to long-term stewardship activities at this time. For example, the portion of roads needed to serve portions of the site that are currently in long-term stewardship has not been included. In the future, as cleanup decisions are made and details on the level of institutional and engineering controls, information management requirements, etc., are known, refinement of these costs will occur.

The costs include the portions discussed in this report, as well as long-term stewardship costs associated with remediation projects listed in Section 2.1 of this report.

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	***Amount***	***Year(s)***	***Amount***	***Year(s)***	***Amount***
FY 2000	$47,000	**FY 2008**	$66,000	**FY 2036-2040**	$5,328,500
FY 2001	$48,000	**FY 2009**	$68,000	**FY 2041-2045**	$5,672,500
FY 2002	$50,000	**FY 2010**	$70,000	**FY 2046-2050**	$183,579,900
FY 2003	$58,000	**FY 2011-2015**	$519,000	**FY 2051-2055**	$201,000,000
FY 2004	$60,000	**FY 2016-2020**	$687,000	**FY 2056-2060**	$199,000,000
FY 2005	$61,000	**FY 2021-2025**	$1,201,000	**FY 2061-2065**	$199,000,000
FY 2006	$62,000	**FY 2026-2030**	$1,524,000	**FY 2066-2070**	$198,000,000
FY 2007	$64,000	**FY 2031-2035**	$2,122,000		

3.0 PORTION OVERVIEW

The remaining sections of this report discuss "portions" of the Hanford Site that will require long-term stewardship by 2006. For purposes of this report, a "portion" is defined as a geographically contiguous and distinct area (which may involve residually contaminated facilities, engineered units, soil, groundwater, and/or surface water/sediment) for which cleanup, disposal, or stabilization will have been completed and long-term stewardship will be required as of 2006. Hanford's historic groupings have been subdivided to allow for a more accurate discussion on the geographic location of long-term stewardship activities at the site as of 2006. Some geographic areas located on Hanford are not represented as portions since long-term stewardship will not be required for those areas, or because remediation activities will not be complete, or stabilization will not occur by 2006. The fifteen portions of Hanford that will require some long-term stewardship activities as of 2006 are listed below and are shown on the following table. All of the portions contain significant numbers of waste sites that will require long-term stewardship activities by 2006. However, there will still be contaminated waste sites and facilities in many of these portions beyond 2006 as described in the subsequent sections. The units covered in this report, and included in the following table, are only those within each geographic area that meet the elements of the data call. In only a few cases (1100 Area, Arid Land Ecology Reserve, North Slope, and Riverland) will the entire portion be in long-term stewardship.

Long-Term Stewardship Information	
Portion	***Long-Term Stewardship Start Year***
100B/C Area	Current – C Reactor 2007 – other waste sites included for data call**
100D Area	2007 – waste sites included for data call**
100F Area	2003 – F Reactor 2007 – other waste sites included for data call**
100H Area	2007 – waste sites included for data call**
100K Area	2007 – waste sites included for data call**
100N Area	2007 – waste sites included for data call**
100 Other Areas	2007 – waste sites included for data call**
200 North Area	2007 – waste sites included for data call**
200-PO-1 Operable Unit	2007 – waste sites included for data call**
300 Area	2000 – groundwater 2001 – waste sites included for data call**
1100 Area	Current
Arid Land Ecology	Current
Environmental Restoration Disposal Facility	2000 – interim cover 2007 – final cover
North Slope	Current
Riverland Portion	Current

** There will be contaminated sites remaining in this Area beyond 2006, therefore, not all of the portion will be in Long-Term Stewardship by the start date provided in the table.

3.1 100B/C Area

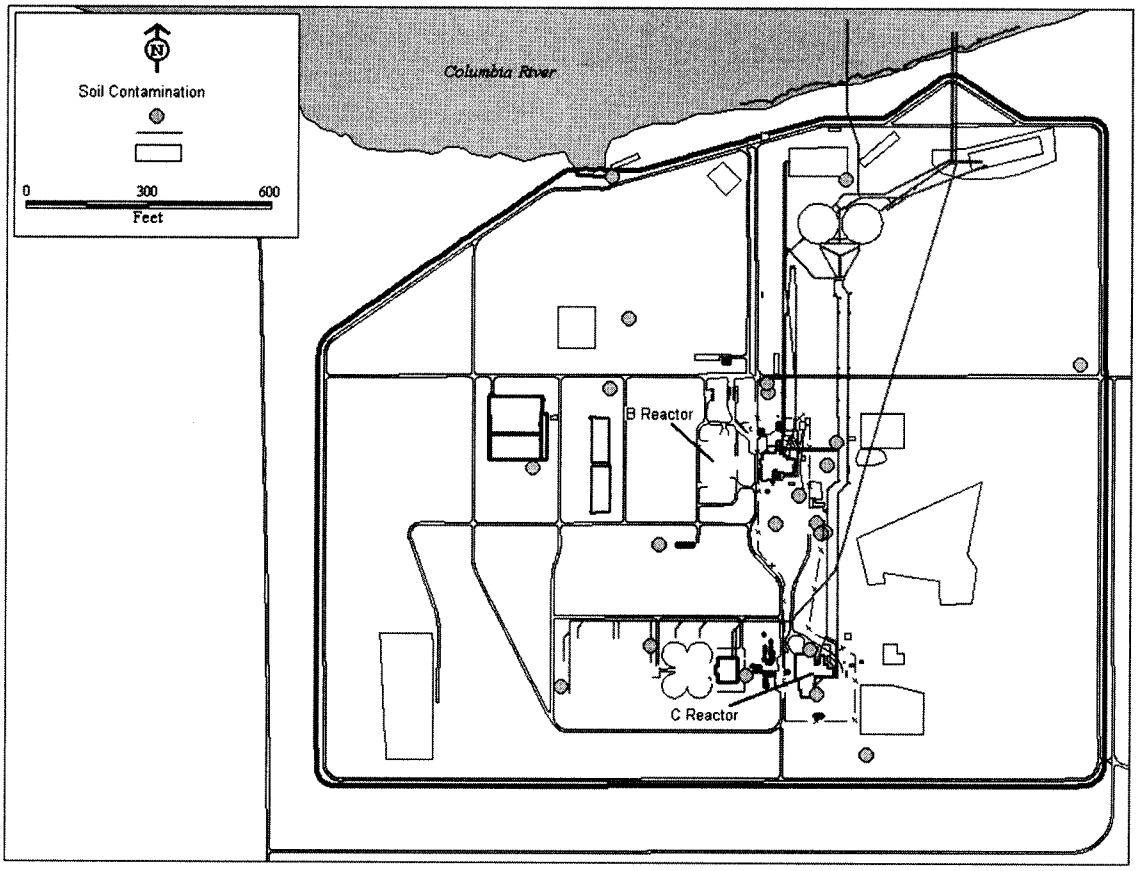
The 100B/C Area portion consists of 249 hectares (616 acres), is located immediately adjacent to the Columbia River, and includes the B and C Reactors. The 100B/C Area was the first reactor area to be developed for Hanford. Construction of the B Reactor began in 1942 and the reactor operated from 1944 to 1968. Construction of the C Reactor began in 1951 and the reactor operated from 1952 to 1969.

100B/C AREA PORTION HIGHLIGHTS

Major Long-Term Stewardship Activities - maintain the C Reactor in interim safe storage, institutional controls
Portion Size - 249 hectares (616 acres)
Estimated Volume of Residual Contaminants - soil - to be determined, facilities - 3 facilities
Long-Term Stewardship Start-End Years - current-in perpetuity

The B Reactor is being developed as a museum. There are some issues (such as plumbing and some contamination) that need to be dealt with before the B Reactor is in its long-term, stable state. The B Reactor will be maintained, presumably in perpetuity, as a historic site. Long-term stewardship costs for B Reactor and the non-reactor areas are unknown.

The C Reactor is currently in long-term stewardship and is expected to remain so for up to 75 years. The end of the long-term stewardship period will occur when the decision is made to move the reactor to the interior plateau.



100B/C Area

Institutional controls for the reactors will be extensive. Because the area will still have contaminated sites in 2006, standard site institutional controls (e.g., badging program, excavation permits, signage, notification of trespass, annual evaluation of institutional controls) will govern the remaining contaminated areas and probably most of the portion. The institutional controls on the C Reactor Safe Storage facility will include a five-year internal area surveillance to verify facility status. This frequency may be adjusted later based on inspection history. An external visual inspection of the roof will be conducted annually. For sites with contamination remaining below 4.6 meters (15 feet) depth, deed restrictions and covenants may need to be filed. Not all sites have been completely characterized (surrogate sites were used to develop cleanup strategies), so the sites that will need such institutional controls will be determined at the time of cleanup. Also, restrictions on certain activities may be required at some locations to prevent the spreading of contaminants. The Remedial Action Objectives and cleanup standards will be re-evaluated as part of the final remedy for the operable unit(s) contained in the 100B/C Area as part of the CERCLA five-year review. Future land use and groundwater use determinations will be evaluated per the Hanford Comprehensive Land Use Plan EIS and must be consistent with the selected remedy. As stated in the Record of Decision for 100 Area Remaining Sites:

> "Because the remedy may result in hazardous substances remaining onsite above levels that allow for unlimited use, a review will be conducted to ensure that the remedy continues to provide adequate protection of human health and the environment within five years after the commencement of the remedial action. This is an Interim Action Record of Decision; therefore, review of this site and remedy will be ongoing as the Tri-Parties continue to develop final remedial measures for the 100 Area National

Priorities List site."

When the B Reactor museum becomes a reality, additional institutional controls (e.g., fences, barricades, and signs) may be required for museum visitors.

The C Reactor is designed to be a minimal maintenance facility. Barriers and postings are used to prevent unwarranted access. No locked fence is necessary around the C Reactor because the structure walls are 1- to 1.5-meters (3 to 5-feet) thick and the metal access doors are spot-welded shut. The C Reactor structure is designed to remain in safe storage for up to 75 years and the reactor has temperature and flood sensors that are remotely monitored. Surveillance and maintenance activities include structural integrity checks, barriers and posting, radiological surveys, repair of confinement systems and structural components, and removal of hazardous substances.

3.1.1 Soil

There are 81 soil waste sites in the 100B/C portion, covering 58.8 hectares (143 acres). Fifty-nine of these will require long-term stewardship activities by 2006, including 13 burial/dump sites, 28 liquid effluent-related sites (ponds, basins, pipelines, french drains, cribs), two burn pits, 11 septic sites, and five chemical storage tanks. The 100B/C Area is the area associated with operations of the B and C Reactors, which had historic missions of special nuclear material production. Contamination resulted from uncontained releases (either by design or unplanned) of radioactive materials and hazardous chemicals. Typical contamination sources were: 1) water treatment chemicals required to clean the river water prior to its use as a reactor coolant; 2) cooling water discharged from the reactor, which was contaminated with radionuclides; 3) Fuel Storage Basin water and sludge from contamination by leaky irradiated reactor fuel; 4) chemicals used to decontaminate other materials and equipment; 5) septic system waste; and 6)disposal of paints and solvents.

The strategy of removing contaminated soil to a depth of 4.6 meters (15 feet), with site-specific determinations made for contamination remaining below 4.6 meters (15 feet), will remove most contamination. The amount of contamination remaining deeper than 4.6-meters (15 feet) is unknown. In many cases, site characterization activities will not be completed until soil removal is initiated. Residual constituents would include mixed fission products from reactor operations, hazardous chemicals common to older reactor operations (e.g., lead, cadmium, and mercury), and hazardous materials used in water treatment (chromium). Antimony contamination is also of potential concern at 100B/C.

3.1.2 Facilities

There are 13 facility waste sites totaling 9,820 square meters (106,000 square feet) in the 100B/C portion. Three of these waste sites will require long-term stewardship activities by 2006, including two reactors (B and C) and one reactor exhaust stack from the B Reactor. The Surplus Production Reactor EIS concluded that all Hanford reactors need to be removed from their near-river locations. However, it was decided to temporarily (~50-75 years) continue surveillance and maintenance to allow further radiological decay. Current plans include leaving the B Reactor in place as a signature building in response to the goals of the Natural Historic Preservation Act. This temporary storage is not expected to result in increased environmental or health risks, but permits radiological decay of energetic gamma emitters to reduce worker and environmental risks.

The stabilized B and C Reactors will contain tritium, carbon-14, chlorine-36, calcium-41, nickel-59, cobalt-60, and lead. The mercury, polychlorinated biphenyls (PCBs), and oil in the C Reactor facility were removed prior to long-term stewardship status. If any hazardous materials other than the lead in the reactor block are encountered during long-term stewardship, they will be removed. Any residual radioactive contamination in the B Reactor or B Stack will be contained to prevent exposures of the public visiting the museum.

The 100B/C facilities have two diverse end states. The B Reactor was entered in the National Register of Historic Places on April 3, 1992, by the National Park Service, has been designated a National Historic Mechanical Engineering Landmark and a National Civil Engineering Landmark, and has received a Nuclear Historic Landmark Award. Because of this, DOE must comply with the National Historic Preservation Act (16 U.S.C. 470) prior to taking any action on the historic site. A report, entitled *105-B Reactor Facility Museum Phase I Feasibility Study Report*, concluded that the use of the facility as a museum is feasible and conversion is ongoing. The primary mission of the B Reactor Museum Association (BRMA) is the long-term preservation of the retired B Reactor and the upgrading of the structure to allow public access and unrestricted tours.

The C Reactor is currently in an interim storage state and is subjected to long-term surveillance and maintenance. The reactor block will sit for more than 50 years, when it will be removed to the 200 Area. All nearby associated facilities that lie outside of the shield walls that surround the reactor were removed (e.g., fuel storage basins and pump houses). A new roof was placed over the remaining structure using the existing shield walls as the "new" outside walls. All existing penetrations in the shield walls and any new penetrations that resulted from removal operations were closed to prevent animal intrusion and water leakage. A single access door was provided to allow periodic inspection of the facility. Prior to removal of the actual reactor block, a restricted area will be fenced around the facility. Other areas in the reactor vicinity are expected to be light, recreational surface use areas.

3.2 100D Area

The 100D Area portion consists of 285 hectares (704 acres), is located adjacent to the Columbia River, and includes two reactors located in the 100D Area– the D Reactor and the DR Reactor. The D Reactor operated from 1944 to 1967 and the DR Reactor operated from 1950 to 1964. The DR Reactor is located immediately adjacent to the Columbia River where the river flows to the northeast.

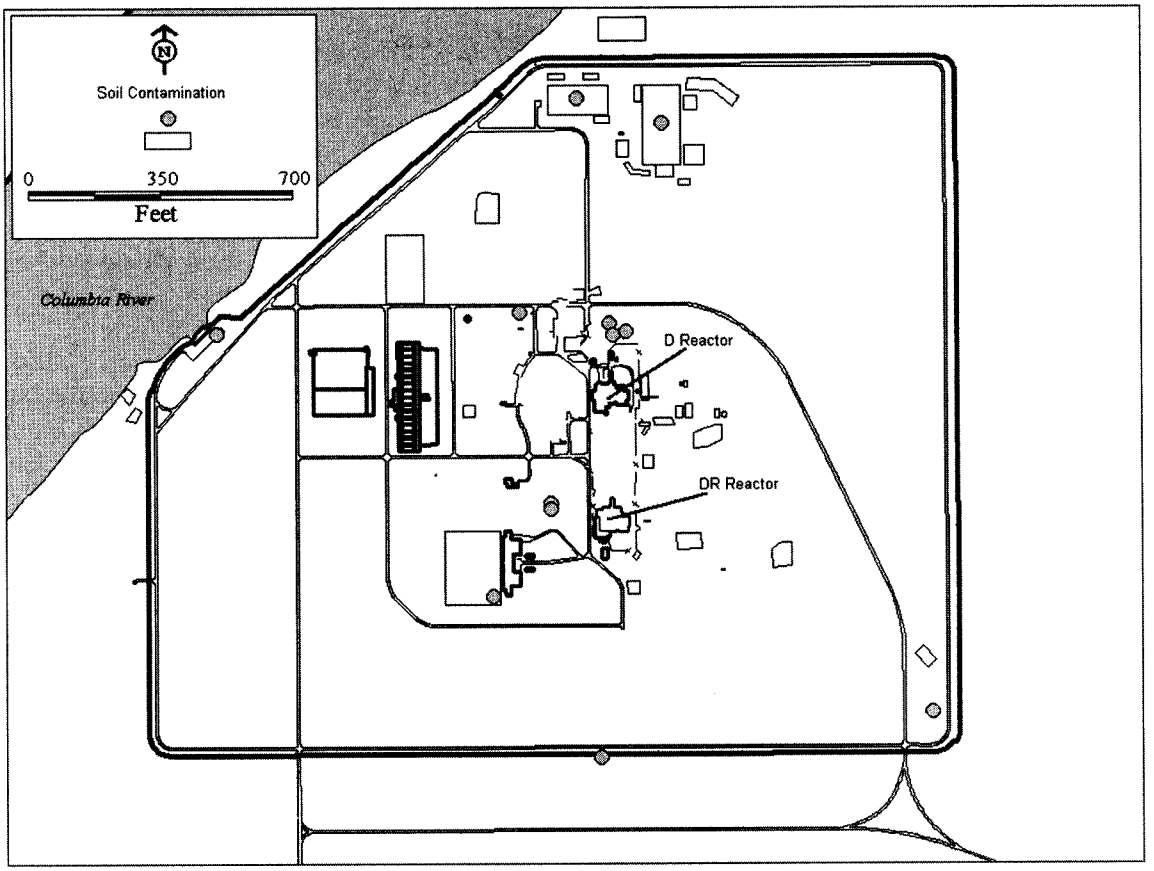
The DR Reactor will be stabilized in accordance with the interim action Record of Decision by 2007.

100D AREA PORTION HIGHLIGHTS

Major Long-Term Stewardship Activities - maintain reactors in interim safe storage until final disposition, institutional controls
Portion Size - 285 hectares (704 acres)
Estimated Volume of Residual Contaminants - to be determined
Long-Term Stewardship Start -End Years for Portion - 2007- in perpetuity

Because DOE plans to remove the contaminated soil in the 4.6 meters (15 feet) below grade from the site, long-term stewardship activities will be limited to confirming that all significant contamination has been removed and revegetation efforts have been successful. Some waste may remain deeper than 4.6 meters (15-feet) below grade. For these sites, long-term stewardship consists of ensuring that the residual contamination will not harm humans or the environment in the future. For the DR Reactor, the cost estimate is not fully developed and costs assume no major maintenance actions will be required. Due to the scattered nature of these waste sites among sites that will be remediated in the future, long-term stewardship is expected to encompass the entire 100D area. Long-term term stewardship would decrease over time as sampling needs for specific sites are eliminated.

Institutional controls for the reactors will be extensive. Because the area will still have contaminated sites in 2006, standard site institutional controls (e.g., badging program, excavation permits, signage, notification of trespass, annual evaluation of institutional controls) will govern the remaining contaminated areas and probably most of the portion. Not all waste sites have been completely characterized (surrogate sites were used to develop cleanup strategies), so the sites that will need institutional controls will be determined at the time of cleanup. Also, restrictions on certain activities may be required at some locations to prevent spreading of contaminants. The Remedial Action Objectives and cleanup standards will be re-evaluated as part of the final remedy for the operable unit(s) contained in the 100D Area as part of the CERCLA five-year review. Future land use and



100D Area

groundwater use determinations will be evaluated per the Hanford Comprehensive Land-Use Plan EIS and must be consistent with the selected remedy.

The DR Reactor engineered controls will be the same as those currently in place for the C Reactor. The reactor storage facility will be designed to be a minimal maintenance facility. Barriers and postings will be used to prevent unwarranted access. No locked fence will be necessary around the DR Reactor because the structure walls are 1- to 1.5-meters (3 to 5-feet) thick and the metal access doors will be spot-welded shut. The DR Reactor structure will be designed to remain in safe storage for up to 75 years, and the reactor will have temperature and flood sensors that are remotely monitored. Surveillance and maintenance activities will include structural integrity checks, barriers and postings, radiological surveys, repair of confinement systems and structural components, and removal of hazardous substances. The 100D soil sites will be cleaned to a 4.6-meter (15-foot) depth and will have intrusion controls with deed restrictions and requirements for drilling permits.

3.2.1 Soil

There are 97 soil waste sites in the 100D portion, covering 11 hectares (26 acres). Fifty-three of these will require long-term stewardship activities by 2006 and include 14 burial grounds, 29 liquid or sludge discharge sites (cribs, trenches, ponds, basins, unplanned releases), nine septic systems and storage tanks, and one pumping/flushing station. The 53 sites are those known or likely locations of sites with soil contamination resulting from uncontained releases (either by design or unplanned) of radioactive materials and hazardous

chemicals. The actual volume of contamination below the 4.6-meter (15-foot) remediation depth is unknown. In many cases, site characterization activities will not be completed until soil removal is initiated. Contaminants consist of mixed fission products from reactor operations, hazardous chemicals common to older reactor operations (lead cadmium, and mercury), and hazardous materials used in water treatment and older buildings (chromium and asbestos). Also included are chemicals commonly used in decontamination (e.g., sodium oxalate). Because the 100D Area is a production reactor area, all contamination results from reactor operations. Typical contamination sources were: 1) water treatment chemicals required to clean the river water prior to its use as a reactor coolant; 2)cooling water discharged from the reactor, which was contaminated with radionuclides; 3) Fuel Storage Basin water and sludge from contamination by leaky irradiated reactor fuel; 4) chemicals used to decontaminate other materials and equipment; 5) septic system waste; and 6) disposal of paints and solvents.

The close proximity of the sites to the Columbia River argues for removal of the waste to the interior of the Hanford Site in order to reduce the risk from human intrusion. None of the sites designated in the Proposed Plan for the 100 Area Burial Grounds Interim Remedial Action are located below the high water table, and, therefore, spread of the contamination via groundwater should not occur in the short term. In the 100 Area Burial Grounds Focused Feasibility Study, DOE proposed a "retrieve, treat, and dispose" remediation strategy. This would effectively remove all waste, moving it to the 200 Area Environmental Restoration Disposal Facility site or other appropriate disposal site. Any residuals would be left if found deeper than the remediation depth of 4.6 meters (15 feet) below ground surface. A Record of Decision for interim remedial actions was published in 1995 and updated in 1997 (to add additional similar sites) for a number of 100 Area liquid disposal sites.

The end use for the Columbia River corridor, as specified in the Hanford Comprehensive Land-Use Plan EIS preferred alternative, is unrestricted use of surface areas. A buffer zone around reactor areas would be maintained until the reactors are moved. Plans include a "visitor services" area near the D/DR Reactor site along a proposed recreational trail. Intrusion and activities that result in liquid effluent disposal would not be permitted.

3.2.2 Facilities

There are 14 facility waste sites, totaling 3,730 square meters (40,200 square feet), in the 100D portion. By 2007, both the D Reactor and the DR Reactor will require long-term stewardship. The Surplus Reactor EIS concluded that all Hanford reactors need to be removed from their near-river locations. However, it was decided to temporarily (~50-75 years) continue surveillance and maintenance to allow for further radiological decay. This temporary storage is not expected to result in increased environmental or health risks, but permits radiological decay of energetic gamma emitters to reduce worker and environmental risks.

The DR Reactor block contains the primary constituents of concern, namely, the long-lived radionuclides (carbon-14, chlorine-36, technetium-99, and uranium-238) and relatively short-lived radionuclides (cobalt-60, cesium-137, strontium-90, nickel-63, tritium, and europium-152 and -154). Lead and cadmium are the hazardous chemicals of most concern. Also of concern are chromium, mercury, PCBs and asbestos. The reactor block will sit for more than 50 years, when it will be removed to the 200 Area. Essentially all structures that lie outside of the shield walls that surround the DR Reactor are to be removed (e.g., fuel storage basins and pump houses). A new roof will be placed over the remaining structure using the existing shield walls as the "new" outside walls. All existing penetrations in the shield walls and any new penetrations resulting from removal operations will be closed to prevent animal intrusion and water leakage. A single access door will be provided to allow periodic inspection of the facility. Prior to removal, a restricted area will be fenced around the facility. Other areas in the reactor vicinity are expected to be light, recreational surface use areas.

3.3 100F Area

The 100F Area portion consists of 256 hectares (632 acres) and is located immediately adjacent to the Columbia River near the old town site of White Bluffs. The F Reactor in the 100 Area and all qualifying waste sites within the reactor exclusion fenceline are included in the portion. The F Reactor operated from 1945 to 1965. One unique feature of the F Area, compared to other Hanford 100 Areas, is the animal farm research facility. Activities at the animal farm investigated the effects of reactor materials (both transuranics and mixed fission products) on domestic animals.

100F AREA PORTION HIGHLIGHTS

Major Long-Term Stewardship Activities - maintain reactors in interim safe storage until final disposition, institutional controls
Portion Size - 256 hectares (632 acres)
Estimated Volume of Residual Contaminants - to be determined
Long-Term Stewardship Start-End Years - 2003-in perpetuity

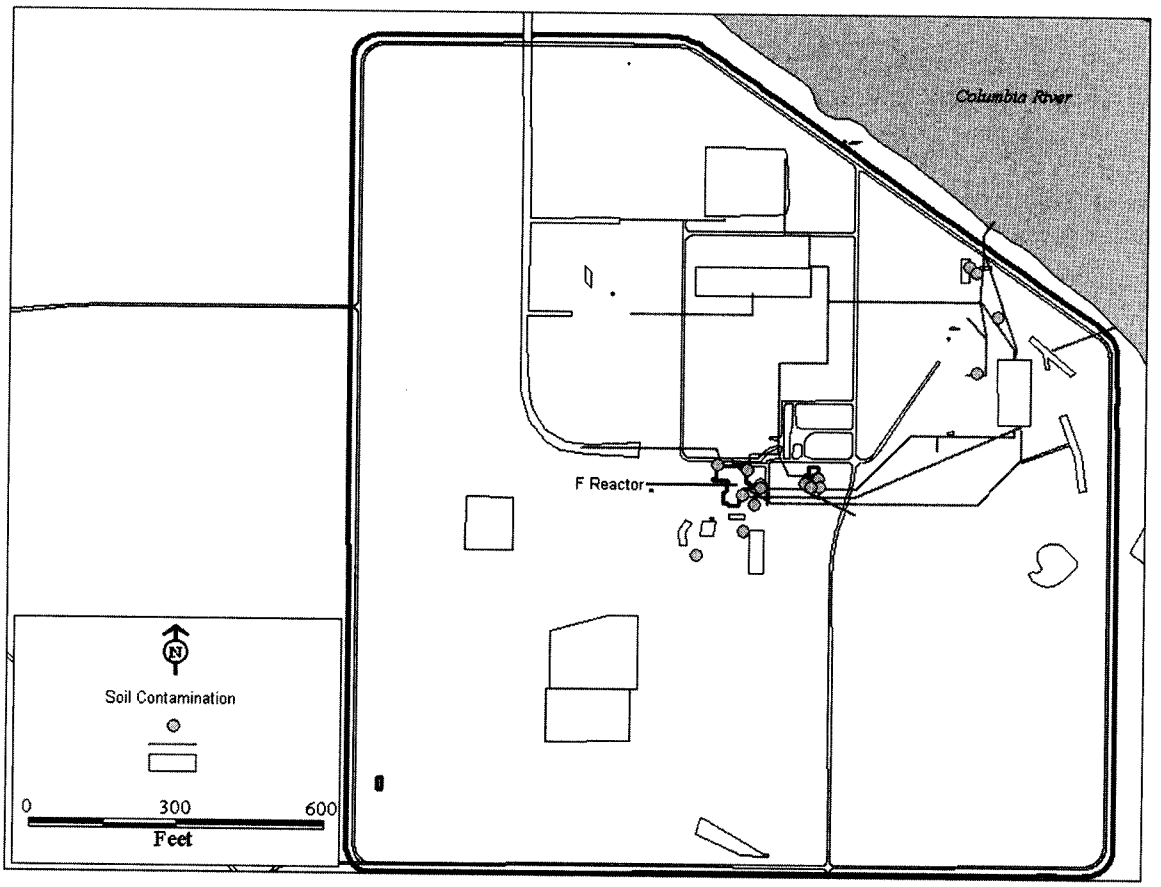
Institutional controls for the 100F Area will be extensive. Because the area will still have numerous contaminated sites in 2006, standard site institutional controls (e.g., badging program, excavation permits, signage, notification of trespass, annual evaluation of institutional controls) will govern the remaining contaminated areas and probably most of the portion. Not all waste sites have been completely characterized (surrogate sites were used to develop cleanup strategies), so the sites that will need institutional controls will be determined at the time of cleanup. Also, restrictions on certain activities may be required at some locations to prevent spreading of contaminants. The Remedial Action objectives and cleanup standards will be re-evaluated as part of the final remedy for the operable unit(s) contained in the 100F Area as part of the CERCLA five-year review. Future land use and groundwater use determinations will be evaluated per the Hanford Comprehensive Land-Use Plan EIS and must be consistent with the selected remedy.

The F Reactor engineered controls will be the same as those currently in place for the C Reactor. The reactor storage facility will be designed to be a minimal maintenance facility. Barriers and postings will be used to prevent unwarranted access. No locked fence will be necessary around the F Reactor because the structure walls are 1- to 1.5-meters (3 to 5-feet) thick, and the metal access doors will be spot-welded shut. The F Reactor structure will be designed to remain in safe storage for up to 75 years, and the reactor will have temperature and flood sensors that are remotely monitored. Surveillance and maintenance activities will include structural integrity checks, barriers and posting, radiological surveys, repair of confinement systems and structural components, and removal of hazardous substances. The 100F soil sites will be cleaned to a 4.6-meter (15-foot) depth and will have intrusion controls with deed restrictions and requirements for drilling permits.

3.3.1 Soil

There are 71 soil waste sites in the 100F portion, covering 18 hectares (45 acres). Forty-five of these will require long-term stewardship activities by 2006, including eight inactive burial grounds and 37 liquid effluent management sites (e.g., basins, cribs, trenches, septic sites, unplanned releases, and animal farm waste disposal sites). These sites are all associated with operations of the F Reactor and are located in close proximity to the Columbia River. They are all inactive.

The contaminated sites resulted from uncontained releases (either by design or unplanned) of radioactive materials and hazardous chemicals. The burial grounds contain an undetermined amount of contaminated reactor parts and equipment, animal waste, organic and hazardous wastes, and demolition waste. The contaminants are mixed fission products from reactor operations, hazardous chemicals common to older reactor operations (lead, cadmium, and mercury), and hazardous materials used in water treatment and older buildings (chromium and asbestos). Also included are chemicals commonly used in decontamination (e.g., sodium oxalate). Liquid effluent contamination resulted from: chemicals used in the pre-treatment of river water prior to reactor use,



100F Area

post-reactor water, water used in the fuel storage basins to shield and cool irradiated reactor fuel, sludge remaining in fuel storage basin pools from fuel ruptures, wash water from the animal farm, decontamination liquid disposal, and historic disposal practices for paints and solvents. The amount of contamination remaining below the 4.6-meter (15-foot) remediation depth is unknown. In many cases, site characterization activities will not be completed until soil removal is initiated.

The close proximity of the sites to the Columbia River argues for removal of the waste to the interior of the Hanford Site in order to reduce the risk of human intrusion. One site designated in the Hanford Comprehensive Land-Use Plan EIS (118-F-2) is close enough to the river that it might be impacted by a high groundwater table, and, therefore, groundwater cleanup standards might also need to be applied at that waste site.

3.3.2 Facilities

There are 11 facility waste sites totaling 4,110 square meters (44,300 square feet) in the 100F portion. One of these (the F Reactor) will be in long-term stewardship by 2006. The F Reactor is scheduled for long-term surveillance and maintenance status beginning in 2003. The Surplus Reactor EIS concluded that all Hanford reactors need to be removed from their near-river locations. However, it was decided to temporarily continue surveillance and maintenance to allow further radiological decay. This temporary storage is not expected to result in increased environmental or health risks but permits radiological decay to reduce future worker and environmental risks.

The reactor block contains the same radionuclides and hazardous chemicals of concern as the DR Reactor. The reactor block will remain in place for more than 50 years, after which time it will be removed to the 200 Area. Prior to removal, a restricted area will be fenced around the facility. Other areas in the reactor vicinity are expected to be light, recreational surface use areas. A new roof will be placed over the remaining structure using the existing shield walls as the "new" outside walls. All existing penetrations in the shield walls and any new penetrations resulting from removal operations will be closed to prevent animal intrusion and water leakage. A single access door will be provided to allow periodic inspection of the facility. Essentially all structures that lie outside of the shield walls that surround the F Reactor are to be removed (e.g., fuel storage basins and pump houses).

3.4 100H Area

The 100H Area portion covers 149 hectares (368 acres) and is located immediately adjacent to the Columbia River where the river sweeps from flowing northeast to southeast. The H Reactor operated from 1949 to 1966. Because the H Reactor will not be in interim safe storage by 2006, the H Reactor and all sites within the reactor exclusion fenceline are not included in this portion for this report. However, 22 soil waste sites are covered.

100H AREA PORTION HIGHLIGHTS

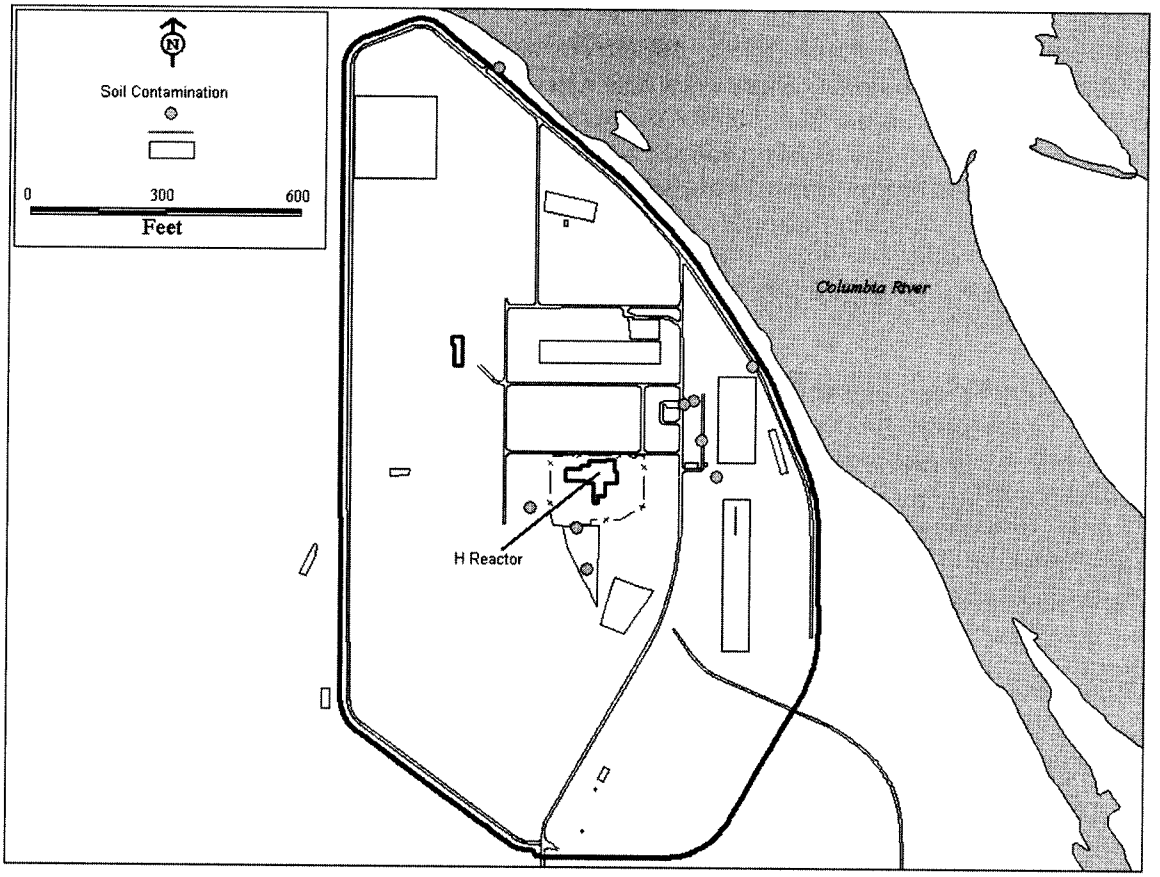
Major Long-Term Stewardship Activities - institutional controls
Portion Size - 149 hectares (368 acres)
Estimated Volume of Residual Contaminants - to be determined
Long-Term Stewardship Start-End Years - 2007-in perpetuity

The 100H area will have fewer remaining contaminated sites to consider than most of the other reactor areas. The 100H sites will be cleaned to a 4.6-meter (15-foot) depth. The Remedial Action objectives and cleanup standards will be re-evaluated as part of the final remedy for the operable unit(s) contained in the 100H area as part of the CERCLA five-year review.

Because DOE plans to remove the contaminated soil in the 4.6 meters (15 feet) below grade from the site (as discussed in Section 3.4.1, below), long-term stewardship activities will be limited to confirming that all significant contamination has been removed and revegetation efforts have been successful. Some contamination may remain deeper than 4.6 meters (15 feet) below grade. For these sites, long-term stewardship consists of ensuring that the residual contamination will not harm humans or the environment in the future. Due to the scattered nature of these waste sites among sites that will be remediated in the future, long-term stewardship is expected to encompass the entire 100H Area. Long-term stewardship activities would decrease over time as sampling needs for specific sites are eliminated.

Institutional Controls for the 100H Area will be extensive. Because the area will still have contaminated sites in 2006, standard site institutional controls (e.g., badging program, excavation permits, signage, notification of trespass, annual evaluation of institutional controls) will govern the remaining contaminated areas and probably most of the portion. Not all waste sites have been completely characterized (surrogate sites were used to develop cleanup strategies), so the sites that will need institutional controls will be determined at the time of cleanup. For sites that have been remediated to a depth of 4.6 meters (15 feet), deed restrictions and covenants may need to be filed. One site (116-H-6, Solar Evaporation Basins) currently has a deed restriction filed. Also, restrictions on certain activities may be required at some locations to prevent spreading of contaminants. Future land use and groundwater use determinations will be evaluated per the Hanford Comprehensive Land-Use Plan EIS and must be consistent with the selected remedy.

The preferred removal option for many of the 100H areas under consideration precludes the need for engineered controls.



100H Area

3.4.1 Soil

There are 55 soil waste sites covering 11 hectares (28 acres) in the 100H portion. Twenty-two of these will require long-term stewardship activities by 2006 and include five burial areas, 12 sites of intentional and unintentional liquid effluent disposal to the soil (e.g., leaks, sludge disposal areas, basins, cribs, trenches, septic sites), three burning grounds, an electrical substation, and an underground petroleum tank site. These sites are all associated with operations of the H Reactor. All H Area facilities are inactive. Burial grounds contain contaminated reactor parts. Liquid effluent contamination resulted from: chemicals used in the pre-treatment of river water prior to reactor use, post-reactor water, water used in the fuel storage basins to shield and cool irradiated reactor fuel, decontamination liquid disposal, and historic disposal practices for paints and solvents. Contaminants are mixed fission products from reactor operations, hazardous chemicals common to older reactor operations (lead, cadmium, and mercury), and hazardous materials used in water treatment and older buildings (chromium and asbestos). Nitrates and fluorides are of particular concern for one site. Other hazardous metals known to be present are: arsenic, barium, silver, copper, and zinc. Polychlorinated biphenyls exist at some locations. Undetermined inorganics and organics are potentially problematic at some sites. Further characterization of the soils is needed.

The close proximity of these sites to the Columbia River argues for removal of the waste to the interior of the Hanford Site to reduce the risk of human intrusion. For the 100H burial grounds, DOE has proposed a preferred alternative of "retrieve, treat, and dispose." Implementing the preferred alternative would effectively remove all

the waste to the 200 Area Environmental Restoration Disposal Facility site or to another appropriate disposal site. The amount of contamination remaining below the 4.6-meter (15-foot) remediation depth is unknown. In many cases, site characterization activities will not be completed until soil removal is initiated. One site has already been cleaned up (solar evaporation basin), but high levels of nitrates and fluorides remaining in the ground have required a deed restriction to be filed.

3.5 100K Area

100K AREA PORTION HIGHLIGHTS

Major Long-Term Stewardship Activities - institutional controls
Portion Size - 98 hectares (242 acres)
Estimated Volume of Residual Contaminants - to be determined
Long-Term Stewardship Start-End Years - 2007-in perpetuity

The 100K Area portion covers 98 hectares (242 acres) and is located immediately adjacent to the Columbia River just east of the 100B/C Area. The K-West and K-East Reactors operated from 1956 to 1971. Unlike most other reactor areas, the K Area has a current active mission as a storage site for legacy spent fuel (it is the site used for consolidating the remaining Hanford Site unprocessed spent fuel). Because the K-East and K-West Reactors will not be in interim safe storage by 2006, the K-East and K-West Reactors and all sites within the reactor exclusion fenceline are not included in the portion for this report. However, 43 soil waste sites are covered. The 100K sites will be cleaned to a 4.6-meter (15-foot) depth. The Remedial Action objectives and cleanup standards will be re-evaluated as part of the final remedy for the operable unit(s) contained in the 100K area as part of the CERCLA five-year review.

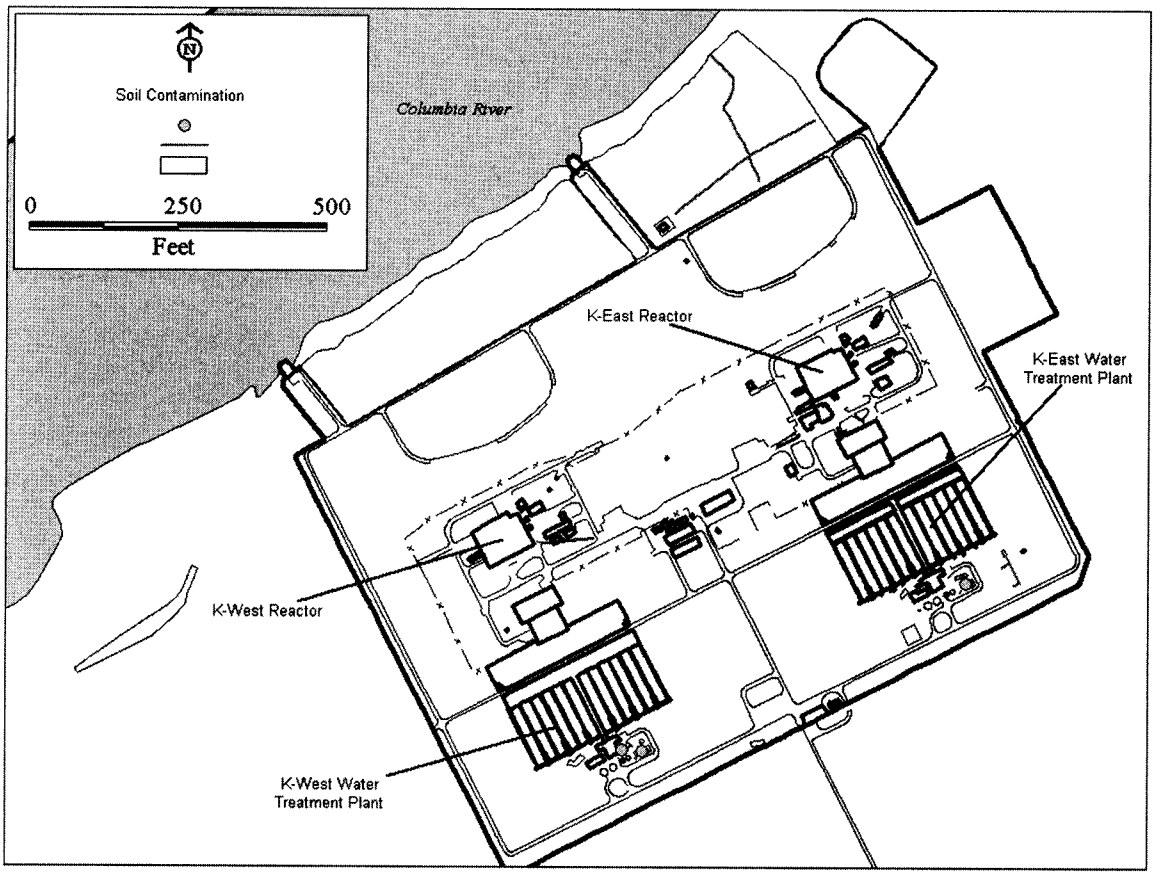
Because DOE plans to remove the contaminated soil in the 4.6 meters (15 feet) below grade from the site, long-term stewardship activities will be limited to confirming that all significant contamination has been removed and revegetation efforts have been successful. Some contamination may remain deeper than 4.6 meters (15 feet) below grade. For these sites, long-term stewardship consists of ensuring that the residual contamination will not harm humans or the environment in the future. Due to the scattered nature of these waste sites among sites that will be remediated in the future, long-term stewardship activities are expected to encompass the entire 100K Area. Long-term stewardship activities will decrease over time as sampling needs for specific sites are eliminated.

Institutional controls for the 100K Area will be extensive. Because the area will still have contaminated sites in 2006, standard site institutional controls (e.g., badging program, excavation permits, signage, notification of trespass, annual evaluation of institutional controls) will govern the remaining contaminated areas and probably most of the portion. Not all waste sites have been completely characterized (surrogate sites were used to develop cleanup strategies), so the sites that will need institutional controls will be determined at the time of cleanup. Also, restrictions on certain activities may be required at some locations to prevent the spread of contaminants. Future land use and groundwater use determinations will be evaluated per the Hanford Comprehensive Land-Use Plan EIS and must be consistent with the selected remedy.

The removal option for many of the 100K Area waste sites under consideration precludes the need for engineered controls. The engineered controls of surrounding contaminated areas are expected to drive the engineered control needs for the 100K Area.

3.5.1 Soil

There are 85 soil waste sites in the 100K portion covering 27 hectares (68 acres). Forty-three of these will require long-term stewardship activities by 2006 and include 22 chemical or septic tanks and tank foundations, 19 liquid effluent sites (e.g., french drains, sump pits, retention basins, trenches), one burn pit, and one dump site.



100K Area

A 4,100-foot (1,250 meter) long trench, which runs parallel to the river, roughly defines the interior boundary of an underlying chromium-contaminated groundwater plume that is undergoing pump-and-treat remediation. All of these sites were associated with K Reactor operations.

Contaminated sites resulted from uncontained releases (either by design or unplanned) of radioactive materials and hazardous chemicals. Typical contamination sources are: 1) water treatment chemicals required to clean the river water prior to its use as a reactor coolant; 2) cooling water discharged from the reactor, which became contaminated with radionuclides; 3) Fuel Storage Basin water and sludge from contamination by leaky irradiated reactor fuel; 4) chemicals used to decontaminate other materials and equipment; 5) septic system waste; and 6) historic disposal practices for paints and solvents. Original contaminants are mixed fission products from reactor operations, hazardous chemicals common to older reactor operations (lead, cadmium, and mercury), and hazardous materials used in water treatment. Other hazardous materials of potential concern are: arsenic, barium, silver, copper, selenium, zinc, sulfate, and petroleum products.

The strategy of removing the top 4.6 meters (15 feet) of contaminated soil, with site-specific determinations made for contamination deeper than 4.6 meters (15 feet), will remove most contamination. The amount of contamination remaining deeper than 4.6 meters (15 feet) is unknown. In many cases, site characterization activities will not be completed until soil removal is initiated.

Long-term stewardship activities for this site will likely be impacted by the remediation action for the

groundwater plume. Many of the sites are not radiologically contaminated. The Hanford Comprehensive Land-Use Plan EIS and the Surplus Reactor EIS have concluded that remediation and restoration will return the Columbia River Corridor to an undeveloped, natural condition for preservation or low-intensity recreational land use. However, restrictions on certain activities may continue to be necessary to prevent spread of the contaminants. The most obvious restrictions are to water discharges to the soil or to excavations below 4.6 meters (15 feet). However, the restoration process may stretch over 75 years, and remediation technologies and/or land use designation may change during that period.

3.6 100N Area

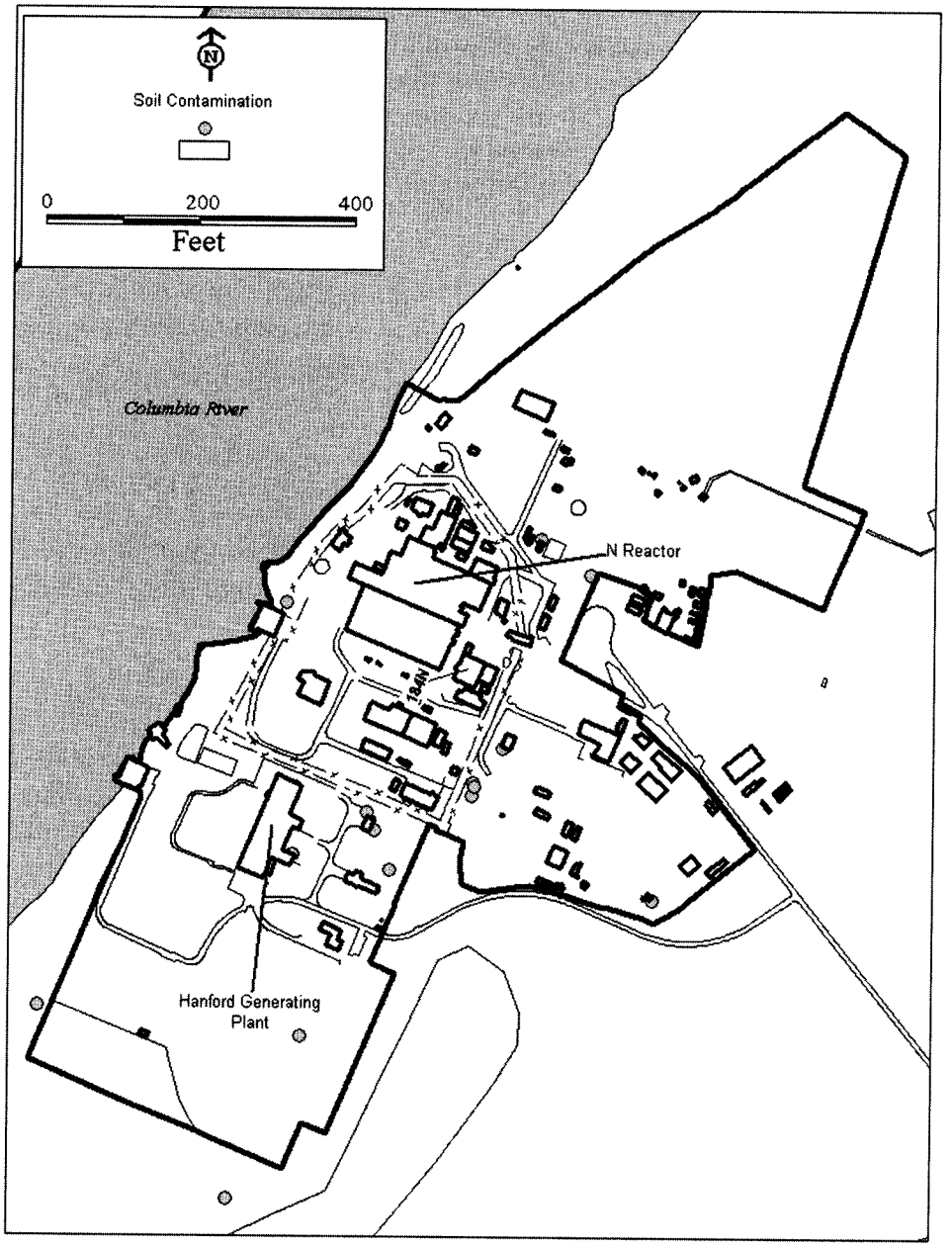
100N AREA PORTION HIGHLIGHTS

Major Long-Term Stewardship Activities - institutional controls
Portion Size - 64 hectares (160 acres)
Estimated Volume of Residual Contaminants - to be determined
Long-Term Stewardship Start-End Years - 2007-in perpetuity

The 100N Area portion consists of about 64 hectares (160 acres) and is located immediately adjacent to the Columbia River between the 100K and 100D and DR Areas. The N Reactor was the last of the nine Hanford reactors to be built and operated from 1963 to 1987. The N Reactor was still operational at the time the decision was made to remove the other eight reactors to the central plateau. Therefore, a long-term decision for N Reactor has not been made. Because the N Reactor will not be in interim safe storage by 2006, the N Reactor and all sites within the reactor exclusion fenceline are not included in the portion for this report. However, 36 soil waste sites and an oil storage building are covered. Designers benefitted from previous reactor experience and designed the N Reactor with the only closed-loop cooling system at Hanford, eliminating the discharge of significant amounts of contamination to the environment. Therefore, few of the waste sites in the 100N portion contain radiological contamination. One unique feature of 100N is that it was the only reactor that was used for both special nuclear material production and electricity generation. The electrical generation component created some oil contamination areas. Another unique feature of the 100N Area is the existence of springs that seep contaminated groundwater along approximately 850 meters (2,800 feet) of riverbank. During N Reactor operations, liquid effluent discharges resulted in greater springflow (seep duration and volume) than exists today. Spring activity continues but is now driven by river-level fluctuations resulting from dam operations.

The riverbank shoreline site has an interim remedial action strategy of institutional control that restricts access to the site. Because DOE plans to remove the contaminated soil in the 4.6 meters (15 feet) below grade from the site (as discussed in Section 3.6.1), long-term stewardship activities will be limited to confirming that all the residual contamination was removed and revegetation efforts have been successful. Some waste may remain deeper than 4.6 meters (15 feet). For these sites, long-term stewardship consists of ensuring that the residual contamination will not harm humans or the environment in the future. Due to the scattered nature of these waste sites among sites that will be remediated in the future, long-term stewardship is expected to encompass the entire 100N Area. Long-term stewardship will decrease over time as sampling needs for specific sites are eliminated.

Institutional controls for the N Reactor will be extensive. Because the area will still have contaminated sites in 2006, standard site institutional controls (e.g., badging program, excavation permits, signage, notification of trespass, annual evaluation of institutional controls) will govern the remaining contaminated areas and probably most of the portion. Not all waste sites have been completely characterized (surrogate sites were used to develop cleanup strategies), so the sites that will need institutional controls will be determined at the time of cleanup. Also, restrictions on certain activities may be required at some locations to prevent the spread of contaminants. Future land use and groundwater use determinations will be evaluated per the Hanford Comprehensive Land-Use Plan EIS and must be consistent with the selected remedy. The removal option for many of the 100N areas under consideration precludes the need for engineered controls.



100N Area

3.6.1 Soil

There are 129 soil waste sites in the 100N portion (outside of the N Reactor exclusion area fenceline) covering 25 hectares (61 acres). Thirty-six of these will require long-term stewardship activities by 2006 and include eight below-ground and above-ground tank sites, four burn pits, eight dumping areas, 13 liquid effluent sites (e.g., cribs, trenches, leak sites, ponds), a former military compound, and two chemical storage areas. Contaminated sites resulted from uncontained releases (either by design or unplanned) of hazardous chemicals. Only a few sites are suspected of containing radiological contaminants. Typical contamination sources are: 1) chemicals used to decontaminate other materials and equipment, 2) petroleum products required for lubrication of the generating

plant turbine, 3) septic system waste, and 4) historic disposal practices for paints and solvents. Minor levels of mixed fission products exist at some sites. Most of the contaminants are hazardous chemicals (for example, PCBs, acids and bases (e.g., sulfuric acid and sodium hydroxide), petroleum products, lead, and mercury).

The interim Records of Decision have been published for many of the relevant sites. Of the 36 sites included in this report, 12 were not identified for actions in the reviewed Record of Decision. These 12 sites include two septic sites, four tanks (one gas, one oil, and two radioactive/hazardous chemical storage), one 90-day pad, three french drains/drywells, one dumpsite, and one liquid effluent crib. The strategy of removing the waste to 4.6 meters (15 feet) for the remaining sites, with site-specific determinations made for contamination remaining below 4.6 meters (15 feet), will remove most contamination. The amount of contamination remaining deeper than 4.6-meters (15 feet) is unknown. In many cases, site characterization activities will not be completed until soil removal is initiated. Residual constituents would include: mixed fission products from reactor operations, hazardous chemicals common to older reactor operations (lead, cadmium, and mercury), and hazardous materials used in water treatment (chromium).

3.6.2 Facilities

There are nine facility waste sites in the 100N portion. One of these, an oil storage facility at the Hanford Generating Plant, will require long-term stewardship by 2006. The nine-square-meter (97- square-foot) facility was used as an oil storage building for the electrical generating plant. It is a basement storage room containing petroleum-contaminated concrete. The interim Records of Decisions for the 100N site designated removal of the contamination or in-situ bioremediation. There will be no remaining contamination unless unexpected petroleum products or other contamination is found below the cement floor.

3.7 100 Other Areas

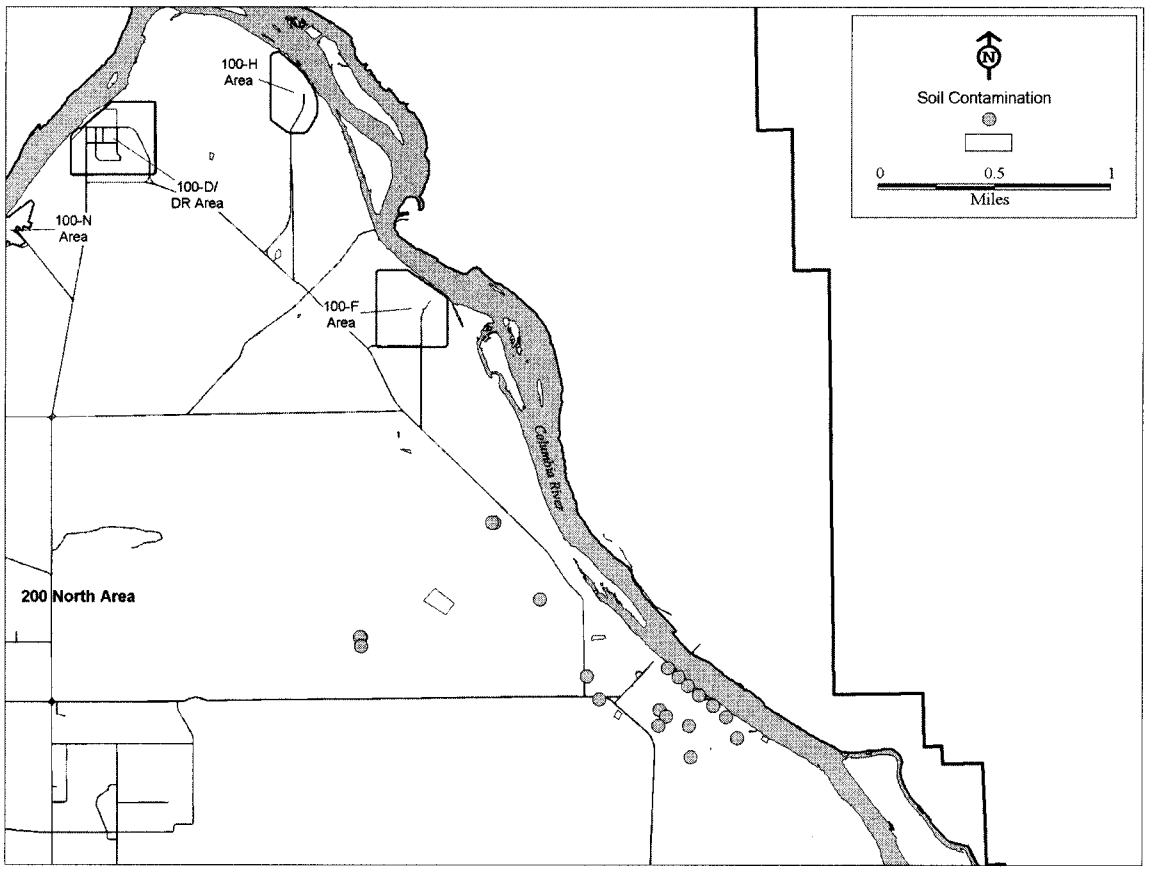
100 OTHER AREAS PORTION HIGHLIGHTS

Major Long-Term Stewardship Activities - institutional controls
Portion Size - 4,600 hectares (11,400 acres)
Estimated Volume of Residual Contaminants - to be determined
Long-Term Stewardship Start-End Years - 2007-in perpetuity

The 100 Other Area portion comprises 4,600 hectares (11,400 acres). This portion consists of soil contamination sites that are, for the most part, located in an interior location (i.e., a substantial distance from the river) that is not within a specific reactor area. Most of these sites are located in the vicinity and west of the old Hanford town site, along the Columbia River south of 100F and north of the 300 Area. In addition, two sites are located inland within the northern bend of the Columbia River, one between the 100D Area and the 100H Area and the other between the 100N Area and 100F Area. The sites range over an area of about 19 kilometers by 5.6 kilometers (12 miles by 3.5 miles). These sites are inactive, inert sites, or sites whose remediation or interim remediation plans will have been finalized or proposed for Record of Decision consideration. The sites will be remediated and revegetated with native plants.

Institutional controls will consist of deed restrictions on sites where contamination remains below the remediation level of 4.6-meters (15-feet deep). If the site is cleaned to below the appropriate Washington State Model Toxics Control Act cleanup level, unrestricted surface or residential use of the site would not be prohibited.

It is unlikely that engineered controls will be necessary for any of these sites, especially given the selected remediation strategy of removal of contaminants for most of the sites.



100 Other Areas

3.7.1 Soil

This soil media sites in this portion are not associated with any specific reactor area but are located across the 100 Area geographic region . There are 81 soil waste sites in the 100 Other Areas portion covering 30 hectares (74 acres). Seventeen of these will require long-term stewardship activities by 2006 and include: five burial/dumping areas, four liquid disposal sites, two septic disposal areas, one storage vault, one underground storage tank, one unplanned release from a laboratory fire, two burn pits, and a rifle range. The sites result from a variety of activities: sites that supported construction of the reactor areas, pre-Hanford facilities, sewage disposal, Hanford site security, chemical storage and handling, and an unplanned release potentially containing radioactive materials. The contents of the waste sites in the 100 Other Area portion are largely uncharacterized. Some old burial grounds contain asbestos and leaded paint. Other potential contaminants in older landfills include organics and pesticides. Brine water, pickling acid, and septic discharges were disposed of in the liquid disposal sites. The burial sites are early solid waste disposal sites. One site is pre-Hanford Reservation.

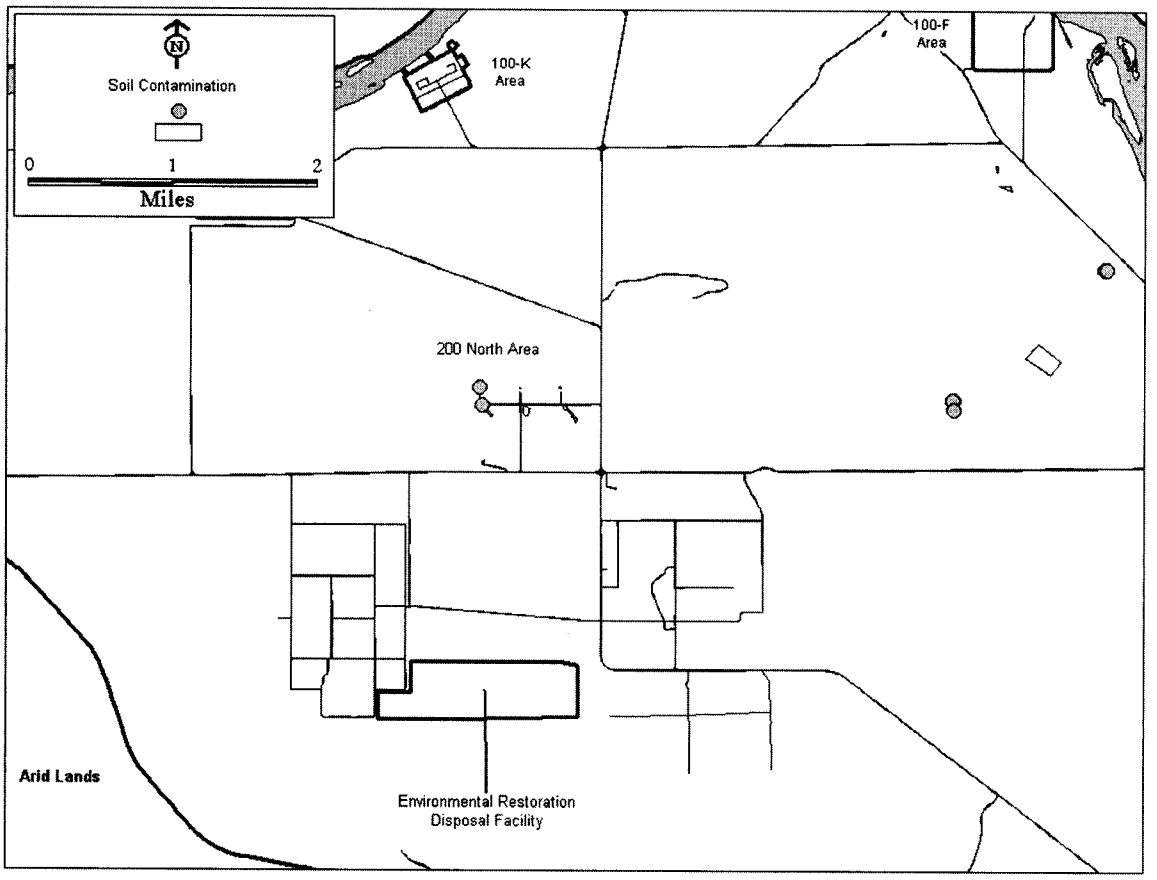
The Record of Decision for the 100 Area Remaining Sites includes 14 of the 17 sites. Not included are two septic sites and one underground fuel tank, the existence of which is uncertain. The remediation actions identified call for disposal of the contamination in a Hanford interior disposal facility. The amount of contamination remaining below 4.6-meters (15 feet) is unknown. In many cases, site characterization activities will not be completed until soil removal is initiated.

3.8 200 North Area

> ***200 NORTH AREA PORTION HIGHLIGHTS***
>
> *Major Long-Term Stewardship Activities* - institutional and engineered controls, long-term monitoring
> *Portion Size* - 225 hectares (556 acres)
> *Estimated Volume of Residual Contaminants* - to be determined
> *Long-Term Stewardship Start-End Years* - 2007-in perpetuity

The 200 North Area portion covers approximately 225 hectares (556 acres) and is located 7 to 12 kilometers (4 to 7.5 miles) south of the 100 Area and immediately north of the 200 Area (for more on the 100 and 200 Areas, see Section 1.2). The 200 North Area lies within an erosional channel that formed during the waning stages of the cataclysmic flooding that ended about 13,000 years ago. The elevation in the vicinity of the 200 North Area ranges from approximately 181 meters (593 feet) in the northeastern corner to approximately 170 meters (560 feet) in the southeastern corner. The vadose zone is approximately 49 meters (160 feet) thick along the western part of the 200 North Area. The groundwater table occurs primarily within the Hanford formation (uncemented gravels, sands, and silts) in the 200 East and 200 North Areas. Former river and flood channels that have become buried may provide preferential pathways for groundwater and contaminant movement.

The 200 North Area waste sites received cooling water and sludge from 100 Area reactor operations. The waste sites included in this submittal are inactive, inert sites, or sites whose remediation or interim remediation plans



200 North Area

will have been finalized or proposed for Record of Decision consideration by 2006. There will be contaminated sites that will not have been remediated remaining in the 200 North Area beyond 2006. The waste sites in this group are similar to liquid waste disposal sites in the 100 Area and are, therefore, considered in the 100 Area Remaining Sites Record of Decision. An Interim Record of Decision (1999) for the 200 North waste site is in place, but these waste sites consist of contaminated soil, structures, and debris for which sufficient information does not exist to determine if remediation is needed to protect human health and the environment. The Interim Action Record of Decision provides a decision framework for deciding whether to leave some contamination in place at a limited number of sites, specifically where contamination is located at depths greater than 4.6 meters (15 feet).

EPA's assumption of land use in this area is for "unrestricted use," but the Tri-Parties may re-evaluate Remedial Action objectives and cleanup goals selected in this Interim Action Record of Decision following issuance of land use determinations by DOE. In the Hanford Comprehensive Land-Use Plan EIS, the preferred alternative land use designation for the 200 North portion is Conservation Mining. Conservation mining would enable the extraction of valuable near-surface geologic resources after demonstrating compliance with *National Environmental Policy Act* (NEPA), RCRA, or CERCLA.

Institutional and engineered controls and long-term monitoring will be required for sites where wastes are left in place and unrestricted land use is precluded. Additional measures may be necessary to ensure the long-term viability of institutional controls if the final remedial actions selected do not allow for unrestricted land use. Any additional controls will be specified as part of the final remedy. Engineered controls will consist of managed site entry, sign installation, and maintenance and surveillance.

3.8.1 Soil

There are seven soil waste sites covering five hectares (13 acres) in the 200 North portion. Seven of these contain structures, debris, and soil with contaminants similar to those found in the 100 Area reactor areas. Potential contaminants include: cobalt-60, strontium-90, cesium-137, europium-155, uranium-238, and plutonium-239 and -240. DOE anticipates that remediation will not be necessary, but confirmatory sampling will be conducted. These sites are candidates for remediation using the "remove, treat, and dispose" alternative. However, since the nature and extent of contamination at the 200 North waste sites is unknown, some residual contamination may be left in place at a limited number of sites, specifically where contamination is located at depths greater than 4.6 meters (15 feet).

3.9 200-PO-1 Operable Unit (Groundwater)

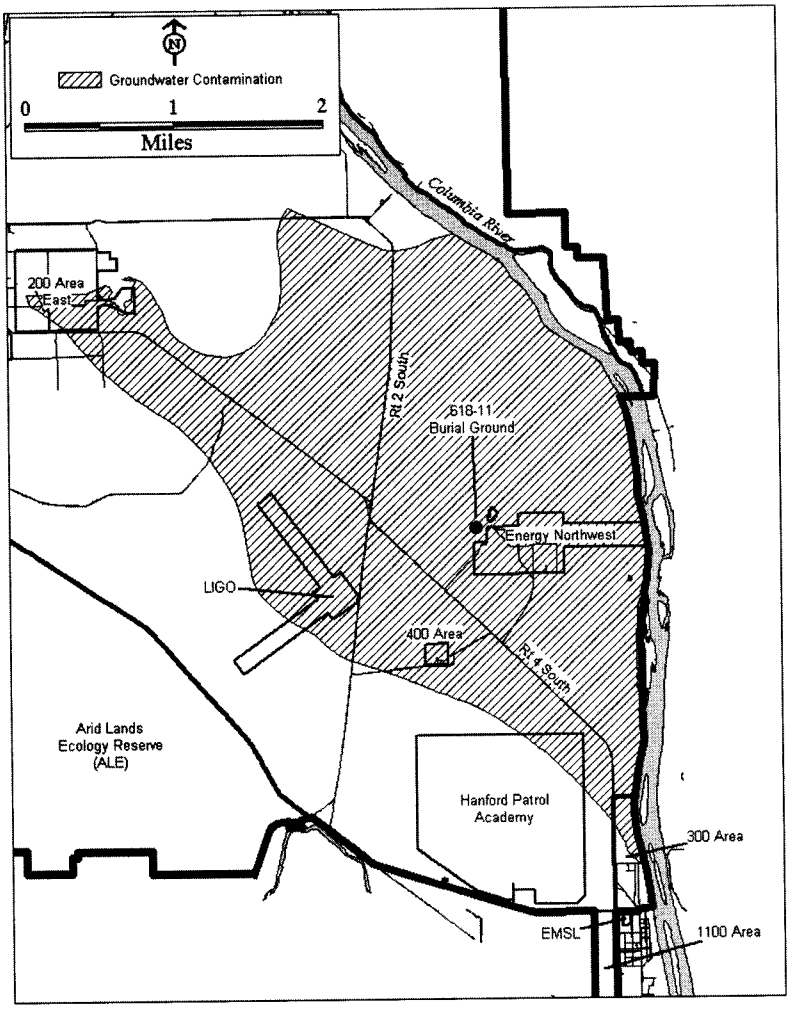
The 200-PO-1 Operable Unit underlies nine RCRA treatment, storage and disposal units (tank farms, four cribs, one ditch, one pond and a portion of another pond, and one landfill) and covers 23,400 hectares (57,900 acres). The operable unit originated from historical liquid waste disposal during operations of the Plutonium/Uranium Extraction Plant and the B Plant in the 200East Area. The majority of the plume is south and east of the 200 Area. The 200-PO-1 Operable Unit is bound by the 2,000 picocuries per liter (pCi/L) tritium contamination plume as it extends eastward and southward from the source(s) located at the southern portion of the 200East Area. The eastern boundary is the Columbia River from the Old Hanford town site to the 300 Area. The southern boundary is adjacent to the 300-FF-5 Operable Unit boundary and does not extend south

200 -PO-1 GROUNDWATER PORTION HIGHLIGHTS

Major Long-Term Stewardship Activities - institutional and engineered controls
Portion Size - 23,400 hectares (57,900 acres)
Estimated Volume of Residual Contaminants - groundwater - to be determined
Long-Term Stewardship Start-End Years - 2007-in perpetuity

of the 399-1-18 A, B, and C well cluster. The operable unit is bounded on the north by the 200-BP-5 Groundwater Operable Unit.

The 200 Area has been listed on EPA's National Priorities List due to soil and groundwater contamination. The groundwater beneath the 200East Area has been divided into two groundwater operable units based on an east-west-trending groundwater divide that exists on the potentiometric surface of the aquifer. The groundwater to the south of the divide flows south and east to the Columbia River and is addressed by the 200-PO-1 Operable Unit. Groundwater flow beneath the 200East Area portion of the 200-PO-1 Operable Unit is complex and changing. The 200-PO-1 Operable Unit lies within the Pasco Basin. The basin is underlain by at least 3,200 meters (10,500 feet) of Columbia River Basalt, which is, in turn, overlain by 0 to over 215 meters (0 to over 700 feet) of fluvial, lacustrine, glaciofluvial, and eolian sediments.



200 Area PO-1 Operable Unit (Groundwater)

Two corrective measure alternatives were identified in the RCRA Corrective Measure Study for the 200-PO-1 Operable Unit (1997) (a final Record of Decision has not been completed). The no-action alternative is protective of human health and the environment in the short term (until 2018 or loss of DOE control of the site) because access to groundwater is controlled. However, after loss of controls, access to contaminated groundwater could result in risk to human health and the environment. Also, because the groundwater RCRA Facility Investigation/Corrective Measures Study (RFI/CMS) process is ahead of the process for the source operable units, some uncertainty exists concerning the relationship between the near-surface operational units and groundwater containment. High levels of tritium in a groundwater monitoring well near the 618-11 burial ground may significantly impact disposition of this groundwater plume. This is a recent discovery and limited information is currently available. Treatability testing for the operable unit contaminants may be required; however, the need for this testing is also being evaluated through supporting studies.

If the Institutional Controls alternative is selected, controls will be maintained after the year 2018 to prevent human contact with the contaminated groundwater until contaminant concentrations are reduced through natural attenuation. Restrictions on drinking water wells and providing alternate water supplies eliminate a major pathway for ingestion of contaminants, resulting in limited risk. Risks associated with ingestion of contaminants

at the river are low because of reduced intakes associated with recreational exposure and natural attenuation of the tritium through decay. Groundwater monitoring is currently in place to track contaminants; this will continue as part of all the alternatives until acceptable groundwater concentrations are reached. Any waste generated as part of the alternative will be properly disposed of according to State and Federal requirements. Other regulatory requirements, such as air emissions standards, are not applicable to the proposed alternatives.

Engineered controls will consist of managed site entry, sign installation, maintenance and surveillance, and administrative systems.

3.9.1 Groundwater

The 200-PO-1 Operable Unit has been designated as a RCRA past-practice unit in the Tri-Party Agreement. This designation places the operable unit in the RCRA Facility Investigation/Corrective Measures Study process. The source operable units associated with the groundwater in the 200-PO-1 Operable Unit are a mix of CERCLA and RCRA past-practice operable units, and the documentation for these units will likewise be a mix between CERCLA and RCRA. A final Record of Decision will likely document the decision for the 200 Area National Priorities List site and incorporate information from all the CERCLA and RCRA documents, as appropriate. The Tri-Party Agreement identifies each site in the 200East Area and the controlling regulatory cleanup process. Closures and cleanup activities under RCRA and remedial activities under CERCLA will be coordinated to ensure efficiency of resources.

Three major plumes extend from the 200East Area toward the Columbia River: iodine-129, nitrate, and tritium. These plumes represent the major contaminants associated with this operable unit. Historical evidence from an earlier plume associated with PUREX operations from 1955 to 1972 indicates that the travel time for tritium to the Columbia River from the 200East Area is approximately 15 to 20 years. Other contaminants or small contaminant plumes are contained on the 200 Area plateau. In general, these contaminants are associated with specific waste sites and treatment, storage, and disposal facilities and include: arsenic, chromium, manganese, strontium-90, and vanadium.

DOE does not currently know how much residual contamination will remain in the groundwater following treatment. Potential corrective measures are being developed and evaluated. However, trends indicate that the majority of contaminant concentrations are declining through either radioactive decay (such as tritium and strontium-90) or dispersion of the contaminants through plume movement. As recent as January 2000, high levels of tritium were found in a groundwater monitoring well near the 618-11 burial ground and this may significantly impact disposition of this groundwater plume. Treatability testing of the operable unit contaminants may be required; however, the need for this testing is also being evaluated through supporting studies.

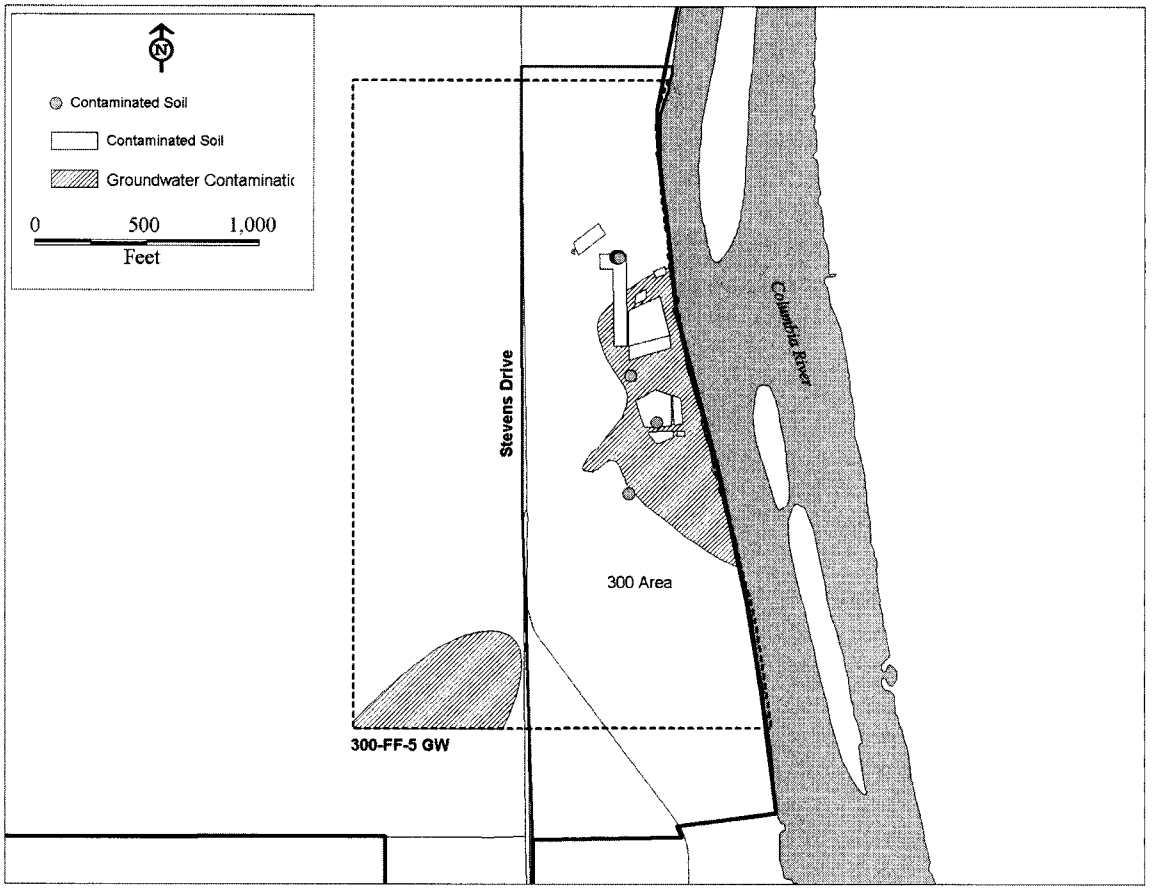
The groundwater will be cleaned up to standards set by the Washington State Model Toxics Control Act. The Washington State Model Toxics Control Act groundwater cleanup levels would be used as follows: 1) for contaminants contained on the plateau, Washington State Model Toxics Control Act-C industrial levels would be the standard; and 2) for contaminants off the plateau or those with the potential to migrate offsite at significant concentration, Washington State Model Toxics Control Act-B levels would be used. In the absence of an appropriate Washington State Model Toxics Control Act standard, the Safe Drinking Water Act maximum concentration limits would be used. Otherwise, the level would default to background. For contaminants with background values greater than regulatory standards, the background value would become the cleanup goal.

DOE expects that long-term monitoring and institutional controls will be maintained in perpetuity. Restrictions will be placed on drinking water wells.

3.10 300 Area

> ***300 AREA PORTION HIGHLIGHTS***
>
> *Major Long-Term Stewardship Activities* - institutional and engineered controls
> *Portion Size* - 51 hectares (126 acres)
> *Estimated Volume of Residual Contaminants* - groundwater and soil - to be determined
> *Long-Term Stewardship Start-End Years* - current-in perpetuity

The 300 Area Portion covers about 51 hectares (126 acres) and is located in the southeast corner of Hanford, approximately five miles north of Richland, Washington. The 300 Area began as a fuel fabrication complex in 1943. As production reactors shut down, fuel fabrication ceased, but research and development activities increased over the years. Two operable units are located within the 300 Area portion: 300-FF-1 and 300-FF-5 (sites currently in the 300-FF-2 Operable Unit are not included in the portion for this report). The two sites are related based on geography and on the basis of the threat or potential threat to public health, welfare, or the environment and, therefore, are treated as a single site under the 1996 Record of Decision for the Hanford 300 Area 300-FF-1 and 300-FF-5 Operable Units. It should be noted that redesignation of boundaries in the mid-2000 time frame may result in the 300-FF-2 sites being included in the 300-FF-5 Operable Unit. A recent proposal has been made to move just the 300-FF-2 waste sites known to impact groundwater into the 300-FF-5 Groundwater Operable Unit. The groundwater plume included in this submittal contains constituents that are migrating into 300-FF-5 that have not yet been fully addressed (e.g., tritium). This is not the only groundwater contamination in the area. Other areas in the 300 Area



300 Area

will not have been remediated by 2006. In addition to the groundwater, there are 39 soil waste sites in the 300 area that contain various degrees of contamination (36 are covered in this report).

3.10.1 Groundwater

Groundwater contamination in the vicinity of the 300-FF-5 Operable Unit generally consists of three main plumes covering 648 hectares (1,600 acres). The first, and only one of the three that is derived from 300 Area operations, is centered beneath the 300-FF-1 Operable Unit. Maximum concentrations occur primarily in the vicinity of the Process Trenches and the north and south process ponds. A second plume, consisting of tritium, is present throughout the north and eastern portions of the 300-FF-5 Operable Unit. This plume is derived from operations in the 200 Area and is migrating into the 300-FF-5 Operable Unit from the north (to be addressed in future Records of Decision). The third plume is migrating from the west (1100-EM-1 Operable Unit) and it has been verified that the plume did not migrate into the 300-FF-5 Operable Unit. Seventeen potential contaminants of concern were identified for 300-FF-5: chloroform, 1,2-dichloroethene (cis), 1,2-dichloroethene (total), dichloroethene (trans) (70 mg/l), trichloroethene (5 mg/l), total coloform, copper, nickel, nitrate, ruthenium-106, strontium-90, technetium-99, tritium, uranium-234, uranium-235, uranium-238, and total uranium (20 mg/l).

The unconfined aquifer is composed of two hydrogeologically distinct formations. Flow in the unconfined system is generally to the Columbia River. Groundwater eventually discharges through springs/seeps in the river bottom and bank. The groundwater flow system has a significant impact on the contaminant distribution observed in the aquifer.

The selected remedy for the 300-FF-5 Operable Unit is an interim remedial action that involves imposing restrictions on the use of the groundwater until such time as health-based criteria are met for uranium, trichloroethene, and 1, 2-dichlorethene (i.e., compliance with Federal and State "applicable or relevant and appropriate requirements" and cost-effectiveness). This is an interim action because there are other constituents (e.g., tritium) which are migrating into the 300-FF-5 Operable Unit that have not yet been fully addressed and because a portion of 300-FF-5 is overlaid by uncharacterized waste sites in 300-FF-2. The inclusion of 300-FF-2 sites has led to questions from EPA regarding characterization. A final remedial action decision for 300-FF-5 will be made after these issues have been addressed. There is a greater degree of uncertainty associated with the exposure assessment, which is based on a large number of assumptions regarding the physical setting of the waste sites and the exposure conditions on the receptor population.

The interim remedy selected will result in hazardous substances remaining onsite above health-based levels for groundwater. Therefore, a review will be conducted within five years after commencement of remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment. Migrating constituents (e.g., tritium) and overlying, uncharacterized waste sites increase uncertainty about the volume of residual contamination in the groundwater.

Continued groundwater monitoring is necessary to verify modeled predictions of contaminant attenuation and to evaluate the need for active remedial measures. The monitoring system will be designed and optimized to confirm that attenuation is occurring. The monitoring frequency will be selected to ensure that achievement of the Remedial Action objectives can be verified. The specific locations and measurements will be documented in an operation and maintenance plan for 300-FF-5, which requires approval by EPA. If monitoring does not confirm the predicted decrease of contaminant levels, DOE and EPA will evaluate the need to perform additional response actions. The RI/FS predicted that the Remedial Action objectives would be attained in three-to-ten years, but progress will be evaluated in a CERCLA five-year review, which is currently ongoing. Although not all contaminants have specified cleanup levels, it is anticipated that target levels will be achieved in 2010.

Current institutional controls will continue, and restrictions on groundwater withdrawal and use will be put in

place and will continue until remediation goals are met. Residual contamination (300-FF-1) and groundwater (300-FF-5) institutional controls include placing written notification of the remedial action in the facility land use master plan. DOE will prohibit any activities that would interfere with the remedial activity without concurrence from EPA. In addition, measures acceptable to EPA that are necessary to ensure the continuation of these restrictions will be taken before any transfer or lease of the property. A copy of the notification will be given to any prospective purchaser/transferee before any transfer or lease. DOE will provide EPA with written verification that these restrictions have been put in place. The first five-year inspection of the 300-FF-5 Operable Unit has been completed and DOE is finalizing paperwork to close the inspection process. A recent deed restriction for the 300 Area Process Ponds has been recorded with the Benton County Auditor's Office.

3.10.2 Soil

There are 39 soil waste sites in the 300 Area portion covering about 16 hectares (40 acres). Thirty-six of these sites will require long-term stewardship by 2006 and include two burial grounds, one burn pit, one coal ash pit, three dumping areas, three ponds, one surface impoundment, and 25 unplanned releases. All of these waste sites are in the 300-FF-1 Operable Unit, which consists of nine waste sites that warranted remedial action using the selected remedy. These sites have been subdivided into two categories, namely, process waste sites (eight) and a burial ground (one). The process waste sites were processing ponds that received primarily liquid wastes. The burial ground received primarily solid waste. There are also more than 20 unplanned releases that are associated with the ponds. Three landfills that received solid waste and a burn pit were grouped with the process waste sites because they were relatively small in size and were located near the ponds.

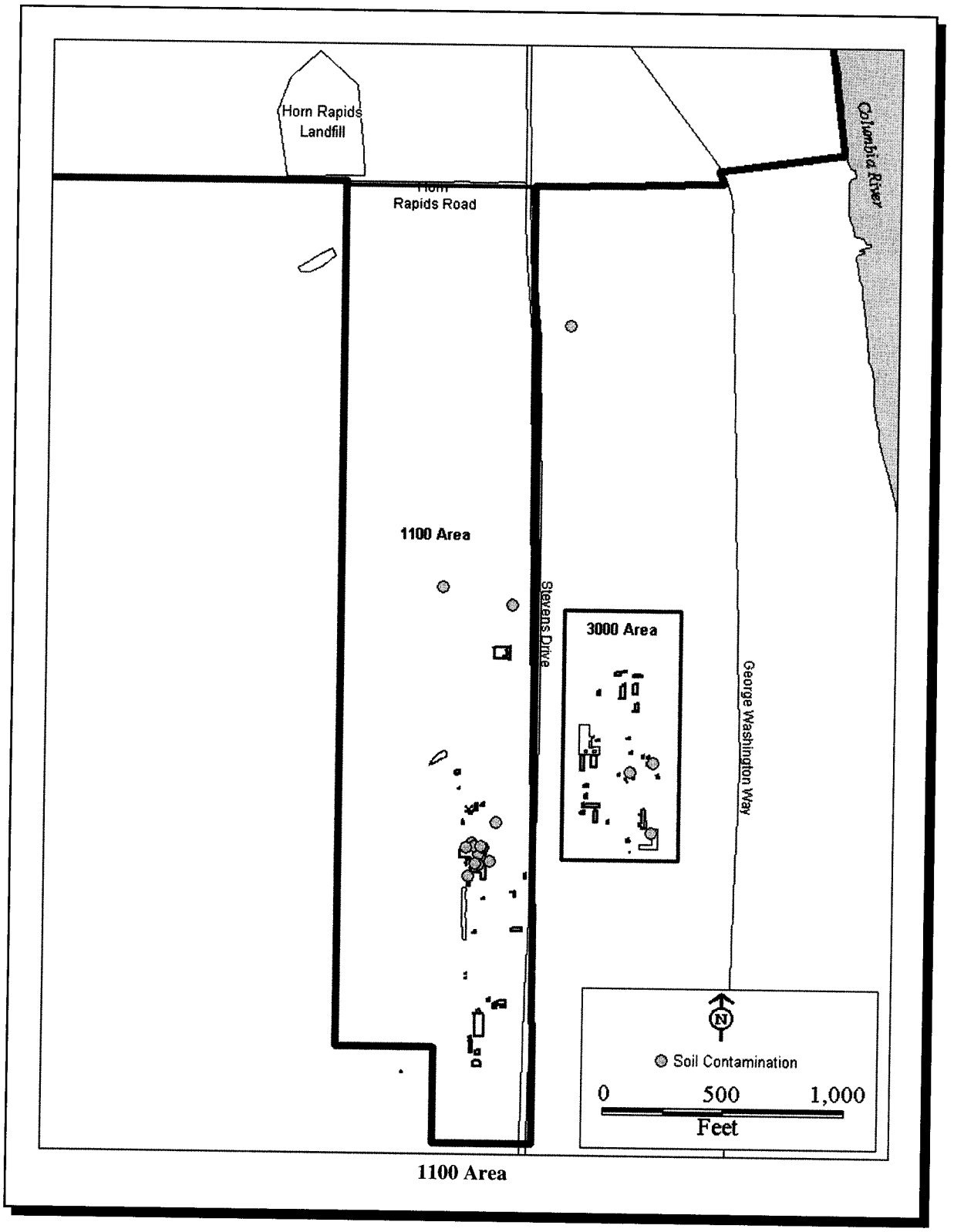
Remedies selected for 300-FF-1 Operable Unit soils include selective excavation and disposal of contaminated soil/ debris from the process waste units and excavation and removal of Burial Ground 618-4. Contaminated soil and debris from process waste units and Burial Ground 618-4 that are above cleanup standards will be removed and disposed of in Hanford's Environmental Restoration Disposal Facility. If the 15-mrem/year industrial cleanup level at process waste units is exceeded by the combination of uranium and cobalt-60 after remediation, institutional controls may be used to allow the cobalt-60 to decay. Any material at the burial ground that exceeds disposal facility acceptance criteria would be stored at the 300-FF-1 Operable Unit in accordance with applicable requirements until acceptance criteria are met by treatment or approval of a treatability variance. The remedies selected will result in hazardous substances remaining onsite above health-based standards. The volume of residual contamination will not be known until remediation is complete. Therefore, a review will be conducted within five years after commencement of remedial action to ensure that the remedies continue to provide adequate protection of human health and the environment.

3.11 1100 Area

The 1100 Area was listed on EPA's National Priorities List in November 1989. This listing was based on the proximity of the 1100-EM-1, 1100-EM-2, and 1100-EM-3 Operable Units to groundwater wells used by the City of Richland to supply drinking water and because up to 56,800 liters (15,000 gallons) of battery acid were disposed in a sand pit in the 1100-EM-1 Operable Unit. The 1100 Area covers 114 hectares (281 acres) and is located near the southeastern corner of Hanford, extending to the upper city limits of Richland, Washington. In 1998, DOE transferred the 100 Area to the Port of Benton, a State of Washington organization. However, the northernmost part of the area, also known as the Horn Rapids Landfill, is still owned and managed

1100 AREA PORTION HIGHLIGHTS

Major Long-Term Stewardship Activities - monitor and maintain the cap at the Horn Rapids Landfill, enforce institutional controls
Portion Size - 114 hectares (281 acres)
Estimated Volume of Residual Contaminants - soil - to be determined
Long-Term Stewardship Start-End Years - current-in perpetuity



by DOE. The Horn Rapids Landfill is located approximately 3.2 kilometers (two miles) west of the southeastern corner of Hanford and approximately eight kilometers (five miles) north of Richland, Washington. It was an unlined landfill used for disposal of trash and was capped to prevent problems due to airborne asbestos.

The 1100 Area is located along the southeastern margin of Hanford, adjacent to the Columbia River. The geologic structure beneath the 1100 Area consists of three distinct levels of soil formations. The deepest level is a thick series of basalt flows that have been warped and folded. The Ringold formation (with its layers of silt, gravel, and sand) forms the middle level. The uppermost level, the Hanford formation, consists of gravels and sands deposited by catastrophic floods during glacial retreat.

A Record of Decision was issued in 1993 for the 1100 Area, and remediation of waste sites was completed in 1995. Although most of the lands in the 1100 Area were transferred to Port of Benton, DOE is still responsible for remediation of any contamination identified in the future.

The groundwater in the vicinity of the Horn Rapids Landfill (HRL) is to be monitored annually to verify that the trichloroethene contamination continues to attenuate and that the plume does not expand beyond designated early warning wells. Plans are in place for DOE to inspect and maintain cap integrity and fencing at HRL. Continued groundwater monitoring around HRL is necessary to verify the modeled contaminant attenuation predictions and to evaluate the need for active remedial measures.

3.11.1 Soil

There are 32 soil waste sites in the 1100 Area portion covering 17 hectares (42 acres). All of these are currently in long-term stewardship and include five depressions/pits, two dumping areas, one pond, one sanitary landfill, one military compound, four septic tanks, 15 storage areas and tanks, three unplanned release areas, and one process unit. All 32 sites are in the 1100-EM-1, 1100-EM-2, and 1100-EM-3 Operable Units that previously contained the central warehousing, vehicle maintenance, and transportation distribution center for the entire Hanford Site. The selected remedy for the 1100 Area National Priorities List Site includes: offsite incineration of BEHP-contaminated soils at the Discolored Soil Site, offsite disposal of PCB contaminated soils at the Ephemeral Pool, an asbestos cap at the HRL, and offsite disposal of contaminated soil and debris from the 1100-EM-2 and 1100-EM-3 Operable Units

The Horn Rapids Landfill, located in the northernmost portion of the 1100-EM-1 Operable Unit, is still owned and managed by DOE. The landfill was an unlined depression that was used for disposal of trash. The volume of residual contamination at the landfill is unknown. The Horn Rapids Landfill was closed as an Asbestos Landfill in accordance with the Asbestos National Emissions Standards for Hazardous Air Pollutants (NESHAP) (40 CFR 61.151). Before the landfill cap was installed, a localized area of soil (contaminated with PCBs) was removed. The HRL asbestos cap was constructed by placing 37,100 cubic meters (48,500 cubic yards) of clean random fill material over the 10-hectare (25-acre) site. Forty-five centimeters (18 inches) of random fill material was placed uniformly over the site following existing contours; no effort was made to direct surface run-off water away from the cap area. Placement of the first 15 centimeters (six inches) layer of this material required the use of special construction practices to limit the exposure of remedial workers to fugitive dust. An additional 15 centimeters (six inches) of topsoil layer was placed and seeded to dryland grasses. Total cap thickness was 60 centimeters (two feet). Plans are in place for DOE to inspect and maintain the integrity of the cap and fencing at the Horn Rapids Landfill. DOE recently recorded a notation on the Horn Rapids Landfill deed after completion of the first CERCLA five-year review following a positive inspection on the Horn Rapids Landfill cap and signage.

Although remedial actions attempted to clean up the area, if there are residual contaminants above certain Washington State Model Toxics Control Act levels (applying to certain units), then adequate institutional controls will be provided to monitor the sites after remediation to prevent future receptor exposure to contaminants. Since hazardous substances remained onsite above levels allowing for unlimited use and unrestricted exposure, a statutory five-year review was conducted in 1998.

Soil and debris from waste sites in the 1100-EM2 and1100-EM-3 Operable Units that were contaminated above Washington State Model Toxics Control Act levels were removed and disposed in a permitted offsite landfill. Field monitoring and analyzed samples were used to confirm that cleanup levels had been met.

All simulated high-level waste slurry (SHLWS) treatment and storage wastes, including a vinyl liner and dangerous waste containers, have been treated and removed. Soils beneath the SHLWS treatment and storage wastes have been sampled, analyzed and removed, as necessary. The 1999 Closure Plan for the SHLWS Treatment and Storage Unit indicates that closure was based on removal of all dangerous wastes and dangerous waste residues, groundwater monitoring, and leachate collection. Run-on and run-off controls are not expected to be necessary.

3.11.2 Facilities

The 1100 Area includes the SHLWS Treatment and Storage facility, which is approximately 0.8 hectares (two acres) in size. The SHLWS Treatment and Storage (T/S) unit was an open area, within a fenced-in yard, that was used to treat and store containerized, simulated high-level waste slurry. It was a unique facility, used to blend chemical products to simulate high-level wastes for use in experimental waste treatment programs. The unit was also used to treat this waste in a grout/stabilization process. The untreated slurry was originally considered to be a mixed waste because, in addition to being designated a dangerous waste, it contained elevated levels of natural radioactivity. However, analysis of the waste at the time of treatment indicated that the radioactivity of the waste was low enough for it to be managed as a nonradioactive waste, defined by the U.S. Department of Transportation under 49 CFR 173 as less than two nanocuries per gram (nCi/g). The slurry was designated as a dangerous waste because it contained toxic constituents, was corrosive and ignitable, and contained dissolved metals above the limits given in the Extraction Procedure Toxicity test. The treated slurry was not designated as dangerous waste, and the levels of radioactivity in the treated waste were low enough for the waste to be managed at Hanford as nonradioactive solid waste.

The SHLWS was procured for a research demonstration program that was subsequently canceled. The treatment program was initiated on September 13, 1988, and ended on October 28, 1998. The SHLWS unit was divided among cordoned areas, including one area used for storage of SHLWS in drums, another used for SHLWS treatment, and one used for accumulations of containerized dangerous wastes for less than 90 days. The treated wastes were removed from the unit and disposed of, and the unit was not used for any additional dangerous or mixed waste management activities. The areas surrounding the facility were used for nonregulated activities, including storage of raw materials and structural materials.

Raw materials stored in the unit included the grout-forming chemicals used for treatment (fly ash, blast furnace slag, and Portland cement). Each area of the SHLWS T/S units was closed by removal of all dangerous wastes and dangerous waste residues. Soil beneath the SHLWS drum storage area, the 90-day-or-less accumulation area, and the treatment area was sampled and analyzed as described in the Sampling and Analysis Plan (SAP). The facility was clean closed and there are no post closure requirements.

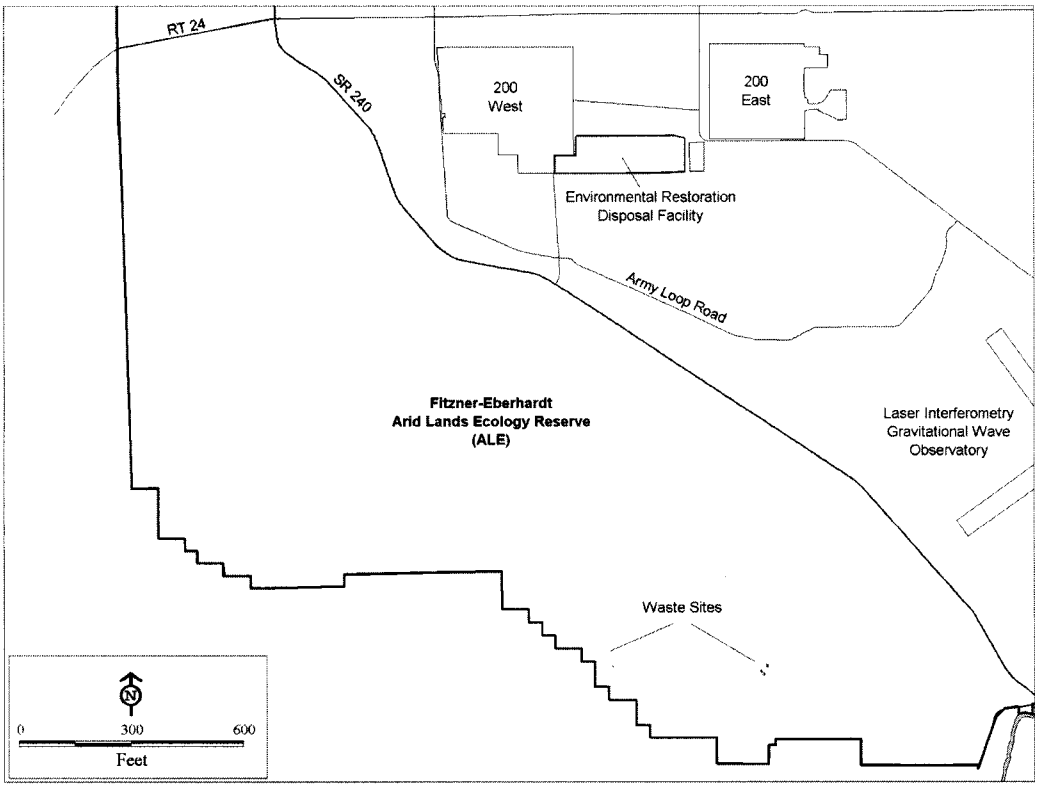
All land and facilities within the former 3000 Area were cleaned up and vacated by DOE in 1996. These lands were turned over to the Port of Benton and the 3000 Area designation was retired.

3.12 Arid Land Ecology Reserve

The 1100 Area, including Fitzner/Eberhardt Arid Lands

FITZNER/EBERHARDT ARID LANDS ECOLOGY RESERVE PORTION HIGHLIGHTS

Major Long-Term Stewardship Activities - institutional and engineered controls
Portion Size - 30,900 hectares (76,400 acres)
Estimated Volume of Residual Contaminants - to be determined
Long-Term Stewardship Start-End Years - current -in perpetuity



Fitzner-Eberhardt Arid Lands Ecology Reserve

Ecology Reserve, was listed on the National Priorities List in November 1989. The listing was based on the proximity of the reserve (1100-IU-1 Operable Unit) to a former NIKE missile base and control missile launching/maintenance and living quarters for personnel located on Rattlesnake Mountain within the Fitzner/Eberhardt Arid Lands Ecology Reserve. The U.S. Army closed/ decommissioned the base in the 1960s. The 311-square-kilometer (120-square-mile) reserve covers 30,900 hectares (76,400 acres) and is a large contiguous block of land forming the southwestern boundary of Hanford. The easternmost boundary of the reserve is approximately 24 kilometers (15 miles) west of Richland, Washington.

A Record of Decision for the 1100 Area was issued in 1993. Waste sites in the 1100-IU-1 Operable Unit were remediated in 1995. The Washington State Department of Ecology and EPA concurred with the proposed deletion of the1100 Area, including the 1100-IU-1 Operable Unit, from the National Priorities List in 1996. According to the Hanford Comprehensive Land-Use Plan EIS, the preferred alternative land use designation for the Fitzner/Eberhardt Arid Lands Ecology Reserve portion is "Preservation."

The Record of Decision for the 1100 Area, which includes the Fitzner/Eberhardt Arid Lands Ecology Reserve, addressed all areas of concern described in the national priorities list listing, as well as areas that were not initially mentioned at the time of the listing. As a result of the remedial actions performed at the Hanford 1100 Area, all possible exposure pathways from contaminated soils were eliminated, and all remedial action objectives established in the Record of Decision have been met. Active groundwater remediation was not required to protect human health or the environment at the 1100 Area; however, continued monitoring is necessary to ensure that contamination levels continue to decrease.

The U.S. Fish and Wildlife Service manages the Fitzner/Eberhardt Arid Land Ecology Reserve for DOE.

Although institutional controls are not required for waste sites at the reserve, the reserve is fenced with locked gate access. The public is not permitted access to ensure preservation of wildlife and native ecosystems. Intermittent surveillance and maintenance of the reserve is conducted by the U.S. Fish and Wildlife Service.

3.12.1 Soil

The Fitzner/Eberhardt Arid Land Ecology Reserve contains six soil waste sites covering 0.7 hectare (1.72 acres) that comprise the 1100-IU-1 Operable Unit. All six sites, which include two dumping areas and four septic tanks, are in the 1100-IU-1 Operable Unit, which is the location of a former NIKE missile base consisting of structures which supported missile launch, control, and maintenance functions, as well as living quarters for base personnel, and storage buildings for hazardous substances used in the maintenance of the physical plant and missile operations. The waste sites in these areas are associated with vehicle maintenance activities and sewage systems built to support the missile base.

A Record of Decision was issued in 1993. As a result, soil and debris that were contaminated above Washington State Model Toxics Control Act levels were removed and disposed in a permitted offsite landfill. Remediation of the site was complete in 1995, and a final close-out report was issued in July 1996. No residual contamination remains in the soil waste sites included in the 1100-IU-1 Operable Unit. Field monitoring and analyzed samples were used to confirm that cleanup levels had been met. A review will be conducted within five years after commencement of remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment and to determine long-term stewardship responsibilities.

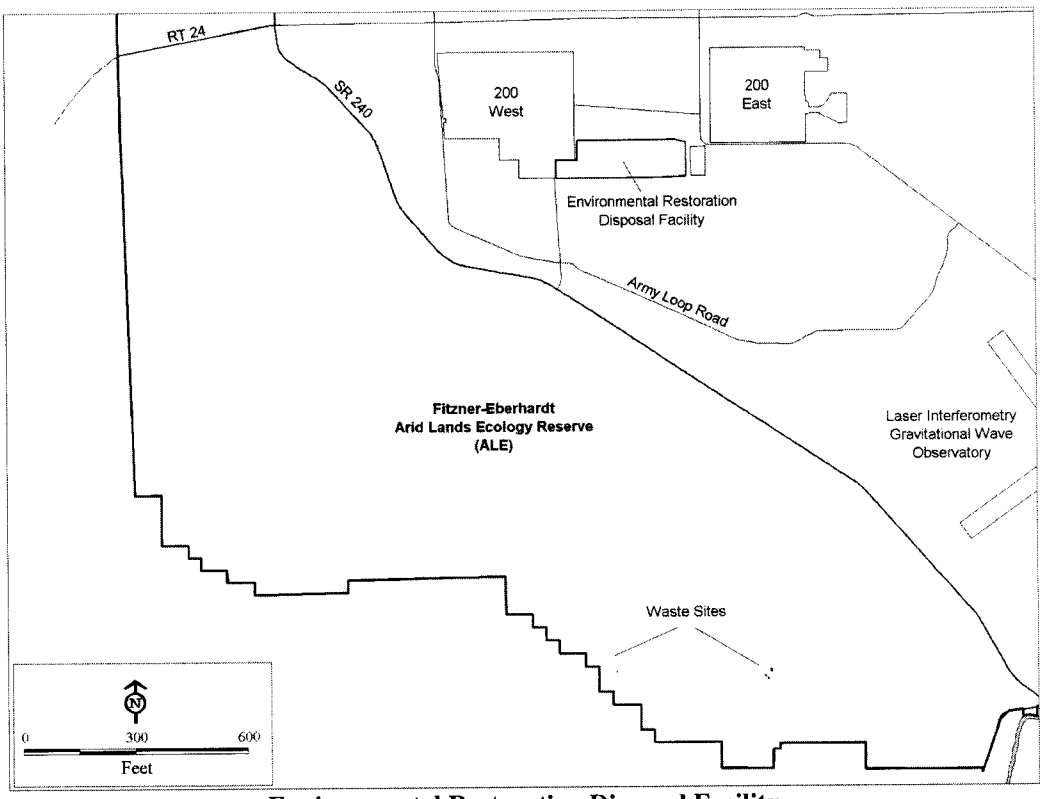
3.13 Environmental Restoration Disposal Facility

ENVIRONMENTAL RESTORATION DISPOSAL FACILITY PORTION HIGHLIGHTS

Major Long-Term Stewardship Activities - monitoring and maintenance of closed Environmental Restoration Disposal Facility cells, and groundwater monitoring
Portion Size - 65 hectares (160 acres)
Estimated Volume of Residual Contaminants - engineered unit 1.8 million metric tons (2 million tons) equivalent of 0.9 million cubic meters (1.2 million cubic yards) for cells 1 and 2 only
Long-Term Stewardship Start-End Years - 2000-in perpetuity

Disposal of radioactive, hazardous/dangerous, asbestos, PCB, and mixed wastes resulting from the remediation of operable units within the 100, 200, and 300 Area National Priorities List sites of Hanford will occur in the Environmental Restoration Disposal Facility. The Environmental Restoration Disposal Facility is a double-lined landfill meeting RCRA 40 CFR Part 264, Subpart N landfill and Subpart F groundwater monitoring requirements. The Environmental Restoration Disposal Facility is located in the central portion of Hanford, southeast of the 200West Area and southwest of the 200East Area, approximately 32 kilometers (20 miles) west of Richland, Washington. The Environmental Restoration Disposal Facility is included in this submittal because Cells 1 and 2 are mostly complete. However, this report does not cover all of the Environmental Restoration Disposal Facility.

All cells will be located within a single waste trench. The Phase I design was a single, 21.3-meter (70-foot) deep trench consisting of two side-by-side cells with final dimensions of 432.8 meters (1,420 feet) long by 219.5 meters (720-feet) wide at the top of the trench. The initial two disposal cells are expected to provide an approximate waste disposal capacity of 0.92 million cubic meters (1.2 million cubic yards). The same RCRA design selected for the existing Environmental Restoration Disposal Facility disposal cells has been used for the Phase II cells (Cells 3 and 4). The facility is equipped with a RCRA double-liner and leachate collection and recovery system. The Environmental Restoration Disposal Facility leachate may be collected and stored at the Environmental Restoration Disposal Facility for use within the trench, as appropriate. Appropriate uses are limited to dust suppression and waste compaction. The leachate must comply with land disposal restrictions,



Environmental Restoration Disposal Facility

Environmental Restoration Disposal Facility Washington Administrative Code, and other health-based limits (whichever is more restrictive). Leachate in excess of Environmental Restoration Disposal Facility recycling capacity/acceptable contaminant levels will be sent to the Effluent Treatment Facility or another approved facility for management

3.13.1 Engineered Unit

Only Hanford environmental cleanup wastes generated as a result of CERCLA or RCRA cleanup actions (investigation-derived waste, decontamination and decommissioning wastes, and RCRA past-practice wastes) are eligible for disposal in the Environmental Restoration Disposal Facility, provided the waste meets Environmental Restoration Disposal Facility Washington Administrative Code and the appropriate decision documents are in place. Additionally, non-process waste (e.g., contaminated soil, debris) generated from closure of inactive RCRA treatment, storage and disposal units may be placed in the Environmental Restoration Disposal Facility if: 1) the units are within the boundaries of a CERCLA or RCRA past-practice operable unit, 2) the closure wastes are sufficiently similar to CERCLA or RCRA past-practice wastes placed in the Environmental Restoration Disposal Facility, 3) the Environmental Restoration Disposal Facility waste acceptance criteria are satisfied, and 4) the appropriate CERCLA decision documents are in place. Revision of the RCRA Permit and closure plans may be required. Actual wastes may consist of hazardous/dangerous, radioactive, mixed (containing both hazardous/dangerous and radioactive waste), PCB (minor amounts), and asbestos wastes. Waste treatment may be conducted before disposal at the Environmental Restoration Disposal Facility instead of at the operable units.

The wastes being disposed of at the Environmental Restoration Disposal Facility are as follows:

Waste from the 100 Area

- Includes soil, solid wastes, sediments, and sludges
  - Solid wastes include hard waste, soft waste, demolition waste and pipes.
  - Soft wastes include collapsed cardboard boxes, paper, rags, clothing, plastic, and miscellaneous trash.
  - Hard wastes include aluminum tubes and spacers, failed steel and stainless steel equipment, timbers, and metal drums.

- Investigation-derived waste generated during RCRA Facility Investigation/Corrective Measures Studies (FI/CMS) or CERCLA Remedial Investigation/Corrective Measures Studies (RI/CMS) may be placed in ERDF if waste criteria are met.

Waste from the 200 Area

- Information is not currently available on the physical characterization of 200 Area soils likely to be disposed in ERDF.

- Investigation-derived waste totals about 380 cubic meters (500 cubic yards). Volumes to be disposed from the 200-ZP-1 Operable Unit and volumes to be generated during future activities will be addressed in the future.

Waste from the 300 Area

- Wastes are in two categories, based on similarities of cleanup requirements: 1) contaminated soil, and 2) solid waste (e.g., pipelines, burial ground waste).

- Investigation-derived waste generated during RCRA Facility Investigation/Corrective Measures Studies (FI/CMS) or CERCLA Remedial Investigation/Corrective Measures Studies (RI/CMS) may be placed in ERDF if waste criteria are met.

- The total volume of residual contamination from wastes from the 300 Area is estimated to be about one million cubic meters (1.3 million cubic yards) of contaminated soil and solid waste.

- Potential contaminants of concern in the 300 Area waste sites include: Non-radioactive (ammonia, arsenic, benzo(a)pyrene, cadmium, chrysene, PCBs, thallium, tetrachloroethene, trichloroethene (TCE)) and radioactive (cesium-137, cobalt-60, thorium-228, uranium-234, uranium-235, uranium-238, zinc-65) contaminants.

A Record of Decision was issued in 1995, and three amendments to the Record of Decision (1996, 1997, 1999) have been issued. A Closure Plan for the first two Environmental Restoration Disposal Facility cells has been developed. The first two cells have received nearly 1.8 million metric tons (two million tons) of contaminated material since mid-1996. Both cells will have an interim cover by July 2000. Construction of two additional cells (Cells 3 and 4) was authorized in 1998 and completed in 1999; Cells 3 and 4 will begin receiving waste in May 2000. A final cover will be placed on Cells 1, 2, 3, and 4 in the 2006-to-2007 time frame (actual date of cover placement is driven by waste volume, settlement/subsidence, and the geometry of the site).

A modified RCRA-compliant closure cover will be placed over the waste. The cover will prevent direct exposure to the waste and includes a vegetated surface layer of fine-grained soils to retain moisture and encourage evapotranspiration, thereby minimizing infiltration and vadose zone transport of contaminants to groundwater.

The upper 50 cm (20 in.) of the soil cover system is composed of a mixture of silt and gravels, which is intended to both reduce infiltration through the cover and enhance the resistance of the cover to burrowing animals and long-term wind erosion. The RCRA-compliant cover will be modified by providing a total of approximately 4.6 meters (15 feet) of soil to deter intrusion. Additional research into closure covers may result in site-specific enhancements to RCRA-compliant designs. Construction of the cover will occur incrementally as the trench is expanded. The design will, at a minimum, comply with applicable RCRA requirements found at 40 CFR Part 264, Subpart N. Hanford Site borrow-pit basalt will not be required for the Environmental Restoration Disposal Facility cover.

Institutional controls will restrict public access to the landfill upon closure. Additional measures may be necessary to ensure long-term viability of the institutional controls if the final remedial actions selected do not allow for unrestricted land use. Any additional controls will be specified as part of the final remedy. Currently active institutional controls include fences, signs, patrols badging/visitor escort, and access restriction language to any land transfer/sale/lease of property, as appropriate. Passive institutional controls will consist of markers, offsite records, and a surface barrier that is at least 4.6 meters (15 feet) thick. The institutional controls will prevent intrusion into the waste for at least 100 years, and passive controls will prevent intrusion for 500 years. DOE will perform annual evaluations of the institutional controls to determine their effectiveness and implementation and will perform five-year reviews from the commencement of remedial actions until final remediation objectives are achieved.

3.14 North Slope

NORTH SLOPE PORTION HIGHLIGHTS

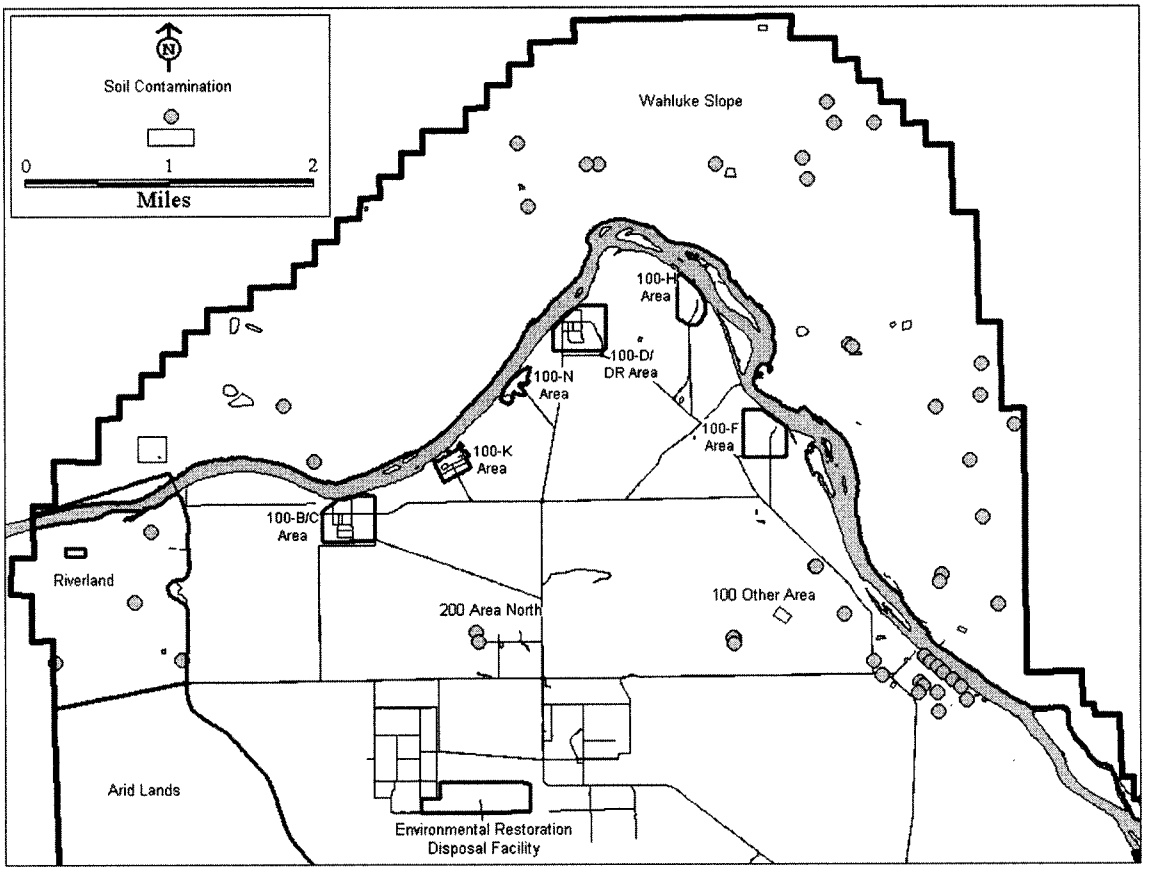
Major Long-Term Stewardship Activities - limit access to maintain the buffer zone around the site; continue revegetation efforts
Portion Size - 35,600 hectares (87,900 acres)
Estimated Volume of Residual Contaminants - to be determined
Long-Term Stewardship Start-End Years - current -in perpetuity

The North Slope (sometimes called the Wahluke Slope) is a large block of land (about 35,600 hectares, or 87,900 acres) located north of the Columbia River in the northeastern portion of Hanford, approximately 32-40 kilometers (20-25 miles) north of Richland, Washington. It is managed by the U.S. Fish and Wildlife Service as part of the Hanford Reach National Monument. Historically tribal land, the area was homesteaded by pioneers before it was taken by the Federal government in 1943 as a security buffer to protect Hanford's defense production facilities. Anti-aircraft artillery and missile sites were located on this land; plutonium production plants or storage facilities were never built there. The topography of the North Slope is marked by the Saddle Mountains to the north and the Columbia River to the south. The geologic structure beneath the North Slope is similar to much of the rest of Hanford, which consists of three distinct levels of soil formations. The waste sites covered in this submittal include all contaminated sites on the North Slope 100-IU-3 Operable Unit.

3.14.1 Soil

There are 39 soil waste sites covering 210 hectares (518 acres) in the North Slope portion. All of these sites are in long-term stewardship and are associated with: homesteading activities that occurred prior to 1943, military activities relating to the defense of Hanford, and Bureau of Reclamation Activities in support of the Columbia Basin Irrigation Project. Many of the sites in this group were landfills for former military installations, with soil contamination resulting from the historic use of petroleum products and pesticides by the military.

All contaminants of concern have been cleaned up to below the Washington State Model Toxics Control Act residential standards. Remediation of sites in the North Slope was completed by the end of 1994. The 39 sites



North Slope

on the North Slope have been investigated, characterized, and remediated where necessary to comply with Washington State Model Toxics Control Act cleanup levels. Cleanup of the 39 sites included the removal of soil contaminated with the pesticide 24-D, DDT and their associated breakdown products and disposal of them in a hazardous waste landfill in Arlington, OR. Petroleum-contaminated soil (PCS) was transported to a PCS treatment facility in Pasco, WA for bioremediation. Several 208-liter (55-gallon) drums of miscellaneous and hazardous substances were sent to appropriate handling facilities. Non-hazardous trash, debris, and concrete were either returned to the excavations or recycled. No known hazardous substances remain onsite. This is supported by the confirmatory sampling results. EPA delisted the North Slope from the National Priorities List on July 8, 1998. Because no hazardous substances remain onsite above Washington State Model Toxics Control Act health-based levels, a five-year review process does not apply to this portion. However, DOE commits to the development and implementation of a Mitigation Action Plan, in coordination with the Natural Resource Trustees, for any additional required mitigation measures. An administrative record of all project documentation is stored at the DOE Richland Administrative Record Center, at the EPA Region 10 Superfund Record Center, and at the Washington State Department of Ecology, Administrative Record in Lacey, Washington.

The entire North Slope is included in the Hanford Reach National Monument, though the land is retained by DOE. Thus, general administrative engineered controls (e.g., surveillance and maintenance and other access controls) are in place.

Institutional controls for residual wastes are not necessary -- no known hazardous wastes remain onsite (100-IU-

3 Operable Unit). According to the Hanford Comprehensive Land-Use Plan EIS, the preferred alternative land use designation for the North Slope portion is "Preservation."

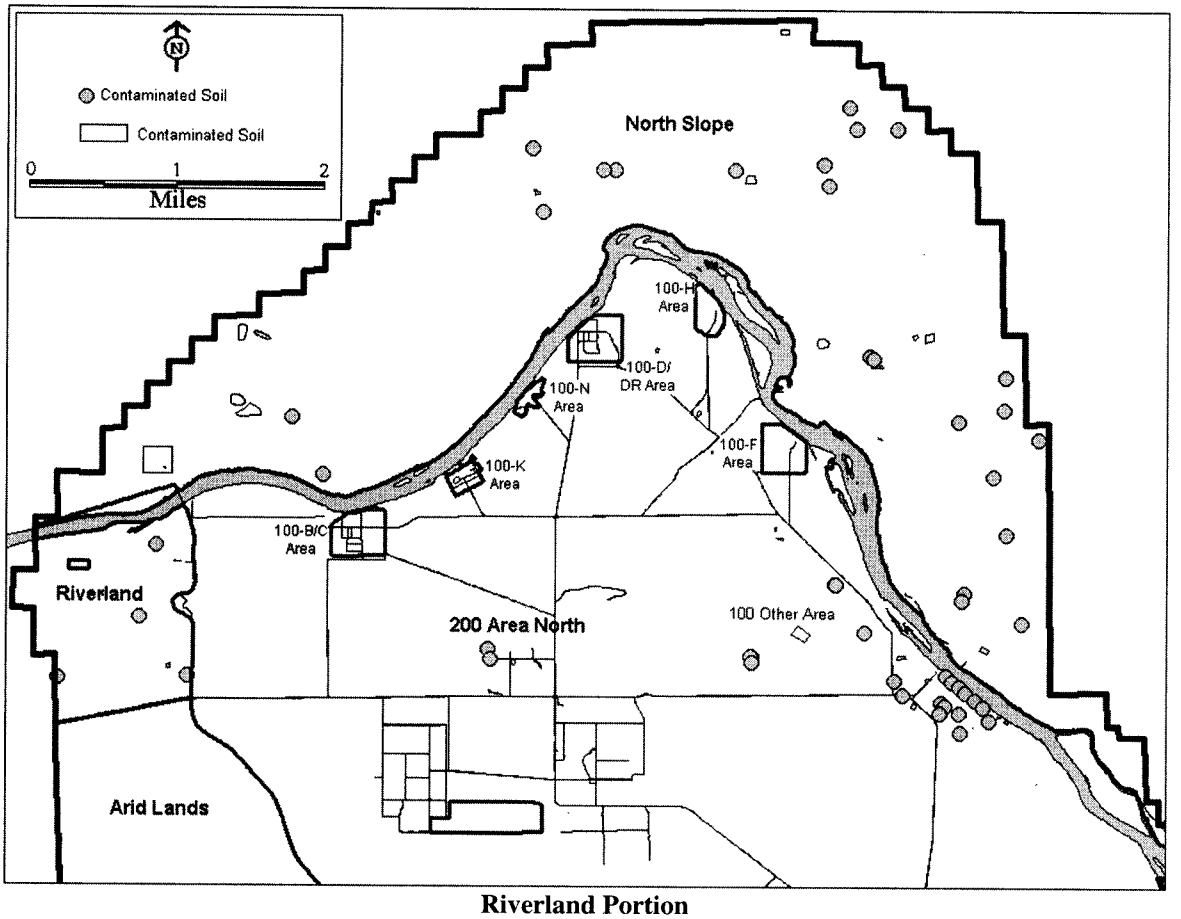
3.15 Riverland

The Riverland Portion covers about 3,500 hectares (8,650 acres) and is included in the Hanford Reach Monument. The Riverland Portion includes the Riverland Rail Yard. The Riverland Rail Yard (100-IU-1 Operable Unit) supported Hanford construction and operation activities from 1943 until 1954, while decontamination of radioactive rail cars continued until 1956. Although the Riverland Rail Yard has been remediated, the other operable units are still contaminated and will remain in the Riverland Area beyond 2006.

RIVERLAND PORTION HIGHLIGHTS

Major Long-Term Stewardship Activities - none
Portion Size - 3500 hectares (8650 acres)
Estimated Volume of Residual Contaminants - to be determined
Long-Term Stewardship Start-End Years - current -in perpetuity

The geologic structure beneath the 100 Area is similar to much of the rest of Hanford, which consists of three distinct levels of soil formations.



Riverland Portion

3.15.1 Soil

There are 12 soil waste sites in the Riverland Rail Yard. Seven of these, covering over 2.2 hectares (5.5 acres), will require long-term stewardship in 2006 and include a 2, 4-D pesticide container site, a rail yard maintenance facility, and two former military installations with associated demolition debris.

Between 1992 and 1994, DOE performed a CERCLA expedited response action for the cleanup of the Riverland Rail Yard Maintenance Facility and pesticide container sites and closure of an empty munitions cache hole. Diesel-contaminated concrete and soil from the rail yard and pesticide sites were removed from the site for bioremediation. Sampling results indicated that levels of the contaminants remaining in the soil at the rail yard are below Washington State Model Toxics Control Act residential standards. Radioactive decontamination of this facility occurred around 1963, after which the maintenance facilities were dismantled and sold. Follow-up radiological surveys were performed in 1977, 1978, and 1993, revealing only natural background levels. Also during the cleanup, a site containing 2,4-D pesticide containers was discovered, sampled, and cleaned up to Washington State Model Toxics Control Act residential standards. Contaminants of concern included Aldrin, Dieldrin, and diesel and heavy oil (all of which have been cleaned up to Washington State Model Toxics Control Act levels). A Record of Decision issued in 1996 declared that no further action is required at the Riverland 100-IU-1 Operable Unit. However, DOE will develop and implement a Mitigation Action Plan, in coordination with the Natural Resource Trustees, for any additional required mitigation measures. EPA and the Washington State Department of Ecology have determined these actions are protective of human health and the environment.

Institutional or engineered controls for residual wastes are not necessary for the Riverland Portion (100-IU-1 Operable Unit) -- no known hazardous substances remain onsite.

Although the remedial action was cleanup under CERCLA, a five-year review does not apply since hazardous substances are not left onsite above health-based levels. The administrative record of this cleanup action is stored at the DOE-Richland Administrative Record Center, the EPA Region 10 Superfund Record Center, and the Washington State Department of Ecology's Administrative Record at Lacey, Washington.

According to the Hanford Comprehensive Land-Use Plan EIS, the preferred alternative land use designation for the Riverland portion is "Preservation."

4.0 FUTURE USES

The Federal government is expected to maintain ownership of most of the site once cleanup is completed, with the DOE Environmental Management program as the steward for all areas of the site retained by the Federal government in perpetuity. To date, about 50 percent of Hanford Site lands have been cleaned up or transferred for alternate uses, mostly for economic development or preservation use. The North Slope, ALE and Reach land have been put under the management of the U.S. Fish and Wildlife Service as the Hanford Reach National Monument , but remains under DOE ownership to maintain a safety buffer zone and pristine habitat.

The Final Hanford Comprehensive Land-Use Plan EIS was issued in September 1999 and the Record of Decision released in November 1999. Of the total 152,000 hectares (375,000 acres), the preferred alternative described in the Comprehensive Land-Use Plan includes eventual land use for Hanford as follows: conservation (mining) – 442,000 hectares (109,000 acres); Industrial – 15,300 hectares (37,900 acres); Industrial-Exclusive – 5,060 hectares (12,500 acres); Preservation – 78,100 hectares (193,000 acres); High-Intensity Recreation – 125 hectares (309 acres); Low-Intensity Recreation – 334 hectares (825 acres); R&D – 4910 hectares (12,100 acres); and Columbia River – 3,640 hectares (9,000 acres). This land use distribution will not be complete by 2007.

Hanford Site Land-Use Designations	
Land-Use Designation	***Definition***
Industrial-Exclusive	An area suitable and desirable for treatment, storage, and disposal of hazardous, dangerous, radioactive, and nonradioactive wastes. Includes related activities consistent with Industrial-Exclusive uses.
Industrial	An area suitable and desirable for activities, such as reactor operations, rail, barge transport facilities, mining, manufacturing, food processing, assembly, warehouse, and distribution operations. Includes related activities consistent with Industrial uses.
Agricultural	An area designated for the tilling of soil, raising of crops and livestock, and horticulture for commercial purposes along with all those activities normally and routinely involved in horticulture and the production of crops and livestock. Includes related activities consistent with agricultural uses.
R&D	An area designated for conducting basic or applied research that requires the use of a large-scale or isolated facility, or smaller scale time-limited research conducted in the field or within facilities that consume limited resources. Includes scientific, engineering, technology development, technology transfer, and technology deployment activities to meet regional and national needs. Includes related activities consistent with Research and Development.
High-Intensity Recreation	An area allocated for high-intensity, visitor-serving activities and facilities (commercial and governmental), such as golf courses, recreational vehicle parks, boat launching facilities, Tribal fishing facilities, destination resorts, cultural centers, and museums. Includes related activities consistent with High-Intensity Recreation.
Low-Intensity Recreation	An area allocated for low-intensity, visitor-serving activities and facilities, such as improved recreational trails, primitive boat launching facilities, and permitted campgrounds. Includes related activities consistent with Low-Intensity Recreation.
Conservation (Mining & Grazing)	An area reserved for the management and protection of archeological, cultural, ecological, and natural resources. Limited and managed mining (e.g., quarrying for sand, gravel, basalt, and topsoil for governmental purposes) and grazing could occur as a special use (i.e., a permit would be required) within appropriate areas. Limited public access would be consistent with resource conservation. Includes activities related to Conservation (Mining and Grazing), consistent with the protection of archeological, cultural, ecological, and natural resources.
Conservation (Mining)	An area reserved for the management and protection of archeological, cultural, ecological, and natural resources. Limited and managed mining (e.g., quarrying for sand, gravel, basalt, and topsoil for governmental purposes) could occur as a special use (i.e., a permit would be required) within appropriate areas. Limited public access would be consistent with resource conservation. Includes activities related to Conservation (Mining), consistent with the protection of archeological, cultural, ecological, and natural resources.
Preservation	An area managed for the preservation of archeological, cultural, ecological, and natural resources. No new consumptive uses (i.e., mining or extraction of non-renewable resources) would be allowed within this area. Limited public access would be consistent with resource preservation. Includes activities related to Preservation uses.

Final decisions on the level of cleanup to be performed on individual waste units continue to be made through the CERCLA or RCRA decision processes. As CERCLA and RCRA decisions are made, revisions to the baseline and Comprehensive Land-Use Plan will be made, as required. End-state goals for the preferred alternative of the Hanford Comprehensive Land-Use Plan EIS for the portions that will require long-term stewardship in 2006 are as follows:

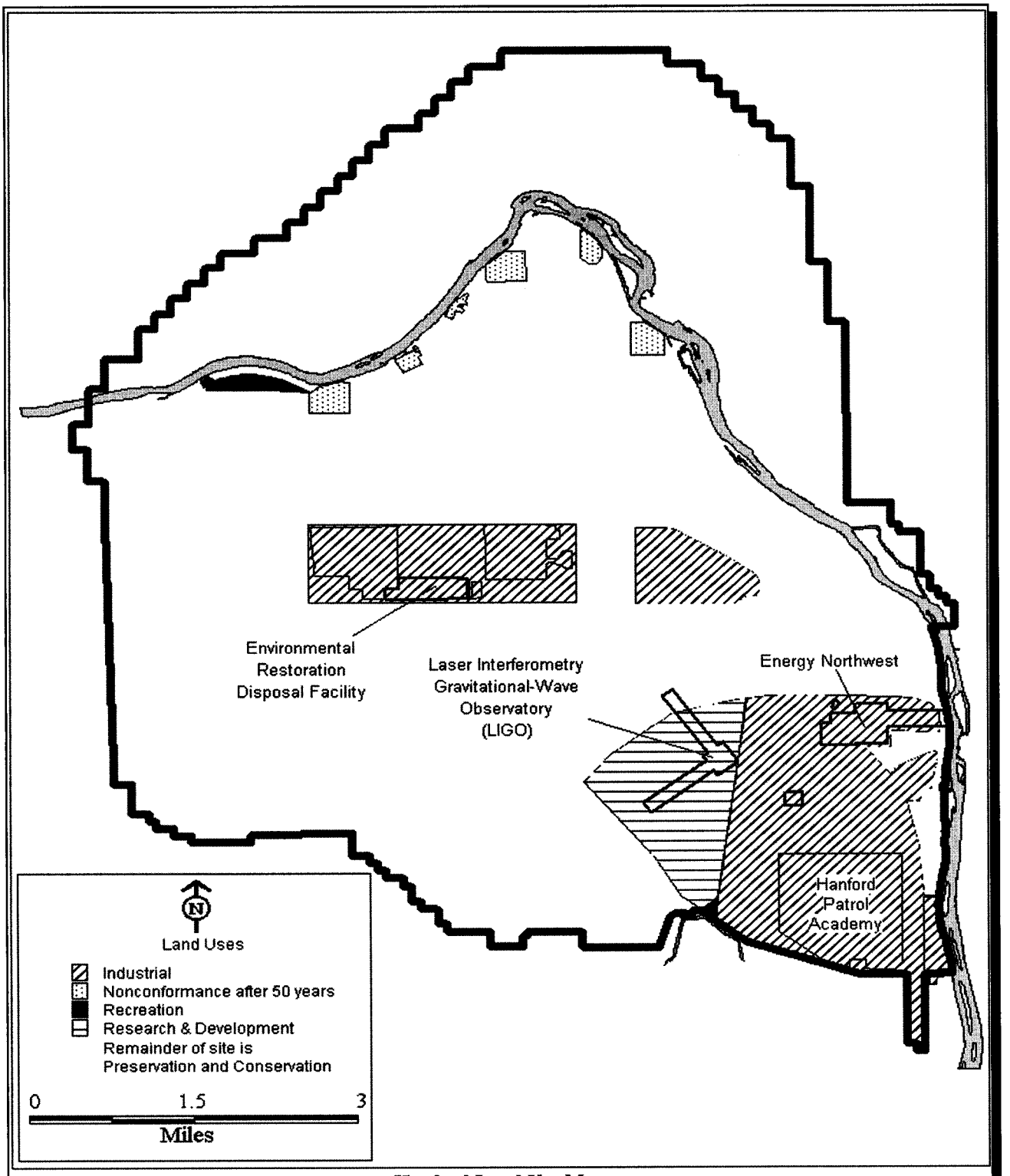
Portion	*End State Goal*
Columbia River Corridor (Portions 100B/C, 100D, 100F, 100H, 100K, 100N, 100 Other, 300)	Land-use designations include high-intensity recreation near the Vernita Bridge, a proposed museum facility at the B Reactor, and two areas on the Wahluke Slope; low-intensity recreation between the Vernita Bridge and the B Reactor museum, near the White Bluffs boat ramp and across the river on the Wahluke Slope, and for proposed recreation facilities near the D/DR Reactors, at the old Hanford High School, and just north of Energy Northwest; and conservation (mining) for the remainder. The river islands and a quarter-mile buffer zone along the river will be designated as preservation to protect cultural and ecological resources. The 300 Area land is designated for industrial use.
Portions 1100 Area and ALE	The 1100 Area is designated for industrial use and has been transferred to the Port of Benton. Most of the Fitzner/Eberhardt Arid Land Ecology Research (ALE) is designated for preservation which is consistent with current management practices by US Fish and Wildlife Service. Part of the ALE is designated for conservation (mining) as a source of materials for remediation projects on Hanford.
Wahluke Slope (Portion North Slope)	The entire slope is designated for preservation, except near the Vernita Bridge, to provide protection for sensitive areas or species. The Wahluke Slope is managed by the US Fish and Wildlife Service and the Washington Department of Fish and Wildlife.
Central Plateau (Portion Environmental Restoration Disposal Facility)	The Central Plateau is designated for industrial – exclusive use to allow for continuation of Waste Management operations such as the Environmental Restoration Disposal Facility. Portions 200 North and 200-PO-1 groundwater Plume are under lands designated for conservation (mining).
Portion Riverland	The land in the vicinity of the Riverlands Rail Yard is designated for preservation; however, the extant railroad grade across the area is considered an active permitted infrastructure.

Since the Final Hanford Comprehensive Land-Use Plan EIS was issued, the Hanford 1100 Area and the Hanford railroad southern connection (from Horn Rapids Road to Columbia Center) have been transferred from DOE ownership to Port of Benton ownership in order to support future economic development. Land use of the 1100 Area and the railroad southern connection would remain Industrial, as proposed in the EIS.

Energy Northwest (formerly known as the Washington Public Power Supply System, or 40 WPPSS) has requested DOE approval of a sublease of a portion of the land they lease from DOE north of the 300 Area. This sublease would be for siting, construction, and operation of an aluminum smelter. Land use of the Energy Northwest-leased land would remain Industrial, as proposed in the EIS.

Planning for Possible Future Missions

The Record of Decision for the Hanford Comprehensive Land-Use Plan EIS identifies lands required to support DOE's current Environmental Management and Science and Technology missions at Hanford, as well as lands for future economic development. DOE is proposing that additional lands be maintained under the Industrial land-use designation in areas where existing infrastructure is available and other compatible uses exist. DOE believes it is prudent to retain land under the Industrial land-use designation to support possible future missions, rather than convert the land to the Conservation or Preservation land-use designation at this time. This would avoid possible conflicts with future missions. DOE anticipates that the need for land under the Industrial land-use designation would continue to be evaluated during future planning efforts, which may result in conversion of some lands to the Conservation, Preservation, or other land-use designations. However, such lands would be managed as conservation until such time as a specific economic development use is identified.



Hanford Land Use Map

For additional information about the Hanford Site, please contact:

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U.S. Department of Energy
Building 825 JADWIN, Room 548
825 Jadwin Avenue
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or visit the Hanford Home Page at http://www.hanford.gov

(WNI) SHERWOOD SITE

1.0 SITE SUMMARY

1.1 Site Description and Mission

The (WNI) Sherwood Site is the location of a former uranium milling site that operated from 1978 until 1984. The site is located near the town of Wellpinit, in western Washington State on the Spokane Indian Reservation. The former mill site is licensed and was operated by Western Nuclear, Inc. (WNI), and covers approximately 154 hectares (380 acres), including a 38-hectare (94-acre) disposal cell used to dispose of the uranium mill tailings and other process-related wastes generated from mill operations. The primary land use in the vicinity of the site is logging, livestock grazing, and wildlife habitat.

LONG-TERM STEWARDSHIP HIGHLIGHTS

Major Long-Term Stewardship Activities - disposal cell monitoring; groundwater monitoring
Total Site Area - 154 hectares (380 acres)
Estimated Volume of Residual Contaminants - disposal cell: soil 268,000 cubic meters (350,000 cubic yards), 2.9 million tons of mill tailings; groundwater unknown
Long-Term Stewardship Start-End Years - 2000-in perpetuity
Average Annual Long-Term Stewardship Cost FY 2000-2006 - $38,700
Landlord - U.S. Department of Energy, Grand Junction Office

The disposal cell is located approximately 1.6 kilometers (1 mile) northeast of the Spokane River arm of Roosevelt Lake. It is in the northern portion of the tailings impoundment area and has an elevation of 563.8 meters (1,850 feet) above sea level, at its southern boundary, and 710 meters (2,330 feet) above sea level, at its northern boundary. Drainage on the site is toward the south and southwest. The site also includes a groundwater monitoring network and surface water diversion channel. The site is underlain by alluvium and a conductive bedrock zone.

The (WNI) Sherwood Site is subject to Title II of the *Uranium Mill Tailings Radiation Control Act of 1978* (UMTRCA). UMTRCA Title II sites are privately owned and operated sites that were active when UMTRCA was passed, or thereafter. The majority of the mining and milling conducted at these sites was for private sale. As such, DOE is responsible for performing long-term stewardship activities at the site, but is not responsible for site remediation.

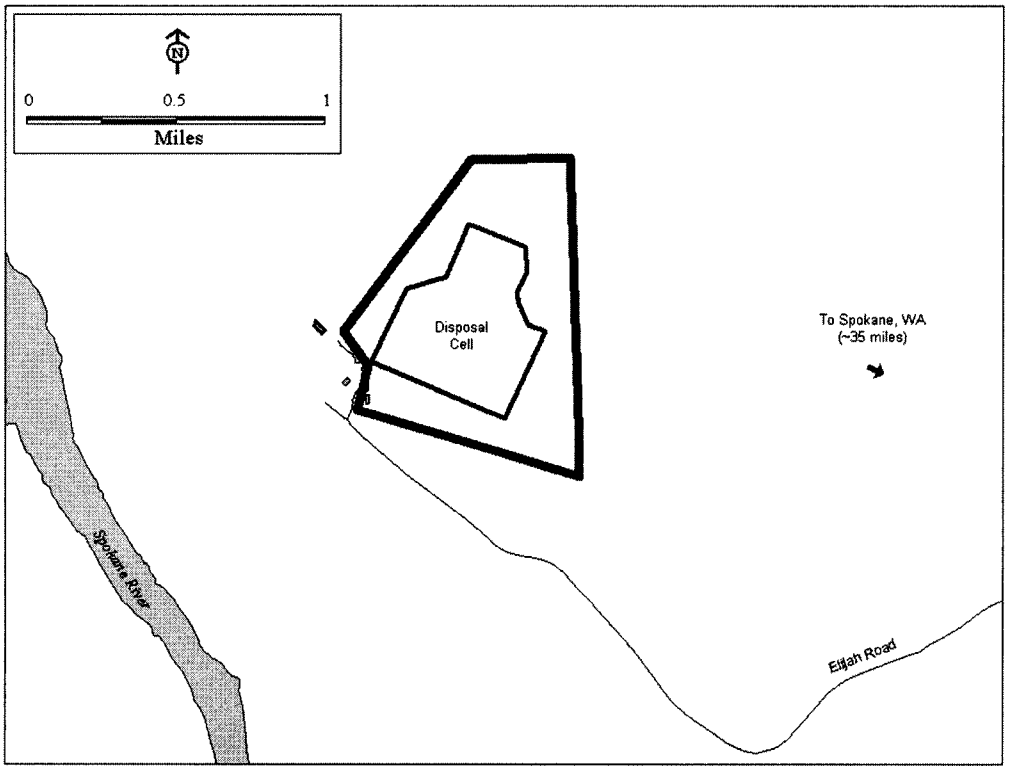
The historic mission of the site was to provide uranium concentrate exclusively to private industry. Reclamation of the site has been completed, and there is no ongoing mission. In 2000, the site will be transferred to the DOE Grand Junction office, which will perform long-term stewardship activities. After transfer, the site's mission will be long-term surveillance and maintenance of the disposal cell, and groundwater monitoring.

1.2 Site Cleanup and Accomplishments

Mill decommissioning activities were initiated in 1992 and were completed in 1995. Washington State regulations prohibit proliferation of small disposal sites; therefore, contaminated materials from the mill site were consolidated in one disposal cell. Acid-leached tailings were neutralized with lime prior to disposal. Approximately 2.9 million tons of uranium mill tailings are disposed of in the cell. In addition, 268,000 cubic meters (350,000 cubic yards) of contaminated soil, building equipment, and debris were removed from the mill site and were also disposed of in the disposal cell. The mill debris had been encapsulated in a compacted clay liner, and a cover was placed within the synthetically lined tailings impoundment prior to the final reclamation of the tailings impoundment.

A containment dam was constructed at the downgradient (south) face of the disposal cell to enclose the disposal

cell drainage area, and riprap (a rocky layer) was used to stabilize the downslope face of the embankment. The disposal cell has a synthetic liner over the bottom and sides of the cell and is capped with between 4 and 6 meters (12.5 and 20 feet) of uncompacted local soil, 15 centimeters (6 inches) of topsoil, and self–sustaining vegetation, including native grass, shrubs, and trees as a radon barrier.



(WNI) Sherwood Site

As a result of the tailings neutralization process, there are few hazardous constituents identified in the tailings fluid in concentrations above background groundwater concentrations or state or federal standards. Groundwater outside the tailings impoundment is apparently not contaminated. However, groundwater in the vicinity of the former tailings impoundment may be contaminated.

No active remediation is planned. DOE will conduct groundwater monitoring for designated indicator parameters and will collect samples annually from three monitoring wells, including one background well and two point-of-compliance wells. Indicator parameters will include sulfates, chloride, and total dissolved solids. Groundwater monitoring results will be included in the annual inspection report for the site. Any changes in the groundwater monitoring plan indicated by the groundwater monitoring data will be coordinated with the Spokane Tribe and the Bureau of Indian Affairs, and will be submitted to the NRC for review and approval.

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

The DOE Grand Junction Office will be responsible for performing long-term stewardship activities at the site. The disposal cell is within the reservation held in trust by the Bureau of Indian Affairs for the Spokane Tribe of

Indians. DOE and the NRC will have permanent rights of access for necessary long-term stewardship and regulatory activities. These activities will include disposal cell surveillance and maintenance, and groundwater monitoring. DOE will perform long-term stewardship activities, as required under the NRC general license to maintain protectiveness and regulatory compliance. Access will be restricted through the use of barriers and warning signs, posted where historic roads cross the site boundaries. DOE maintains a 24-hour phone line for reporting site concerns. Drilling and other intrusive activities will be prevented within site boundaries through institutional controls. DOE will conduct an annual inspection to ensure the integrity of the cell covers and other engineered features and that institutional controls remain effective.

Site records will be kept in permanent storage at the DOE Grand Junction Office. The types of records to be maintained include characterization data, remedial action design information, the site completion report, the long-term monitoring plan, annual inspection reports, and monitoring data.

2.2 Specific Long-Term Stewardship Activities

Engineered Units

The Washington State Department of Health and Environment has indicated that the site reclamation design for the 38-hectare (94-acre) disposal cell meets state regulatory requirements for permanent isolation without ongoing active maintenance, and that the previous three years of state inspections found no long-term site instability. Therefore, the Washington State Department of Health and Environment anticipates that only minor site monitoring and maintenance activities will be required after termination of the state license and transfer of site custody to DOE. The disposal cell's vegetated cover and rock-covered dam will prevent erosion, and the cover vegetation will prevent infiltration of precipitation into the disposal cell.

STAKEHOLDER INVOLVEMENT

Because the (WNI) Sherwood Site is on Reservation land, the Spokane Tribe is provided the opportunity to review and comment on the Final Report on Reclamation Activities and other site documentation. Copies of the annual inspection report for the WNI Sherwood Site and other sites will be distributed to the Tribe, the Bureau of Indian Affairs, the local library and any stakeholders that request copies. The report also will be published on the DOE Grand Junction Office website at www.doegjpo.com.

The reclamation site will not be fenced to allow access for cattle grazing and wildlife habitat. The reclamation site and disposal cell will require annual monitoring to ensure the integrity of the cap, vegetation, and drainage system. The site has a minimum 3.9- meter (13-foot) thick unconsolidated soil cover that acts as a radon barrier, as well as a rooting medium for natural vegetation. Vegetation on the disposal cell cover will be monitored by annual visual inspections. Any reseeding that is indicated as a result of visual inspection will be conducted in accordance with the specification for the disposal cell.

Groundwater

DOE will collect annual samples of groundwater from three monitoring wells in the vicinity of the former tailings impoundment. Additional groundwater monitoring or remediation activities may be determined, in coordination with the Spokane Tribe and the Bureau of Indian Affairs (subject to NRC approval), depending on results of sampling.

2.3 Regulatory Regime

The site was licensed to WNI by the Washington State Department of Health and Environment, Division of Radiation Protection, under the NRC's Agreement State licensing program. The Washington State Department of Health and Environment was responsible for overseeing all reclamation of the Site. Reclamation of the site has been completed and there is no ongoing mission for the site, except for long-term surveillance of the disposal

cell by DOE. Because the disposal cell is located on the Spokane Indian Reservation, which is owned by the Federal Government and held in trust for the Tribe, no agreement of transfer is required to convey property rights for the (WNI) Sherwood Site to DOE. In accordance with the provisions of Section 83(b)(8) of the *Atomic Energy Act of 1954*, as amended, DOE and the Spokane Tribe of Indians have executed an agreement that provides DOE with the necessary rights of site access to carry out its mission in accordance with the terms of the NRC license for the site. The Agreement has not yet been signed, but all parties are expected to do so.

The site is regulated under the Title II provisions of the *Uranium Mill Tailings Radiation Control Act of 1978* (UMTRCA). The Washington State licensing program for UMTRCA Title II sites operates under state regulation as part of the Agreement State Program. The Washington State Department of Health and Environment will terminate the state license for the (WNI) Sherwood Site in accordance with NRC requirements. A perpetual care and maintenance fund is to be transferred to the Federal Government in accordance with NRC license termination procedures.

DOE anticipates that the state license for the site will be terminated sometime in the second half of 2000. As part of transfer of the site to DOE, the site will come under a general license issued by NRC for custody and long-term care of residual radioactive disposal sites (contained at Title 10 of the *Code of Federal Regulations,* Section 40.28). The purpose of the general license is to ensure that such sites will be cared for in a manner that protects human health and safety and the environment. The general license will go into effect when NRC concurs that the site conforms to cleanup standards and formally accepts the site-specific long-term surveillance plan. DOE will be the long-term custodian for the site under the NRC license for long-term surveillance. States do not have right of first refusal for long-term custody of federally-owned Title II sites that are located on reservation land. The Spokane Tribe of Indians and the Bureau of Indian Affairs will review any changes to the site's long-term surveillance plan.

In addition to UMTRCA, long-term stewardship activities at the (WNI) Sherwood Site will be governed by several requirements in the following regulations: the *Atomic Energy Act of 1954,* as amended; a cooperative agreement between DOE and the State of Washington; and the *National Environmental Policy Act of 1969*, as amended.

2.4 Assumptions and Uncertainties

The site's long-term surveillance plan is currently under review by the NRC. Significant revisions are not expected. Cleanup levels will be achieved before the site is transferred to DOE. Groundwater monitoring will be conducted to verify continued compliance with cleanup levels. Site inspections will continue indefinitely as a condition of the NRC license. Groundwater monitoring may or may not continue indefinitely, based on site-specific hydrology and circumstances or until the cell demonstrates infiltration control.

3.0 Estimated Long-Term Stewardship Costs

Cost estimates are based on the actual cost of long-term stewardship activities at this site and other disposal cells currently managed by the DOE's Grand Junction Program. The annual long-term stewardship costs are higher in fiscal year 2000 due to pretransfer requirements, including the development of the site's long-term stewardship plan and negotiating an access agreement with the Spokane Tribe of Indians.

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	*Amount*	*Year(s)*	*Amount*	*Year(s)*	*Amount*
FY 2000	$52,900	**FY 2008**	$35,100	**FY 2036-2040**	$170,500
FY 2001	$41,600	**FY 2009**	$35,100	**FY 2041-2045**	$170,400
FY 2002	$36,100	**FY 2010**	$34,300	**FY 2046-2050**	$170,500
FY 2003	$34,900	**FY 2011-2015**	$163,500	**FY 2051-2055**	$170,400
FY 2004	$35,300	**FY 2016-2020**	$159,200	**FY 2056-2060**	$170,500
FY 2005	$35,500	**FY 2021-2025**	$159,700	**FY 2061-2065**	$170,400
FY 2006	$34,800	**FY 2026-2030**	$168,700	**FY 2066-2070**	$170,500
FY 2007	$35,300	**FY 2031-2035**	$170,400		

4.0 FUTURE USES

The (WNI) Sherwood Site will be a permanent uranium mill tailings repository. The reclamation site will not be fenced to allow access for grazing and wildlife habitat.

For more information about the (WNI) Sherwood Site, contact:

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U.S. Department of Energy, Grand Junction Office
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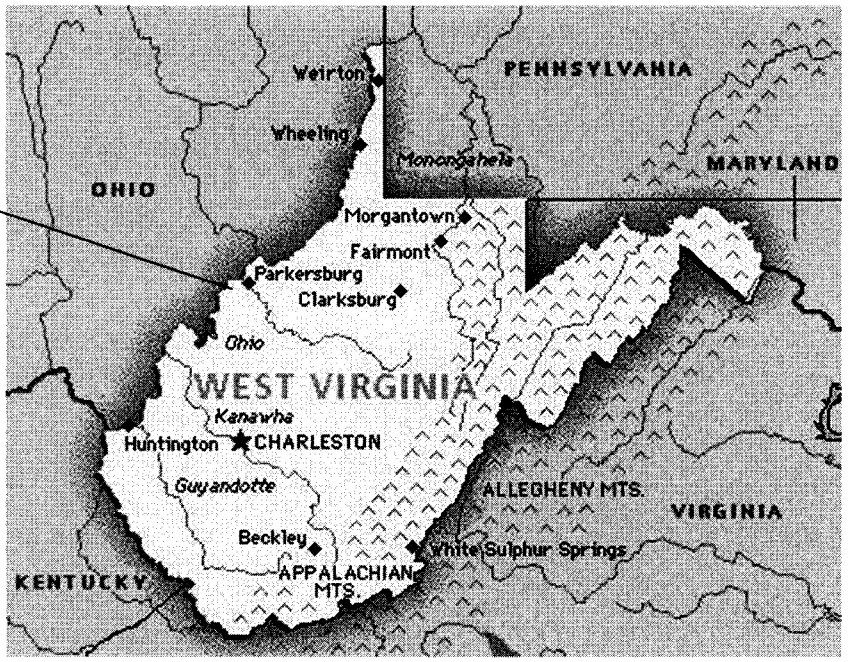
Phone: 970-248-6037
or visit the Internet website at http://www.doegjpo.com

West Virginia

Parkersburg Site



Long-Term Stewardship Site Highlights

Parkersburg Site (page 3)

Major Activities - disposal cell monitoring; groundwater monitoring; access restrictions; inspections; maintenance
Site Size - 6.06 hectares (15 acres)
Start-End Years - 1983/in perpetuity
Estimated Average Annual Cost FY 2000-2006 - $16,400

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Parkersburg Site 3

PARKERSBURG SITE

1.0 SITE SUMMARY

1.1 Site Description and Mission

The Parkersburg Site is the location of a former uranium mill and currently contains an engineered disposal cell. The six-hectare (15-acre) site is located eight miles southwest of Parkersburg, West Virginia. The land surrounding the site is primarily agricultural and industrial, with some residential use, and is moderately populated. Contamination of the site resulted from previous mining and milling operations. Some of the zirconium ore processed at the Parkersburg Site was radioactive. The initial process used at the site generated waste material that was pyrophoric (capable of causing fires and explosions). Waste materials were stored in drums that subsequently deteriorated and leaked, resulting in soil contamination. Approximately 3,000 drums of ore, waste, and contaminated soil were disposed of offsite in 1968. The remaining contamination was consolidated in an onsite engineered disposal cell. The grass-covered, gently sloping disposal cell occupies an area of approximately five hectares (12 acres) and rises to a maximum height of approximately three meters (nine feet). American Metals Climax (AMAX) completed remediation of the site in 1983.

LONG-TERM STEWARDSHIP HIGHLIGHTS

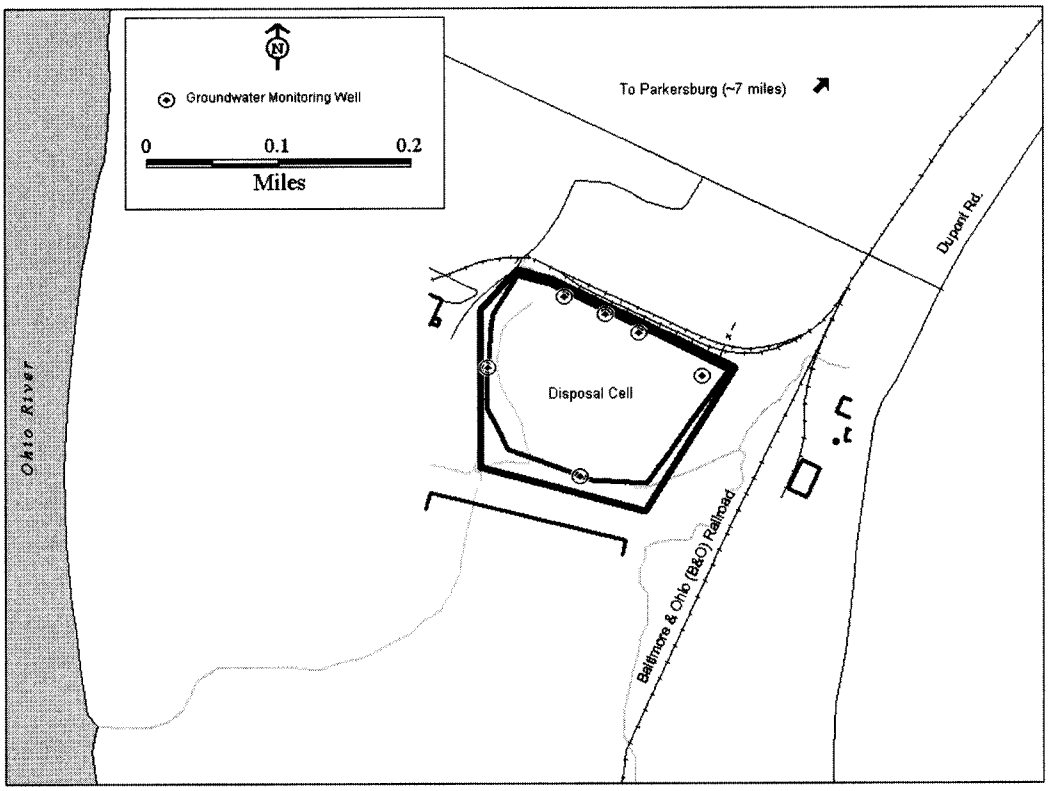
Major Long-Term Stewardship Activities - disposal cell monitoring; groundwater monitoring; access restrictions; inspections; maintenance
Total Site Area - 6.06 hectares (15 acres)
Estimated Volume of Residual Contaminants - disposal cell 15,300 cubic meters (20,000 cubic yards)
Long-Term Stewardship Start-End Years - 1983-in perpetuity
Average Annual Long-Term Stewardship Cost FY 2000-2006 - $16,400
Landlord - U.S. Department of Energy, Grand Junction Office

The DOE Grand Junction Office is the present landlord at the site. The current mission for the Parkersburg Site is maintaining and monitoring the onsite disposal cell. The historic mission of the site was to produce zirconium metal for use in the construction of nuclear reactors for the U.S. Navy. The Carborundum Company developed the Parkersburg site in 1957. AMAX assumed ownership of the plant in 1967, becoming the U.S. Nuclear Regulatory Commission (NRC) licensee to process and possess radioactive ores and waste materials at this location. According to the provisions of the *Nuclear Waste Policy Act of 1982* (NWPA), the site was transferred to DOE in 1994 for long-term monitoring and maintenance.

1.2 Site Cleanup and Accomplishments

Remediation of the site was completed by AMAX in 1983, which consisted of demolishing site structures and burying contaminated structural materials, radioactive soils, and pyrophoric materials in the onsite engineered disposal cell. Less than 15,300 cubic meters (20,000 cubic yards) of waste are contained in the disposal cell. The precise volume of the waste is unknown since the design drawings of the cell were not provided to DOE at the time of site transfer. The disposal cell is capped with clay and revegetated with grasses to prevent erosion.

To date, no groundwater contamination has been detected at the site. Groundwater samples determined that groundwater complies with the State of West Virginia's groundwater standards and with the Federal Safe Drinking Water Act.



Parkersburg Site

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

Long-term stewardship activities at the Parkersburg Site began in 1983, prior to the site's transfer to DOE. The site was transferred to DOE 1994, and DOE is now responsible for conducting all long-term stewardship activities at the site. A two-meter (six-foot) tall locked fence surrounds the site, controlling access to the disposal cell. To prevent human exposure to the buried waste, no drilling or other intrusive activities are allowed on the property, except for installation of additional groundwater monitoring wells.

Boundary monuments define the six corners of the legal boundary of the site property. Warning signs are placed at intervals along the security fence around the site perimeter. Six groundwater monitoring wells are located around the perimeter of the stabilization mound and inside the security fence. A total of six wells are located in the north (three wells), west-central, south-central, and northeast parts of the site. DOE's responsibility for the safety and integrity of the Parkersburg site will continue in perpetuity.

Site records are kept in permanent storage at the DOE Grand Junction Office in Colorado. The types of records maintained include site characterization data, remedial action design information, the radiological assessment, long-term monitoring plans, annual inspection reports, and current and historic monitoring data.

2.2 Specific Long-Term Stewardship Activities

Engineered Units

The contaminated materials were placed on concrete building slabs located over the buried pyrophoric waste and covered with a cap. The cap was designed to minimize radionuclide leaching, reduce radon emissions, prevent erosion and dispersion of the contaminated materials, and eliminate the potential for contact with pyrophoric wastes. A layer of compacted clayey soil was placed over the waste, followed by a layer of low-permeability clay. A layer of compacted topsoil was placed over the clay cap to protect it from weathering and erosion, followed by a layer of uncompacted topsoil to support the grass cover. A clay-filled barrier trench was constructed around the perimeter of the stabilization mound to protect it from horizontal movement of offsite shallow groundwater. In addition, a shallow drainage furrow was constructed to channel water away from the mound.

STAKEHOLDER INVOLVEMENT

Community interaction has been minimal since the remediation was completed by the private owner in 1983. When the site is inspected annually, the inspectors meet with the adjacent land owner(s) to determine if any issues of concern exist. Copies of the annual inspection report are distributed to the local library and any stakeholders requesting them. The report is also published on the DOE Grand Junction Office website at www.doegjpo.com.

Long-term stewardship activities include annual site inspections of the disposal cell and minor maintenance activities, such as fence repairs, sign replacement, and cap maintenance. DOE will perform long-term stewardship activities at the disposal cell, including access restrictions, in perpetuity.

Groundwater

Site characterization by DOE in 1994 showed that groundwater beneath the site was not contaminated. As a best management practice, DOE monitors groundwater at five-year intervals to ensure the integrity of the disposal cell in perpetuity.

2.3 Regulatory Regime

Long-term stewardship activities at the Parkersburg Site is governed by several regulations, including the *Nuclear Waste Policy Act* (NWPA), Section 151(C); the *Atomic Energy Act of 1954*, as amended; and the *National Environmental Policy Act of 1969, as amended.* Section 151(C) of the NWPA, required that if low-level radioactive waste is the result of a licensed activity to recover zirconium, hafnium, and rare earth metals from source material, DOE shall assume title and custody of the site if requested by the site owner.

The need for continued groundwater monitoring at the Parkersburg Site was evaluated in accordance with DOE Orders 5440.1E, "National Environmental Policy Act (NEPA) Compliance Program," and 5400.1, "General Environmental Protection Program."

2.4 Assumptions and Uncertainties

DOE assumes that groundwater monitoring will continue to occur at five-year intervals in perpetuity.

Because the site has been monitored for almost 20 years, the long-term stewardship activities at the site are well known and are not expected to change dramatically. Sound scope and cost estimates for the long-term stewardship activities at the site have been developed.

3.0 ESTIMATED LONG-TERM STEWARDSHIP COSTS

AMAX made a one-time payment of $230,000 to the U.S. Treasury in January 1994, as required under the NWPA to cover the costs associated with long-term stewardship activities at the site. Long-term stewardship costs for the site are relatively constant, with slight spikes every fifth year due to costs from groundwater monitoring.

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	***Amount***	***Year(s)***	***Amount***	***Year(s)***	***Amount***
FY 2000	$15,923	**FY 2008**	$15,300	**FY 2036-2040**	$88,000
FY 2001	$15,700	**FY 2009**	$22,900	**FY 2041-2045**	$88,000
FY 2002	$15,400	**FY 2010**	$15,300	**FY 2046-2050**	$88,000
FY 2003	$14,800	**FY 2011-2015**	$80,300	**FY 2051-2055**	$88,000
FY 2004	$22,500	**FY 2016-2020**	$80,200	**FY 2056-2060**	$88,000
FY 2005	$15,300	**FY 2021-2025**	$82,300	**FY 2061-2065**	$88,000
FY 2006	$15,100	**FY 2026-2030**	$87,100	**FY 2066-2070**	$88,000
FY 2007	$15,400	**FY 2031-2035**	$88,000		

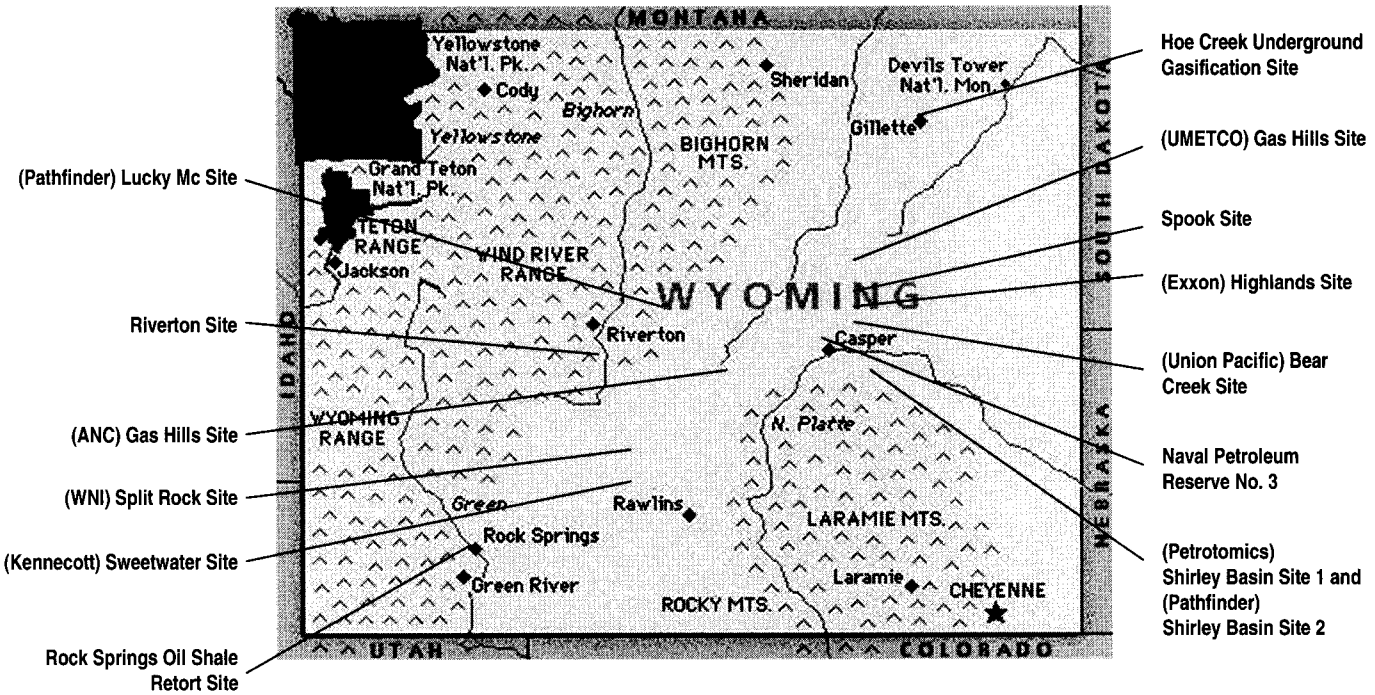
4.0 FUTURE USES

The future use of the site will be restricted to monitoring and maintaining the disposal cell in perpetuity.

For more information about the Parkersburg Site, please contact:

Art Kleinrath, Long-Term Surveillance and Maintenance Program Manager
U.S. Department of Energy, Grand Junction Office
2597 B3/4 Road, Grand Junction, CO 81503
Phone: 970-248-6037
or visit the Internet website at http://www.doegjpo.com

Wyoming



Long-Term Stewardship Site Highlights

(ANC) Gas Hills Site (page 3)
Major Activities - disposal cell and groundwater monitoring; institutional control enforcement; erosion control; access restrictions
Site Size - 242 hectares (600 acres)
Start/End Years - 2001/in perpetuity
Estimated Average Annual Cost FY 2000-2006 - $19,300

(Exxon) Highlands Site (page 7)
Major Activities - disposal cell monitoring; groundwater monitoring
Site Size - 162 hectares (400 acres)
Start/End Years - 2002/in perpetuity
Estimated Total Annual Cost FY 2002-2006 - $26,500

Hoe Creek Underground Gasification Site (page 11)
Major Activities - institutional controls; groundwater monitoring
Site Size - 32.4 hectares (80 acres)
Start/End Years - 2004-2014
Estimated Total Cost FY 2004-2014 - $3,000,000

(Kennecott) Sweetwater Site (page 13)
Site Size - unknown
Current Landlord - Kennecott Uranium Company
Expected Future Landlord - U.S. Department of Energy, Grand Junction Office

Naval Petroleum Reserve No.3 (page 17)
Major Activities - monitoring and maintenance of the onsite industrial waste landfill
Site Size - 3,800 hectares (9,400 acres)
Start/End Years - 2001-unknown
Estimated Average Annual Cost FY 2001-2006 - $2,500

(Pathfinder) Lucky Mc Site (page 19)
Major Activities - disposal cell monitoring and maintenance; groundwater monitoring
Site Size - unknown
Start/End Years - 2005/in perpetuity
Estimated Average Annual Cost FY 2005-2006 - $35,150

(Pathfinder) Shirley Basin Site 2 (page 25)
Major Activities - disposal cell maintenance and monitoring; groundwater monitoring
Site Size - 202 hectares (500 acres)
Start/End Years - 2006/in perpetuity
Estimated Average Annual Cost FY 2006 - $34,800

(Petrotomics) Shirley Basin Site 1 (page 31)
Major Activities - access control; disposal cell monitoring; groundwater monitoring
Site Size - 243 hectares (600 acres)
Start/End Years - 2002/in perpetuity
Estimated Average Annual Cost FY 2002-2006 - $35,300

Riverton Site (page 37)
Major Activities - groundwater monitoring; institutional controls
Site Size - 57 hectares (140 acres)
Start/End Years - 1989/2070
Estimated Average Annual Cost FY 2003-2006 - $6,000

Rock Springs Oil Shale Retort Site (page 41)
Major Activities - groundwater and surface vegetation monitoring; institutional controls
Site Size -130 hectares (320 acres)
Start/End Years - 2005-2010
Estimated Average Annual Cost FY 2005-2010 - $2,000,000

Spook Site (page 43)
Major Activities - disposal cell monitoring; institutional controls; access restrictions
Site Size - 7 hectares (14 acres)
Start/End Years - 1993/in perpetuity for disposal cell
Estimated Average Annual Cost FY 2000-2006 - $28,000

(UMETCO) Gas Hills Site (page 49)
Major Activities - monitoring and maintenance of disposal cells; groundwater monitoring
Site Size - 810 hectares (2,000 acres)
Start-End Year - 2002/in perpetuity
Estimated Average Annual Cost FY 2002-2006 - $35,300

(Union Pacific) Bear Creek Site (page 55)
Major Activities - disposal cell monitoring; groundwater monitoring
Site Size - approximately 405 hectares (1,000 acres)
Start/End Years - 2001/in perpetuity
Estimated Average Annual Cost FY 2000-2006 - $33,900

(WNI) Split Rock Site (page 59)
Major Activities - disposal cell monitoring and maintenance; groundwater monitoring
Site Size - 2,104 hectares (5,200 acres) (acreage to be transferred to DOE for is unknown)
Start/End Years - 2002/in perpetuity
Estimated Average Annual Cost FY 2002-2006 - $35,300

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(ANC) GAS HILLS SITE

1.0 SITE SUMMARY

1.1 Site Description and Mission

The (ANC) Gas Hills Site is the location of a former uranium mill that operated from 1959 until 1994. The 242-hectare (600-acre) site is currently owned by the American Nuclear Corporation (ANC) and is located in Gas Hills, Wyoming, approximately 137 kilometers (85 miles) west of Casper. The site will likely include a single, 57-hectare (140-acre) disposal cell for uranium mill tailings generated from the mining and milling of uranium and thorium.

LONG-TERM STEWARDSHIP HIGHLIGHTS

Major Long-Term Stewardship Activities - disposal cell and groundwater monitoring; institutional control enforcement; erosion control; access restrictions
Total Site Area - 242 hectares (600 acres)
Estimated Volume of Residual Contaminants - disposal cell 3.29 million cubic meters (4.30 million cubic yards); groundwater unknown
Long-Term Stewardship Start-End Years - 2001-in perpetuity
Average Annual Long-Term Stewardship Cost FY 2000-2006 - $19,300
Landlord - U.S. Department of Energy, Grand Junction Office (expected in 2001)

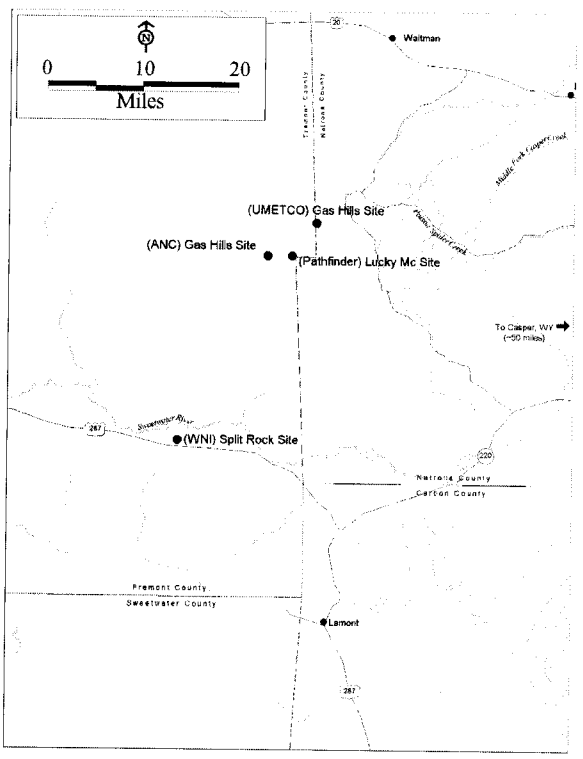
The current site mission is remediation and disposal of mill tailings into an onsite disposal cell to be approved by the U.S. Nuclear Regulatory Commission (NRC). The Wyoming Department of Environmental Quality is conducting the site's remediation and disposal activities. The (ANC) Gas Hills Site is subject to Title II of the *Uranium Mill Tailings Radiation Control Act of 1978* (UMTRCA). UMTRCA Title II sites are privately owned and operated sites that were licensed when UMTRCA was passed, or thereafter. The majority of the mining and milling conducted at these sites was for private sale, but a portion of the uranium was sold to the U.S. Government. As such, the U.S. Department of Energy (DOE) is responsible for long-term stewardship activities at the site but is not responsible for site remediation. Upon completion of remediation and closure of the disposal cell, the site will be transferred to DOE for long-term stewardship. This is expected to occur in FY 2001. The number of acres that will be transferred to DOE has not yet been formalized but is expected to range from 81 to 242 hectares (200 to 600 acres). Once the site is transferred to DOE, the only site mission will be long-term monitoring and maintenance of the disposal cell, and monitoring of the groundwater.

The historic mission of the (ANC) Gas Hills Site was to mine and mill uranium for sale to the U.S. Atomic Energy Commission (a predecessor agency to DOE) and various electric utilities. The uranium was obtained through open pit surface mining. ANC began mining and milling activities at the site in 1959 and continued to operate its mill for commercial customers until it discontinued operations and went out of business in 1994. The Atomic Energy Commission discontinued purchases of uranium from the site in 1971. Approximately 7,250 tons of uranium concentrates were produced at the (ANC) Gas Hills Site mill over its operating life.

1.2 Site Cleanup and Accomplishments

When ANC went out of business in 1994, the reclamation bond was forfeited to the Wyoming Department of Environmental Quality, which then became responsible for all site remediation activities. At that time, the mill and associated buildings were dismantled, and the building materials buried in one of the two adjacent tailings ponds. These tailing ponds also contained the processed ores produced by the mill (mill tailings). The mill tailings in the two impoundments were graded into mounds covering approximately 16 hectares and 32 hectares (40 and 80 acres), respectively. A cover of native earth was placed over the mounds, and the tailings, soils, and construction debris allowed to settle and compact naturally.

The Wyoming Department of Environmental Quality has continued its reclamation work and is consolidating the contaminated material into an engineered disposal cell. The final disposal cell is expected to have a low-permeability radon barrier cover and rock surface layer for erosion control. Erosion control will be provided for all potentially vulnerable features, and the site will be graded to provide positive drainage. Disturbed areas will be revegetated. The two tailing impoundments are being reclaimed separately. At this time, DOE is uncertain whether the materials in the two impoundments are being excavated and placed in a separate disposal cell, or are being merged into one cell by excavating the area between the two existing impoundments.



(ANC) Gas Hills Site

Groundwater below the mill site is known to be contaminated with uranium and radium as a result of uranium milling operations. However, DOE does not know the specific levels of contamination. DOE does not anticipate that any active groundwater remediation will be conducted. Rather, natural flushing will be relied upon to achieve cleanup objectives. DOE assumes that groundwater monitoring will be required as part of the site's long-term stewardship activities.

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

Upon the transfer of the (ANC) Gas Hills Site from the Wyoming Department of Environmental Quality to DOE in 2001, DOE will be responsible for performing long-term stewardship activities. In order for the site to be transferred to DOE, the Wyoming Department of Environmental Quality must make a one-time payment to the U.S. Treasury fully funding inspections and ongoing maintenance.

Anticipated long-term stewardship activities include restricting access by fencing and posting warning signs along the site boundary. DOE will repair the fence and replace signs, as necessary, and staff a 24-hour phone line for reporting site concerns. Drilling and other intrusive activities will be prevented within site boundaries through institutional controls.

Site records are in permanent storage at the DOE Grand Junction Office in Colorado. The types of records maintained include the site characterization data, remedial action design information, the site completion report, long-term monitoring plans, annual inspection reports, and current and historic monitoring data.

2.2 Specific Long-Term Stewardship Activities

Engineered Units

The site is expected to contain one lined, low-level waste disposal cell. The exact size of the cell is not yet known but is expected to be approximately 57 hectares (140 acres). The estimated total volume of contamination to be contained in the cell is 3.3 million cubic meters (4.3 million cubic yards). The disposal cell contains uranium mill tailings, and soils and construction debris contaminated with uranium, radium, and thorium. Once remediation is complete, the disposal cell will have a low-permeability radon barrier cover and rock surface layer for erosion control.

> ***STAKEHOLDER INVOLVEMENT***
>
> Community interaction is expected to be minimal once the remedial action is completed. Copies of the annual inspection report for the (ANC) Gas Hills Site will be distributed to the local library and any stakeholders requesting them. The report is also published on the DOE Grand Junction Office website at www.doegjpo.com.

Long-term stewardship activities include annual site inspections of the disposal cell, as well as minor maintenance activities, such as fence repairs, sign replacements, and cap maintenance. Long-term stewardship activities of the disposal cell, including access restrictions, will continue in perpetuity.

Groundwater

DOE assumes that the groundwater will require annual monitoring until verification that natural attenuation has achieved the cleanup objectives. The actual groundwater monitoring requirements will be detailed in the long-term surveillance plan to be approved by NRC at the time of site transfer (expected in FY 2001).

2.3 Regulatory Regime

To terminate the site's NRC license, the Wyoming Department of Environmental Quality must conduct NRC-approved reclamation of any onsite radioactive waste. NRC will then determine when the site will be transferred to DOE for custody and long-term care.

The Wyoming Department of Environmental Quality will complete site reclamation at the (ANC) Gas Hills Site in accordance with Title II of the *Uranium Mill Tailings Radiation Control Act of 1978* (UMTRCA) and will dispose of the tailings in an NRC-approved disposal cell. Cleanup and reclamation standards were promulgated by NRC in Title 10 of the *Code of Federal Regulations,* Part 40, Appendix A. These standards conform to the U.S. Environmental Protection Agency standards specified in Title 40 of the *Code of Federal Regulations,* Part 192. The site will be transferred under general license by NRC to DOE for long-term custody. The NRC general license is in accordance with Title 10 of the *Code of Federal Regulations* Part 40.28, *General License for Custody and Long-Term Care of Uranium or Thorium Byproduct Materials Disposal Sites.*

Once the site is transferred to DOE under general license, long-term stewardship activities of the site will be governed by several requirements in the following regulations: UMTRCA; the *Atomic Energy Act of 1954,* as amended; EPA standards, including Subparts D and E of Title 40 of the *Code of Federal Regulations*, Part 192; a cooperative agreement between DOE and the State of Wyoming; and the *National Environmental Policy Act of 1969*, as amended.

2.4 Assumptions and Uncertainties

Based on ongoing conversations with NRC, DOE assumes that the site will be transferred to DOE in 2001.

DOE anticipates that natural attenuation will achieve the site's groundwater cleanup objectives.

DOE is uncertain if the Wyoming Department of Environmental Quality is consolidating the original mill tailings piles into a single disposal cell or leaving the tailings in the two smaller on-site impoundments with a separate cap over each cell. Long-term stewardship activities and associated costs at the (ANC) Gas Hills Site are not expected to be significantly impacted by this uncertainty.

3.0 ESTIMATED LONG-TERM STEWARDSHIP COSTS

The cost estimates, identified in the table below, are based on the actual costs of long-term stewardship activities at other disposal cells under DOE's management. Actual costs will vary depending upon the result of groundwater sampling, sampling frequency, number of samples analyzed, and the number of sampling points (e.g., wells). Contingency costs, such as cap replacement, are not reflected in the cost estimates.

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	***Amount***	***Year(s)***	***Amount***	***Year(s)***	***Amount***
FY 2000	$4,200	**FY 2008**	$21,100	**FY 2036-2040**	$102,300
FY 2001	$25,000	**FY 2009**	$21,100	**FY 2041-2045**	$102,300
FY 2002	$21,700	**FY 2010**	$20,600	**FY 2046-2050**	$102,300
FY 2003	$20,900	**FY 2011-2015**	$98,100	**FY 2051-2055**	$102,300
FY 2004	$21,100	**FY 2016-2020**	$95,500	**FY 2056-2060**	$102,300
FY 2005	$21,300	**FY 2021-2025**	$95,800	**FY 2061-2065**	$102,300
FY 2006	$20,900	**FY 2026-2030**	$101,200	**FY 2066-2070**	$102,300
FY 2007	$21,200	**FY 2031-2035**	$102,300		

4.0 FUTURE USE

The future use of the site will be restricted to monitoring and maintaining the disposal cell in perpetuity.

For more information about the (ANC) Gas Hills Site, please contact:

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U.S. Department of Energy, Grand Junction Office
2597 B3/4 Road, Grand Junction, CO 81503
Phone: 970-248-6037
or visit the Internet website at http://www.doegjpo.com

(EXXON) HIGHLANDS SITE

1.0 SITE SUMMARY

1.1 Site Description and Mission

The (Exxon) Highlands Site is the location of a former uranium mine and mill. The site is privately owned and operated by Exxon Mobil Corporation and is located in Converse County, Wyoming, 40 miles northeast of Glen Rock in the Powder River Basin. The site covers 162 hectares (400 acres) and has a 69-hectare (170-acre) onsite disposal cell for wastes generated during uranium milling operations.

LONG-TERM STEWARDSHIP HIGHLIGHTS

Major Long-Term Stewardship Activities - disposal cell monitoring; groundwater monitoring
Total Site Area - 162 hectares (400 acres)
Estimated Volume of Residual Contaminants - disposal cell 6.5 million cubic meters (8.5 million cubic yards)
Long-Term Stewardship Start-End Years - 2002-in perpetuity
Average Annual Long-Term Stewardship Cost FY 2002-2006 - $26,500
Landlord - U.S. Department of Energy, Grand Junction Office (beginning in 2002)

The current mission of the site is remediation and disposal of the uranium mill tailings into a disposal cell approved by the U.S. Nuclear Regulatory Commission (NRC). These activities are being conducted by Exxon Mobil Corporation. The (Exxon) Highlands Site is subject to Title II of the *Uranium Mill Tailings Radiation Control Act of 1978* (UMTRCA). UMTRCA Title II sites are privately owned and operated sites that were active when UMTRCA was passed, or thereafter. The majority of the mining and milling conducted at these sites was for private sale, but a portion of the uranium was sold to the U.S. Government. As such, the U.S. Department of Energy (DOE) is responsible for long-term stewardship activities at the site but is not responsible for site remediation. Based on ongoing discussions with NRC, DOE assumes that the (Exxon) Highlands site will be transferred to DOE for long-term stewardship activities in 2002. At that time, the only mission for the site will be the ongoing monitoring and maintenance of the disposal cell, and groundwater monitoring.

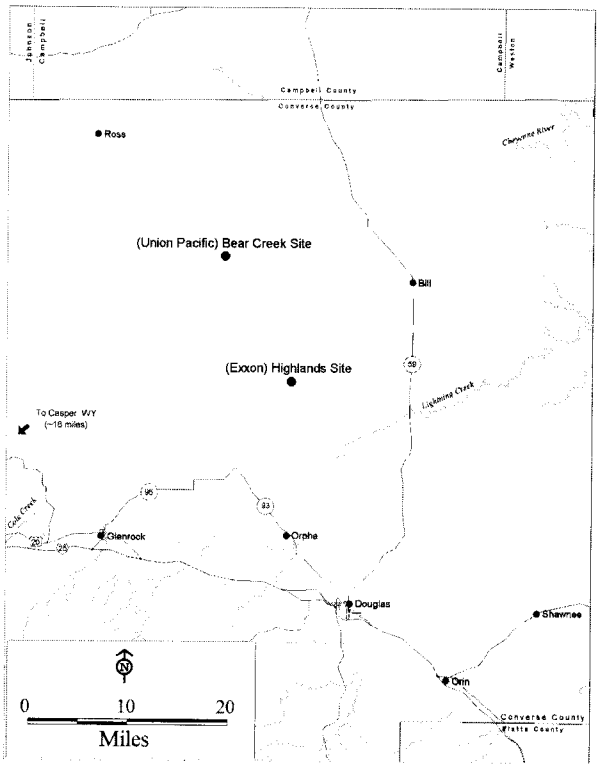
The site's historic mission was the mining and milling of uranium ore for commercial and government use. To terminate the site's NRC license, the owner must conduct NRC-approved reclamation of any onsite radioactive waste. NRC will then determine if the site is ready to be transferred to DOE for custody and long-term care. In order for the site to be transferred to DOE, Exxon must provide a one time payment to the U.S. Treasury to fully fund inspections and maintenance.

1.2 Site Cleanup and Accomplishments

Exxon Mobil Corporation is conducting remediation activities at the site. An onsite disposal cell was constructed to encapsulate the uranium mill tailings and materials from the dismantling of the mill. The 69-hectare (170-acre) cell contains approximately 6.5 million cubic meters (8.5 million cubic yards) of uranium mill tailings and contaminated soil and debris, which have been reshaped, capped, and revegetated. The disposal cell has a low-permeability radon barrier cover and a grass surface layer for erosion control. Erosion control has been provided for all potentially vulnerable features, and the site has been graded to provide positive drainage. Areas disturbed during remediation activities were revegetated.

Groundwater is contaminated with radionuclides as a result of mining operations. The radionuclide contaminants include radium-226, radium-228, and uranium. In December 1998, Exxon proposed using alternate concentration limits (ACLs), cleanup standards that are based on site-specific considerations, as remediation strategy for

groundwater. For the alternate concentrations to be approved, evidence must be provided that the ACLs will not adversely impact human health or the environment. Based on an evaluation of Exxon's request, NRC concluded that using the ACLs for groundwater would not pose substantial present or future risks to human health and the environment and that no further groundwater remediation would be necessary. Climatological extremes and sparse vegetation indicate that future use of groundwater is likely to be limited to seasonal livestock and wildlife watering. Domestic use of groundwater at the site is highly unlikely because of the low volume of available groundwater and the remote location of the site.



(Exxon) Highlands Site

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

Upon transfer of the site to DOE, the DOE Grand Junction Office will be responsible for providing long-term stewardship for the disposal cell and conducting groundwater monitoring activities at the (Exxon) Highlands Site. Anticipated site-wide long-term stewardship activities include restricting access through the use of fencing and posting warning signs along the site boundary. DOE will repair the fence and replace signs, as necessary. DOE will staff a 24-hour phone line for reporting site concerns. Drilling and other intrusive activities will be prevented within site boundaries through the use of institutional controls.

Site records will be placed in permanent storage at the DOE Grand Junction Office in Colorado. The types of records that will be maintained include site characterization data, remedial action design information, the site completion report, long-term monitoring plans, annual inspection reports, and current and historic monitoring data.

2.2 Specific Long-Term Stewardship Activities

Engineered Units

The Grand Junction Office will conduct annual inspections of the 69-hectare (170-acre) disposal cell to ensure the integrity of the cap and other engineered features. Maintenance and repairs will be conducted on an as-needed basis. Long-term stewardship activities will continue for the disposal cell in perpetuity.

STAKEHOLDER INVOLVEMENT

Community interaction is expected to be minimal once the site is transferred to DOE. Copies of the annual inspection report for the (Exxon) Highlands Site will be distributed to the local library and stakeholders who request them. The site's annual inspection report will also be published on the DOE Grand Junction Office website at www.doegjpo.com.

Groundwater

Groundwater will be monitored periodically to ensure compliance with the approved ACLs. DOE anticipates that groundwater monitoring will be conducted on an annual basis in perpetuity. The actual groundwater monitoring requirements will be detailed in the long-term surveillance plan to be approved by NRC at the time of site transfer (expected in 2002).

2.3 Regulatory Regime

This site is owned by the Exxon Mobile Corporation and is subject to Title II of the *Uranium Mill Tailings Radiation Control Act of 1978* (UMTRCA). These sites are privately owned and operated sites that mined or milled uranium ores for use in Atomic Energy Commission national defense missions. Under Title II of UMTRCA, DOE has a statutory obligation to accept title to uranium and thorium byproduct material disposal sites for long-term surveillance and maintenance if the state in which the site is located does not become the long-term custodian. After termination of the specific license for a Title II site and NRC acceptance of the site's long-term surveillance plan, the site will come under DOE's general license for custody and long-term care pursuant to Title 10 of the *Code of Federal Regulations*, Part 40.28, *General License for Custody and Long-Term Care of Uranium or Thorium Byproduct Materials Disposal Sites*. These standards conform to the U.S. Environmental Protection Agency standards specified in Title 40 of the *Code of Federal Regulations*, Part 192.

Once the site is transferred to DOE under general license, long-term stewardship activities of the site will be governed by several requirements in the following regulations: UMTRCA; the *Atomic Energy Act of 1954,* as amended; and EPA standards, including Subparts D and E of Title 40 of the *Code of Federal Regulations*, Part 192; a cooperative agreement between DOE and the State of Wyoming; and the *National Environmental Policy Act of 1969,* as amended.

2.4 Assumptions and Uncertainties

Because licensing of the (Exxon) Highlands Site by NRC is not expected until 2002, the exact conditions at closure and the future long-term stewardship responsibilities are not known. However, reasonable estimates can be generated by comparisons to long-term stewardship activities at other sites with similar disposal cells.

The groundwater sampling frequency, sampling duration, number of monitoring wells, and number of samples analyzed are unknown.

DOE assumes that no future groundwater remediation will be needed.

Cost estimates are based on actual cost of long-term stewardship activities at other similar sites currently managed by DOE's Grand Junction program.

DOE assumes that the engineered unit's cap will not have to be replaced for at least 200 years.

3.0 Estimated Long-Term Stewardship Costs

Cost estimates identified in the table below are based on the actual costs of long-term stewardship activities at other disposal cells under DOE's management. Actual costs will vary depending upon the results of groundwater sampling, sampling frequency, number of samples analyzed, and the number of sampling points (e.g., wells) that will be identified in the site's long-term surveillance plan. Contingency costs, such as cap replacement, are not incorporated into the cost estimate.

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	***Amount***	***Year(s)***	***Amount***	***Year(s)***	***Amount***
FY 2000	$0	**FY 2008**	$26,300	**FY 2036-2040**	$127,900
FY 2001	$0	**FY 2009**	$26,300	**FY 2041-2045**	$127,800
FY 2002	$27,100	**FY 2010**	$25,700	**FY 2046-2050**	$127,900
FY 2003	$26,100	**FY 2011-2015**	$122,700	**FY 2051-2055**	$127,800
FY 2004	$26,400	**FY 2016-2020**	$119,400	**FY 2056-2060**	$127,900
FY 2005	$26,600	**FY 2021-2025**	$119,800	**FY 2061-2065**	$127,800
FY 2006	$26,100	**FY 2026-2030**	$126,600	**FY 2066-2070**	$127,900
FY 2007	$26,500	**FY 2031-2035**	$127,800		

4.0 FUTURE USE

The future use of the site will be limited to disposal cell monitoring and maintenance, and groundwater monitoring. Under UMTRCA provisions, access to the site will be restricted indefinitely.

For more information about the (Exxon) Highlands Site, please contact:

Art Kleinrath, Long-Term Surveillance and Maintenance Program Manager
U.S. Department of Energy, Grand Junction Office
2597 B3/4 Road, Grand Junction, CO 81503
Phone: 970-248-6037
or visit the Internet website at http://www.doegjpo.com

HOE CREEK UNDERGROUND GASIFICATION SITE

1.0 SITE SUMMARY

1.1 Site Description and Mission

The Hoe Creek Underground Gasification Site occupies 32.4 hectares (80 acres) of private land located in Campbell County, Wyoming, near the town of Gillette. The site was used to investigate the process and environmental parameters of underground coal gasification technologies in the 1970s. No experiments have been conducted since the late 1970s. As a result of these investigations, an onsite coal seam aquifer is contaminated with elevated levels of petroleum hydrocarbons.

LONG-TERM STEWARDSHIP HIGHLIGHTS

Major Long-Term Stewardship Activities - institutional controls; groundwater monitoring
Total Site Area - 32.4 hectares (80 acres)
Estimated Volume of Residual Contaminants - unknown
Long-Term Stewardship Start-End Years - 2004-2014
Total Long-Term Stewardship Cost FY 2004-2014 - $3,000,000
Landlord - U.S. Department of Energy, Office of Fossil Energy

The U.S. Department of Energy's (DOE) current mission is limited to completing environmental remediation activities at the site. This property is owned by the Bureau of Land Management (BLM), which granted a right-of-way to DOE for conducting underground coal gasification experiments and subsequent groundwater clean-up activities.

1.2 Site Cleanup and Accomplishments

Elevated levels of petroleum hydrocarbons, including coal tars, residual organic carbon, and organic compounds (e.g., benzene, toluene, ethyl benzene, and xylene) have contaminated an onsite coal seam aquifer situated about 55 meters (180 feet) beneath the surface. The contaminated groundwater has migrated onto private property adjacent to the site. DOE's Office of Fossil Energy is conducting remediation activities at the site in cooperation with the State of Wyoming. An air sparge/bioremediation system for remediating the contaminated groundwater was approved by the Wyoming Department of Environmental Quality in July 1997, and construction of the system was completed in January 1998. In 1998, DOE installed 64 air sparge wells in the Hoe Creek 2 well field, with 45 wells in the Felix 1 coal seam and 19 wells in the Felix 2 coal seam. In 1999, an additional 50 wells were installed in the Hoe Creek 3 well field, with 42 wells in the Felix 1 coal seam and 8 wells in the Felix 2 coal seem.

The air sparge/bioremediation system will operate at the site through 2002 and, then will be shut down for one year to determine if the contaminants in the groundwater have been removed. If the contamination is still present, the system will resume operations for another year (until the end of 2004) or until levels of contamination are acceptable to the Wyoming Department of Environmental Quality. After 2004, the system will be disassembled.

ACCOMPLISHMENTS

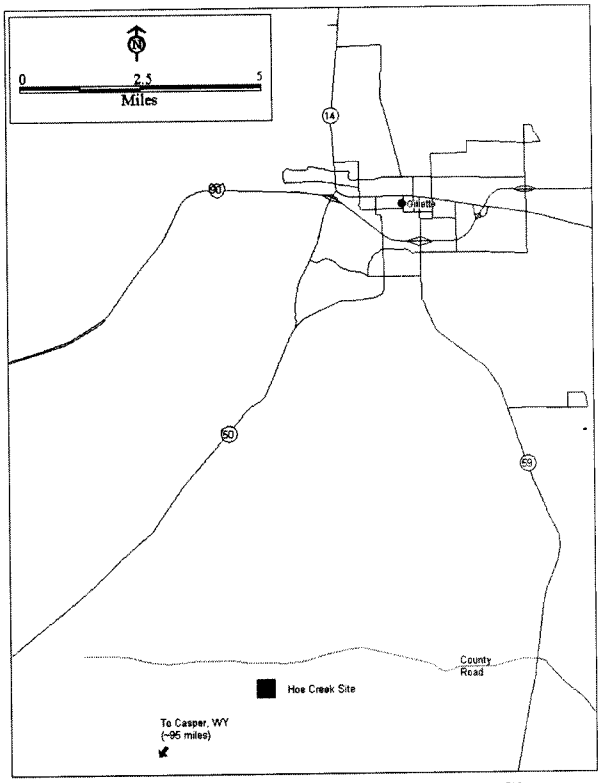
- Completed construction of air sparge system
- Installed 114 groundwater monitoring wells

BY 2006, HOE CREEK WILL HAVE:

- Completed active groundwater remediation
- Revegetated all disturbed surface areas

In order for the gasification experiments to be conducted, DOE acquired a research and development mining license (permit) from the Wyoming Department of Environmental Quality, Land Quality Division. The primary laws governing activities at the field site were

the *Wyoming Environmental Quality Act of 1973* and the *Surface Mine Control Reclamation Act of 1977*. As a result, these laws must be satisfied prior to release from the property. Groundwater must be returned to background conditions or maintain a certain class restriction through the use of a Best Practicable Technology (BPT). The remediation system in place at the property are considered to be BPT.



Hoe Creek Underground Gasification Site

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

DOE is responsible for surveillance and maintenance activities at the Hoe Creek Underground Gasification Site. After remediation is complete in 2004, DOE will monitor the groundwater and surface vegetation through 2014 in accordance with the State of Wyoming and the Department of the Interior's Office of Surface Mining long-term monitoring requirements. Anticipated site-wide long-term stewardship activities include groundwater and surface vegetation monitoring, record-keeping, and institutional controls. If necessary, drilling restrictions will be implemented through the Wyoming State Engineer's Office.

3.0 ESTIMATED LONG-TERM STEWARDSHIP COSTS

The estimated costs for long-term stewardship activities, including groundwater monitoring, record-keeping, and institutional controls enforcement are $3 million dollars between 2004 and 2014.

4.0 FUTURE USES

After long-term stewardship activities are complete in 2014, BLM may sell the property following groundwater cleanup in order to divest itself of small in-holdings surrounded by private land. Following groundwater remediation, DOE will be released from liability by the Wyoming Department of Environmental Quality, and the research and development mining permit will be terminated. The land is expected to be sold by the BLM and used for livestock grazing.

For additional information about the Hoe Creek Underground Gasification Site, please contact:

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craig.zamuda@hq.doe.gov

(KENNECOTT) SWEETWATER SITE[1]

1.0 SITE SUMMARY

1.1 Site Description and Mission

> ***LONG-TERM STEWARDSHIP HIGHLIGHTS***
>
> *Total Site Area* - unknown
> *Current Landlord* - Kennecott Uranium Company
> *Expected Future Landlord* - U.S. Department of Energy, Grand Junction Office
> *Reason Not Subject to NDAA Requirements* - The site closure and cleanup dates are unknown. Site may resume operations.

The (Kennecott) Sweetwater Site (also known as the Sweetwater Uranium Mill Site) is the location of a uranium mill that operated from 1981 through 1983. The site is located in Sweetwater County, Wyoming, approximately 64 kilometers (40 miles) northwest of the town of Rawlins, and is owned by the Kennecott Uranium Company. Currently, the uranium mill is on standby (not in operation). The site contains a 24-hectare (60-acre) disposal cell containing byproduct material generated from processing uranium ores during its two years of operation. The byproduct material consists mostly of uranium mill tailings, as well as radioactive soil and rock that remained after the uranium ore was processed.

The (Kennecott) Sweetwater Site is subject to Title II of the *Uranium Mill Tailings Radiation Control Act of 1978* (UMTRCA). UMTRCA Title II sites are privately owned and operated sites that were licensed when UMTRCA was passed, or thereafter. The majority of the uranium produced at these sites was for private sale, but a portion was sold to the U.S. Government.

The current mission of the (Kennecott) Sweetwater Site is to perform long-term stewardship activities, including monitoring and maintenance of the disposal cell and groundwater monitoring. The Kennecott Uranium Company is currently conducting these activities. The historic mission of the site was to provide uranium for private industry. Kennecott Uranium Company milled uranium from 1981 until 1983, when the mill was shut down.

Based on the renewed U.S. Nuclear Regulatory Agency (NRC) license (NRC Source Material License SUA-1350), the Kennecott Uranium Company is allowed to resume mill operations and, if necessary, construct one new tailings impoundment and up to eight evaporation ponds. In addition, the site's reclamation plan provides for stabilization of the existing tailings impoundment, future stabilization of new tailings impoundments, reclamation of land, and decommissioning of the mill facility. If the mill operates for 20 years, construction of an additional five tailings impoundments and two evaporation ponds may be requested.

Since the mill may resume operations, the year and the number of acres that will be transferred to DOE for long-term stewardship activities is unknown. Once the (Kennecott) Sweetwater Site is transferred to DOE, the site

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[1]This report is developed in response to a Congressional request in the Fiscal Year (FY) 2000 National Defense Authorization Act (NDAA). As requested by the Act, this report addresses current and anticipated long-term stewardship activities at each site or portion of a site by the end of calendar year 2006 ("Conference Report on S.1059, National Defense Authorization Act for Fiscal Year 2000," *Congressional Record,* August 5, 1999).

Based on current planning, the (Kennecott) Sweetwater Site is not expected to be transferred to the U.S. Department of Energy (DOE) for long-term stewardship until after 2006, and for this reason the site is not the primary focus of this report. This brief summary of the site cleanup activities is provided for background information and potential future long-term stewardship activities. (See Section 3.2 of Volume I).

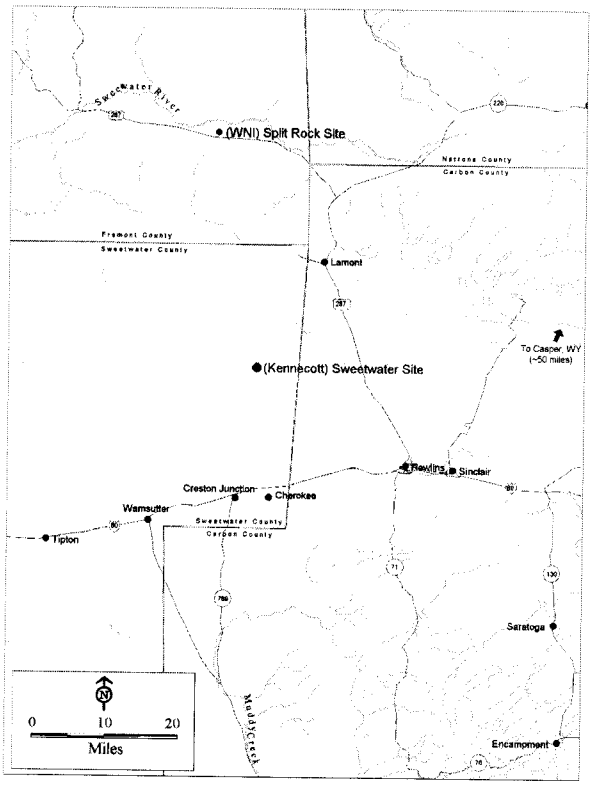
mission will be long-term monitoring and maintenance of the disposal cell and, possibly, groundwater monitoring.

1.2 Site Cleanup and Accomplishments

Kennecott Uranium Company has not begun remediation activities at the (Kennecott) Sweetwater Site. The site has a monitoring system in place to monitor effluent releases and to detect whether the applicable regulatory limits are being exceeded. Radiological effluents from the site have been and are expected to remain below the regulatory limits. DOE estimates that a total of 1.3 million cubic meters (1.7 million cubic yards) of uranium mill tailings will be disposed in the 24 hectare (60 acres) onsite disposal cell when the site actually closes.

2.0 EXPECTED FUTURE USES AND SITE RESPONSIBILITY

Kennecott Uranium Company is currently responsible for all activities at the (Kennecott) Sweetwater Site. After remediation is complete (date unknown), the site is expected to be transferred to DOE for long-term custody. DOE will be responsible for long-term stewardship activities at the site. When remediation activities are completed, the disposal cells (the number of disposal cells will depend on whether or not the mill resumes operations) will have a low-permeability radon barrier with an erosion control layer. Erosion control will be provided for all potentially vulnerable features, and the site will be graded to provide positive drainage. Disturbed areas will be revegetated. The disposal cells will be similar to other uranium mill tailings disposal cells and will require similar long-term stewardship activities. Based on other similar sites, DOE anticipates that long-term stewardship activities at the (Kennecott) Sweetwater Site will cost approximately $27,500 a year.



(Kennecott) Sweetwater Site

Anticipated site-wide long-term stewardship activities include restricting access by fencing and posting warning signs along the site boundary. DOE will repair the fence and replace signs, as necessary. Drilling and other intrusive activities on the site will be prevented through institutional controls. DOE will staff a 24-hour phone line for reporting any site concerns.

DOE assumes that groundwater monitoring will be required on a periodic basis to ensure continued protection of the environment and human health. The precise monitoring requirements will be prescribed in the site-specific long-term surveillance plan that will be developed and approved by NRC at the time of site transfer.

Site records will be kept in permanent storage at DOE's Grand Junction Office in Colorado. The types of records maintained will include site characterization data, remedial action design information, the site completion report,

long-term monitoring plans, annual inspection reports, and current and historic monitoring data.

For additional information about the (Kennecott) Sweetwater Site, please contact:

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Elaine Brummett, Project Manager
Uranium Recovery and Low-Level Waste
Branch
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Washington, DC 20555-001
Phone: 301-415-6606
or visit the Internet website at http://www.nrc.gov

NAVAL PETROLEUM RESERVE NO. 3

1.0 SITE SUMMARY

1.1 Site Description and Mission

The Naval Petroleum Reserve No. 3 is located 56 kilometers (35 miles) north of Casper, Wyoming, in Natrona County. The site covers approximately 3,800 hectares (9,400 acres) and is being used to produce petroleum for commercial production.

DOE's current mission at this site is to continue producing petroleum until oil production at the site is no longer profitable. DOE currently produces over 600 barrels of oil per day at the site. In addition, DOE's Office of Fossil Energy is conducting remediation at the Site.

LONG-TERM STEWARDSHIP SITE HIGHLIGHTS

Major Long-Term Stewardship Activities - monitoring and maintenance of the onsite industrial waste landfill
Total Site Area - 3,800 hectares (9,400 acres)
Estimated Volume of Residual Contaminants - unknown
Long-Term Stewardship Start-End Years - 2001-unknown
Average Annual Long-Term Stewardship Cost FY 2001-2006 - $2,500
Landlord - U.S. Department of Energy, Office of Fossil Energy

1.2 Site Cleanup and Accomplishments

DOE is responsible for conducting all remediation and long-term stewardship activities at this site. Waste generated as a result of the oil production activities are disposed in an industrial waste landfill that covers approximately four hectares (ten acres) of the site. DOE expects to begin closing and capping the landfill in 2001. Although a final agreement has not been reached with the regulators, DOE anticipates capping the landfill with a soil cover.

Additional soil and groundwater at the site may be contaminated by petroleum byproducts including petroleum hydrocarbons, residual organic carbon, and other organic compounds. If contamination is found, the State of Wyoming will determine what remediation is necessary. Potential remediation may include removing all contaminated material to an approved offsite disposal site.

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

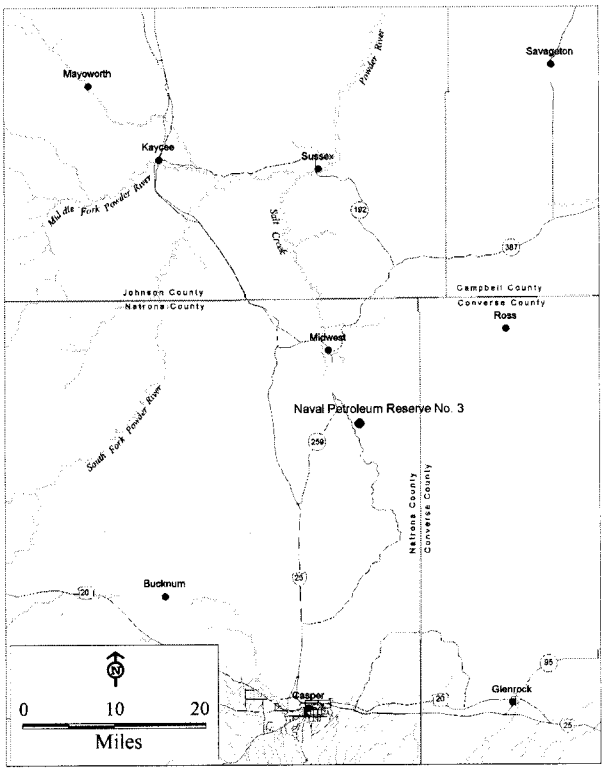
DOE expects to begin conducting long-term stewardship activities in 2001 when the cap is completed. DOE owns this site and will maintain responsibility for long-term stewardship activities of any remaining environmental contamination. DOE currently anticipates that annual groundwater monitoring will continue for five to 30 years after remediation is completed, but the actual duration of monitoring activities will be determined by the State of Wyoming. Additional activities will also include visual inspections and maintenance of the landfill cap.

ACCOMPLISHMENTS

- Placed monitoring wells at the site and has begun monitoring
- Requested bids for a closure plan
- Awarded contract for the site remediation

BY 2006, DOE WILL HAVE

- Capped the contamination and will be monitoring the site as required by the State of Wyoming



Naval Petroleum Reserve No.3

3.0 ESTIMATED LONG-TERM STEWARDSHIP COSTS

The estimated annual cost for fiscal year 2001-2006 groundwater monitoring at the site is $2,500.

4.0 FUTURE USES

DOE owns this site and will retain long-term stewardship responsibility if a site transfer occurs. Petroleum production activities at the site will continue for as long as production is profitable. No plans for use of the site after production operations cease have been developed at this time.

For additional information about the Naval Petroleum Reserve No. 3, please contact:

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Washington, DC 20585
Phone: 202-586-6367
craig.zamuda@hq.doe.gov

(PATHFINDER) LUCKY Mc SITE

1.0 SITE SUMMARY

1.1 Site Description and Mission

The (Pathfinder) Lucky Mc Site is the location of the former Lucky Mc Uranium Mill, which operated from 1958 until 1988. The site is located in the Gas Hills Uranium Mining District, west of Casper, Wyoming. Decommissioning of the uranium mill was initiated in 1993. The milling operations created process-related waste and tailings. The site includes six tailings ponds that are undergoing reclamation. The site is licensed by the U.S. Nuclear Regulatory Commission (NRC) to the Pathfinder Mines Corporation, located in Riverton, Wyoming.

LONG-TERM STEWARDSHIP HIGHLIGHTS

Major Long-Term Stewardship Activities - disposal cell monitoring and maintenance; groundwater monitoring
Total Site Area - unknown
Estimated Volume of Residual Contaminants - engineered unit 6.65 million cubic meters (8.70 million cubic yards); groundwater unknown
Long-Term Stewardship Start-End Years - 2005-in perpetuity
Average Annual Long-Term Stewardship Cost FY 2005-2006 - $35,150
Landlord - U.S. Department of Energy, Grand Junction Office (beginning in 2005)

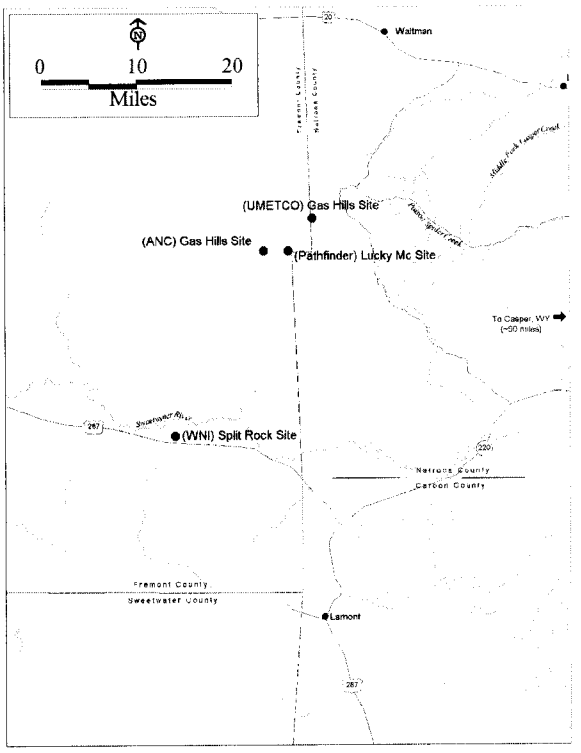
The head of Reid Draw is located on the downgradient side of the site. This stream flows intermittently based on the season. The nearest neighbor is the Philp Sheep Company located downstream of the (Pathfinder) Lucky Mc Site on the Reid Draw. Reid Draw terminates into Reid Reservoir, approximately 3,000 meters (1.9 miles) downstream of the site. After constructing the mill on the (Pathfinder) Lucky Mc Site, the mill tailings management structures were built at the head of Reid Draw. In the early days of mill operation, there was only one embankment, the No.1 solid tailings dam. It served as the sole tailings storage facility from the inception of milling in 1958 until 1960, when the No. 2 dam was constructed. Excess tailings solution was routinely discharged down the Reid Draw from the No. 1 dam until June 1, 1960, when the No. 2 dam was commissioned. Apparently, this discharge was considered acceptable and normal practice in those days since the site was subject to Atomic Energy Commission (AEC) inspections during the time frame of interest. Dam No. 4, the furthest downgradient embankment in the tailings system, was constructed in 1961.

The current mission at the (Pathfinder) Lucky Mc Site is remediation and disposal of mill tailings, and monitoring and remediation of groundwater by Pathfinder Mines. The (Pathfinder) Lucky Mc Site is subject to Title II of the *Uranium Mill Tailings Radiation Control Act of 1978* (UMTRCA). UMTRCA Title II sites are privately owned and operated sites that were licensed when UMTRCA was passed, or thereafter. The majority of the mining and milling conducted at these sites was for private sale, but a portion was sold to the U.S. Government. As such, DOE is responsible for long-term stewardship activities of the site, but is not responsible for site remediation. The U.S. Department of Energy (DOE) Grand Junction Office expects the (Pathfinder) Lucky Mc Site to be transferred to DOE for long-term stewardship activities in 2005. Once the site is transferred, the only site mission will be long-term surveillance and maintenance of the disposal cell, and groundwater monitoring. The historic mission of the site was to mine and mill uranium for the U.S. Government and for commercial sale.

1.2 Site Cleanup and Accomplishments

Past mining and milling activities at the site resulted in uranium mill tailings, contaminated soil, and construction debris, which required stabilization and disposal. Pathfinder Mines Corporation, the current site owner, is conducting remediation activities in accordance with an NRC-approved site reclamation plan. The remediation process included characterization of 85 hectares (210 acres) that were affected by windblown tailings. A

completion report for this activity was submitted to NRC in February 1999. The site includes six tailings ponds, three which (1, 2, and 2A) were used for solid waste tailings disposal and three (3, 3A, and 4) which are being used for solution disposal. Approximately 420,500 cubic meters (550,000 cubic yards) of windblown material were removed and placed in the toe of Tailings Pond 2A, along with mill components and other residual radioactive material from site reclamation activities. Three smaller ponds incorporated into Pond 2A are being used as part of the site groundwater remediation system. Because the solutions from the groundwater system are relatively clean, they are being used for fugitive dust control within the disposal cells. Interim radon covers were installed on Ponds 1 and 2 in 1999. NRC approved placement of a radon barrier on Pond 2A in November 1999, finding that the pond had consolidated sufficiently for construction of an interim cover. Ponds 3 and 4 have solutions in them and Pond 3 also has an active sprinkler system for evaporation. Part of Pond 4 is dammed off for solutions, but the remainder of Pond 4 and Pond 3A are dry and they are being prepared for an interim cover.



(Pathfinder) Lucky Mc Site

Groundwater on the site is contaminated by radionuclides, including radium and uranium, as a result of mining and milling operations. DOE does not know the areal extent of this contamination. NRC has approved a groundwater corrective action plan for the (Pathfinder) Lucky Mc Site. Pathfinder Mines Corporation is currently required to operate a groundwater extraction and remediation system and a groundwater monitoring system at the site. The groundwater extraction and remediation system, includes operation of a well-water injection system and the associated filtration and chlorination system for the injection well, and operation of the seepage recovery wells, the Tailings Pond No. 1 dewatering wells, and the Tailings Pond 3 and Pond 4 enhanced evaporation system. Pathfinder Mines is required to monitor groundwater quarterly for chloride, sulfate, nitrate, acidity/alkalinity, and conductivity; and semi-annually for arsenic, beryllium, cadmium, chromium, nickel, radium-226, radium-228, selenium, thorium-230, and uranium. The NRC site license specifies groundwater protection standards for one point-of-compliance well for arsenic, beryllium, cadmium, chromium, nickel, radium, selenium, thorium-230, and uranium. According to NRC, the objective of the groundwater corrective action program is to return site groundwater concentrations to below the groundwater protection standards specified in the site license.

According to NRC, Pathfinder Mines intends to submit an application for alternate concentration limits (ACLs) to terminate the pumping of groundwater at the site, which will allow the remaining solution ponds to be dried and covered. Groundwater monitoring data in 1999 indicated no significant trends in groundwater quality. Groundwater from the site is not being used for drinking water, and the dose to the nearest resident did not exceed the 100 millirem per year dose limit (required in Title 10 of the *Code of Federal Regulations*, Part 20.1301), based on 1998 effluent and environmental monitoring data.

Surface water sediment contamination was identified in the Reid Draw. The early releases, as well as the No. 4 dam breach in 1963, account in part for the levels of radionuclides found in Reid Draw. It is also likely that there is a natural contribution to the radionuclide levels in Reid Draw because the stream originates at the outcrop of the naturally mineralized area. The measurable contamination in the draw terminates just above Reid Reservoir. Radionuclide analysis of surface water and a sample of water taken from Reid Reservoir indicate that the concentrations are well within the NRC effluent water concentration limits. In 1999, NRC approved Pathfinder Mine's proposal to terminate cleanup of the Reid Draw. NRC determined that the "no action" proposal will not have long-term impacts on the environment. In addition, NRC was concerned that remediation would cause irreversible damage to the stable environment of Reid Draw.

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

Because of the nature of the contaminants present on the site, residual contamination will remain after remediation is complete. Upon transfer to DOE, the DOE Grand Junction Office will be responsible for providing long-term stewardship for the groundwater and disposal cell at the (Pathfinder) Lucky Mc Site. DOE will control land use within site boundaries; the site is not expected to have any future land uses. Access will be restricted through the use of fencing and warning signs posted, as necessary, along the site boundary. DOE maintains a 24-hour phone line for reporting site concerns. Drilling and other intrusive activities will be prevented within site boundaries through institutional controls. DOE will conduct annual inspections to ensure the integrity of cell covers and other engineered features, and to ensure that institutional controls are effective and the site complies with applicable requirements. Prior to transfer, DOE will prepare a long-term surveillance plan for the (Pathfinder) Lucky Mc Site. An inspection report will be submitted annually to NRC to summarize, describe, and evaluate all surveillance and maintenance actions, as required under Title 10 of the *Code of Federal Regulations*, Part 40, and as specified in the long-term surveillance plan.

Site records for the (Pathfinder) Lucky Mc Site will be maintained in permanent storage at DOE's Grand Junction Office. The types of records maintained will include the characterization data, remedial action design information, the site completion report, long-term monitoring plans, annual inspection reports, and historical monitoring data.

2.2 Specific Long-Term Stewardship Activities

Groundwater

Once the site is transferred to DOE to perform long-term stewardship activities, DOE will monitor groundwater to demonstrate the integrity of the disposal cell(s) in isolating the encapsulated wastes. Groundwater monitoring is expected to continue in perpetuity. The monitoring requirements will be specified in the site's long-term surveillance plan. The site will not be transferred to DOE until NRC approves the site's long-term surveillance plan.

STAKEHOLDER INVOLVEMENT

When licensed and transferred to DOE, copies of the annual inspection report for the (Pathfinder) Lucky Mc Site will be distributed to the local library and stakeholders requesting them. The annual inspection report will be published on the Grand Junction Office website at www.doegjpo.com.

Engineered Units

There are six tailings ponds present on the (Pathfinder) Lucky Mc Site that are in the process of being remediated and reclaimed. DOE estimates the volume of uranium mill tailings; soil contaminated with uranium, radium, and

thorium; and construction debris contained in the cell to be 6.65 million cubic meters (8.70 million cubic yards). It is not known whether the contaminated materials in all six tailings ponds are included as part of the 6.65 million cubic meters, or whether they will be reclaimed and encapsulated in another disposal cell to be built later. Once remediation is completed, the disposal cell will be capped with a clay and rock cap. The cap will require annual inspections to evaluate the condition of surface features. In addition, DOE will be responsible for performing maintenance and vegetation control, as necessary. A fence will surround the cell(s) to restrict access in perpetuity.

2.3 Regulatory Regime

Pathfinder Mines will complete site reclamation at the (Pathfinder) Lucky Mc Site in accordance with Title II of the *Uranium Mill Tailings Radiation Control Act of 1978* (UMTRCA), and dispose of the tailings in an NRC-approved disposal cell. Cleanup and reclamation standards were promulgated by NRC in Title 10 of the *Code of Federal Regulations,* Part 40, Appendix A. These standards conform to the U.S. Environmental Protection Agency standards specified in Title 40 of the *Code of Federal Regulations,* Part 192.

Upon completion of remediation, the site will come under a general license issued by NRC for custody and long-term care of residual radioactive disposal sites (contained at Title 10 of the *Code of Federal Regulations,* Section 40.28, *General License for Custody and Long-Term Care of Uranium or Thorium Byproduct Materials Disposal Sites*). The purpose of the general license is to ensure that such sites will be cared for in a manner that protects human health and safety and the environment. The general license will go into effect when NRC concurs that the site conforms to cleanup standards and formally accepts the site-specific long-term surveillance plan.

Once the site is transferred to DOE under general license to the NRC, long-term stewardship of the site will be governed by several requirements in the following regulations: UMTRCA, the *Atomic Energy Act of 1954,* as amended; EPA standards, including Subparts D and E of Title 40 of the *Code of Federal Regulations*, Part 192; a cooperative agreement between DOE and the State of Wyoming; and the *National Environmental Policy Act of 1969,* as amended.

2.4 Assumptions and Uncertainties

DOE expects that the (Pathfinder) Lucky Mc Site will be transferred to DOE for long-term stewardship activities in 2005. However, the exact date of the transfer depends on the completion of remedial activities being conducted by the owner, any observation period after remediation that may be required by NRC, and the amount of time necessary to handle the administrative details associated with transferring the site to DOE. Cleanup levels will be achieved before the site is transferred to DOE for long-term stewardship activities. Groundwater monitoring will be conducted to verify continued compliance with cleanup levels. Groundwater monitoring may or may not continue indefinitely, depending upon site-specific circumstances and hydrology, and whether or not the cell demonstrates infiltration control.

3.0 Estimated Long-Term Stewardship Costs

For the site to be transferred to DOE, the site owner must make a one-time payment to the U.S. Treasury fully funding inspections and anticipated maintenance at the site. Therefore, there will be no additional cost to the U.S. Government for long-term stewardship activities at the (Pathfinder) Lucky Mc Site. Cost estimates for this site, identified in the table below, are based on comparisons of actual costs of long-term stewardship activities at other similar sites that are currently managed by DOE. Actual costs for groundwater monitoring will vary, depending upon the results of groundwater sampling, sampling frequency, number of analyses sampled, and the number of sampling points (e.g., wells) that will be identified in the long-term surveillance plan.

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	***Amount***	***Year(s)***	***Amount***	***Year(s)***	***Amount***
FY 2000	$0	**FY 2008**	$35,100	**FY 2036-2040**	$170,500
FY 2001	$0	**FY 2009**	$35,100	**FY 2041-2045**	$170,400
FY 2002	$0	**FY 2010**	$34,300	**FY 2046-2050**	$170,500
FY 2003	$0	**FY 2011-2015**	$163,500	**FY 2051-2055**	$170,400
FY 2004	$0	**FY 2016-2020**	$159,200	**FY 2056-2060**	$170,500
FY 2005	$35,500	**FY 2021-2025**	$159,700	**FY 2061-2065**	$170,400
FY 2006	$34,800	**FY 2026-2030**	$168,700	**FY 2066-2070**	$170,500
FY 2007	$35,300	**FY 2031-2035**	$170,400		

4.0 FUTURE USES

The site will be a permanent uranium mill tailings repository. Public access to the disposal cell(s) will be restricted in perpetuity.

For more information about the (Pathfinder) Lucky Mc Site, please contact:

Art Kleinrath, Long-Term Surveillance and Maintenance Program Manager
U.S. Department of Energy, Grand Junction Office
2597 B3/4 Road, Grand Junction, CO 81503
Phone: 970-248-6037
or visit the Internet website at: http://www.doegjpo.com

(PATHFINDER) SHIRLEY BASIN SITE 2

1.0 SITE SUMMARY

1.1 Site Description and Mission

The (Pathfinder) Shirley Basin Site 2 is the location of a former uranium mine and mill that operated from 1971 until 1992. The site is located in a remote area of Carbon County, Wyoming, 88.5 kilometers (55 miles) south of the town of Casper, and approximately 6.4 kilometers (4 miles) east of State Highway 487. The 202-hectare (500-acre) site is located adjacent to the Petrotomics, Shirley Basin Site. A conventional acid leaching process was used to process uranium at the site. The milling operations created process-related waste and tailings. Site remediation activities began in 1996. Once remediation is complete, the site will contain a 146-hectare (360-acre) mill tailings disposal cell. Approximately 8.2 million tons of uranium mill tailings are expected to be disposed of in the disposal cell. The site is licensed by the U.S. Nuclear Regulatory Commission (NRC) to Pathfinder Mines Corporation.

LONG-TERM STEWARDSHIP HIGHLIGHTS

Major Long-Term Stewardship Activities - disposal cell maintenance and monitoring; groundwater monitoring
Total Site Area - 202 hectares (500 acres)
Estimated Volume of Residual Contaminants - engineered units 4.66 million cubic meters (6.10 million cubic yards); groundwater unknown
Long-Term Stewardship Start-End Years - 2006-in perpetuity
Annual Long-Term Stewardship Cost FY 2006 - $34,800
Landlord - U.S. Department of Energy, Grand Junction Office (beginning in 2006)

The current mission at the (Pathfinder) Shirley Basin Site 2 is reclamation of the site, remediation and disposal of mill tailings, and implementation of the site groundwater, air quality, and radiation monitoring programs by Pathfinder Mines. The (Pathfinder) Shirley Basin Site 2 is subject to Title II of the *Uranium Mill Tailings Radiation Control Act of 1978* (UMTRCA). UMTRCA Title II sites are privately owned and operated sites that were licensed when UMTRCA was passed, or thereafter. The majority of the mining and milling conducted at these sites was for private sale, but a portion was sold to the U.S. Government. As such, the Department of Energy's (DOE) Grand Junction Office will be responsible for performing long-term stewardship activities at the site, but is not responsible for site remediation. DOE expects the (Pathfinder) Shirley Basin Site 2 to be transferred for long-term stewardship in 2006. Once the site is transferred to DOE, the site mission will be the long-term surveillance and maintenance of the disposal cell and groundwater monitoring. The historic mission of this site was to mine and mill uranium for commercial sale.

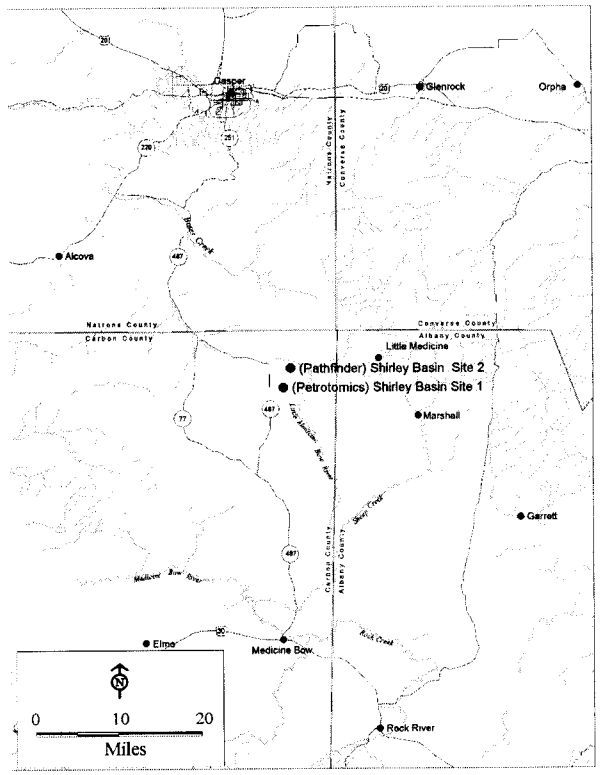
1.2 Site Cleanup and Accomplishments

Past mining and milling activities at the site resulted in uranium mill tailings, contaminated soil, and construction debris, which require stabilization and disposal. NRC has approved Pathfinder Mines Corporation's reclamation plan, which includes remediation of the mill area, tailings facilities, tailings ponds, and solution pond. The mill area is approximately six hectares (14 acres), and the tailings ponds are approximately 45 hectares (111 acres) and 61 hectares (150 acres), and the solution pond is approximately six hectares (14 acres). All of these areas will be reclaimed. There are two tailings dams at the site that were in service during mill operation. One of the two tailings dams will be buried as a result of reclamation activities. The other tailings dam will continue to be subject to NRC standards for tailings dams and to the technical evaluation and inspection requirements of the site license.

The mill has been dismantled, and windblown tailings have been retrieved and placed on the tailings pile. Placement of the interim cover to decrease the potential for tailings dispersal and erosion will be completed by

the end of 2001. Placement of the final radon barrier is scheduled for completion by the end of 2004, and placement of the erosion protection cell cap is scheduled for completion by the end of 2005. Groundwater corrective action is scheduled to be completed by the end of 2005.

The reclamation of the site consists of stabilizing the tailings and ensuring that radon emanating from the disposal cell will not exceed 20 picocuries per square meter per second. The disposal cell will incorporate excavated materials from other areas that are contaminated above the release limit. Once the cell is filled, it will be capped with soil and rock in accordance with the reclamation plan. The cap is designed to control radon emanation and prevent erosion, water infiltration, and leaching of the contaminants from the cell. In accordance with U.S. Environmental Protection Agency (EPA) standards, the cover is designed to remain effective for 200 to 1,000 years.



(Pathfinder) Shirley Basin Site 2

As a result of historic mining and milling operations, groundwater on the site is contaminated by radionuclides, including radium and uranium. The areal extent of this contamination is currently unknown. Pathfinder Mines Corporation is required to implement a groundwater compliance monitoring system as a condition of its site license, and also to comply with groundwater protection standards at the point of compliance wells identified in the site license. The groundwater is neither a current nor potential source of drinking or irrigation water due to high levels of background radiation. As a result, no active groundwater remediation has occurred, nor is expected to occur, on this site. Natural flushing will be relied upon as the remediation method.

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

Due to the nature of the contaminants present on the site, residual contamination will remain onsite after remediation is complete. Upon transfer to DOE, the Grand Junction Office will be responsible for providing long-term stewardship for the groundwater and disposal cell at the (Pathfinder) Shirley Basin Site 2. DOE will control land use within site boundaries. DOE will conduct long-term stewardship activities as required under the NRC license to maintain protectiveness and regulatory compliance. Access will be restricted through the use of fencing and warning signs posted, as necessary, along the site boundary. DOE maintains a 24-hour phone line for reporting site concerns. Drilling and other intrusive activities will be prevented within site boundaries through management control. DOE will conduct annual inspections to ensure the integrity of cell covers and other engineered features, and to ensure that institutional controls are effective and the site complies with applicable requirements.

Prior to transfer, DOE will prepare a draft long-term surveillance plan for the site. NRC approval is required prior to termination of the state license and transfer of the site to DOE. Site records for the (Pathfinder) Shirley Basin Site 2 will be maintained in permanent storage at the DOE Grand Junction Office. The types of records to be maintained include the characterization data, remedial action design, the site completion report, long-term monitoring plans, annual inspection reports, and monitoring data. In addition, DOE will submit an annual report to NRC that summarizes, describes, and evaluates all surveillance and maintenance actions, in accordance with the long-term surveillance plan and NRC regulations (Title 10 of the *Code of Federal Regulations*, Part 40).

2.2 Specific Long-Term Stewardship Activities

Groundwater

When long-term stewardship activities begin, DOE will monitor the groundwater periodically (quarterly and semi-annually) to ensure the integrity of the disposal cells in isolating the encapsulated wastes and to ensure that natural attenuation is achieving cleanup objectives. Quarterly groundwater indicator parameters include chloride, sulfate, acidity/alkalinity, total dissolved solids, and water level. Semi-annual groundwater monitoring parameters include arsenic, barium, beryllium, cadmium, chromium, gross alpha, lead, molybdenum, nickel, radium-226, radium-228, selenium, thorium-230, and uranium. Uranium concentrations measured within the plume do not exceed the maximum concentration limits set forth by the EPA. Groundwater monitoring is expected to continue in perpetuity.

> ***STAKEHOLDER INVOLVEMENT***
>
> When licensed and transferred to DOE, the annual inspection report will include the report for the (Pathfinder) Shirley Basin Site 2 and will be distributed to the local library and stakeholders requesting them. The annual inspection repot will also be published on the DOE Grand Junction Office website at www.doegjpo.com.

Engineered Units

The (Pathfinder) Shirley Basin Site 2 has one 146-hectare (360-acre) disposal cell. DOE estimates the volume of uranium mill tailings; soil contaminated with uranium, radium, and thorium; and construction debris contained in the cell to be 4.6 million cubic meters (6.1 million cubic yards). Once remediation is complete, the disposal cell will be capped with a clay and rock cap, including a 0.76-meter (2.5-foot) clay layer as a radon barrier, a 15.2 centimeter (6 inch) sand layer, 9.1 centimeters (3.6 inches) of rock filler, and 9.1 centimeters (3.6 inches) of rock mulch. The cap will require annual inspections to evaluate the condition of the cell's surface features. In addition, DOE will be responsible for performing maintenance and vegetation control, as necessary. A fence will surround the cell to restrict access in perpetuity.

2.3 Regulatory Regime

The (Pathfinder) Shirley Basin Site 2 is completing reclamation under provisions of Title II of the *Uranium Mill Tailings Radiation Control Act of 1978* (UMTRCA). DOE is required under UMTRCA to provide long-term stewardship for this site after completion of remedial action or reclamation activities in the event the host state does not exercise its authority. Requirements for NRC licensing of closed UMTRCA Title II sites are defined under NRC regulations (Title 10 of the *Code of Federal Regulations*, Part 40.28). UMTRCA sites are remediated to EPA standards (Title 40 of the *Code of Federal Regulations*, Part 192).

Following remediation, the site will come under a general license issued by NRC for custody and long-term care of residual radioactive disposal sites (contained at Title 10 of the *Code of Federal Regulations,* Section 40.28, *General License for Custody and Long-Term Care of Uranium or Thorium Byproduct Materials Disposal Sites*).

The purpose of the license is to ensure that the site will be cared for in a manner that protects human health and safety and the environment. The general license will go into effect when NRC concurs that the site conforms to cleanup standards and formally accepts the site-specific long-term surveillance plan.

Once the site is transferred to DOE under general license to the NRC, long-term stewardship activities at the site will be governed by several requirements in the following regulations: UMTRCA, the *Atomic Energy Act of 1954,* as amended; EPA standards, including Subparts D and E of Title 40 of the *Code of Federal Regulations*, Part 192; a cooperative agreement between DOE and the State of Wyoming; and the *National Environmental Policy Act of 1969*, as amended.

2.4 Assumptions and Uncertainties

DOE expects the (Pathfinder) Shirley Basin Site 2 to be transferred to DOE for long-term stewardship activities in 2006. However, the exact date of the transfer depends on completion of the remedial activities being conducted by the Pathfinder Mines Corporation. Cleanup levels will be achieved before the site is transferred to DOE for long-term stewardship. Groundwater monitoring will be conducted to verify continued compliance with cleanup levels. Groundwater monitoring may or may not continue indefinitely, depending upon site-specific circumstances and hydrology, and whether or not the cell demonstrates infiltration control.

3.0 Estimated Long-Term Stewardship Costs

Estimated costs for long-term stewardship activities at the (Pathfinder) Shirley Basin Site 2 are identified in the table below. Cost estimates are based on comparisons of the actual costs of long-term stewardship activities at other similar sites that are currently managed by DOE. For the site to be transferred to DOE, the site owner must make a one-time payment to the U.S. Treasury to fully fund inspections and anticipated maintenance at the site. Therefore, there will be no additional cost to the U.S. Government for long-term stewardship activities at the (Pathfinder) Shirley Basin Site 2. Actual costs for groundwater monitoring will vary depending upon the results of groundwater sampling, frequency, number of analyses sampled, and the number of sampling points (e.g., wells) that will be identified in the long-term surveillance plan.

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	***Amount***	***Year(s)***	***Amount***	***Year(s)***	***Amount***
FY 2000	$0	**FY 2008**	$35,100	**FY 2036-2040**	$170,500
FY 2001	$0	**FY 2009**	$35,100	**FY 2041-2045**	$170,400
FY 2002	$0	**FY 2010**	$34,300	**FY 2046-2050**	$170,500
FY 2003	$0	**FY 2011-2015**	$163,500	**FY 2051-2055**	$170,400
FY 2004	$0	**FY 2016-2020**	$159,200	**FY 2056-2060**	$170,500
FY 2005	$0	**FY 2021-2025**	$159,700	**FY 2061-2065**	$170,400
FY 2006	$34,800	**FY 2026-2030**	$168,700	**FY 2066-2070**	$170,500
FY 2007	$35,300	**FY 2031-2035**	$170,400		

4.0 FUTURE USES

The (Pathfinder) Shirley Basin Site 2 will be a permanent uranium mill tailings repository. Public access to the disposal cell will be restricted in perpetuity.

For more information about the (Pathfinder) Shirley Basin Site 2, please contact:

Art Kleinrath, Long-Term Surveillance and Maintenance Program Manager
U.S. Department of Energy, Grand Junction Office
2597 B3/4 Road, Grand Junction, CO 81503
Phone: 970-248-6037
or visit the Internet website at http://www.doegjpo.com

(PETROTOMICS) SHIRLEY BASIN SITE 1

1.0 SITE SUMMARY

1.1 Site Description and Mission

The (Petrotomics) Shirley Basin Site 1 is the location of a former uranium mill that operated from 1962 until 1985. The site occupies 243 hectares (600 acres) and is located in a remote area of Carbon County, Wyoming, 88.5 kilometers (55 miles) south of the town of Casper. The former uranium mill site is located adjacent to the (Pathfinder) Shirley Basin Site 2. A conventional acid leaching process was used to process uranium at the site. The milling operations created process-related waste and tailings. The site contains a 65-hectare (160-acre) mill tailings disposal area and the site is licensed by the U.S. Nuclear Regulatory Commission (NRC) to the Petrotomics Company.

LONG-TERM STEWARDSHIP HIGHLIGHTS

Major Long-Term Stewardship Activities - access control; disposal cell monitoring; groundwater monitoring
Total Site Area - 243 hectares (600 acres)
Estimated Volume of Residual Contaminants - engineered units 3.6 million cubic meters (4.7 million cubic yards); groundwater unknown
Long-Term Stewardship Start-End Years - 2002-in perpetuity
Average Annual Long-Term Stewardship Cost FY 2002-2006 - $35,300
Landlord - U.S. Department of Energy, Grand Junction Office (beginning in 2002)

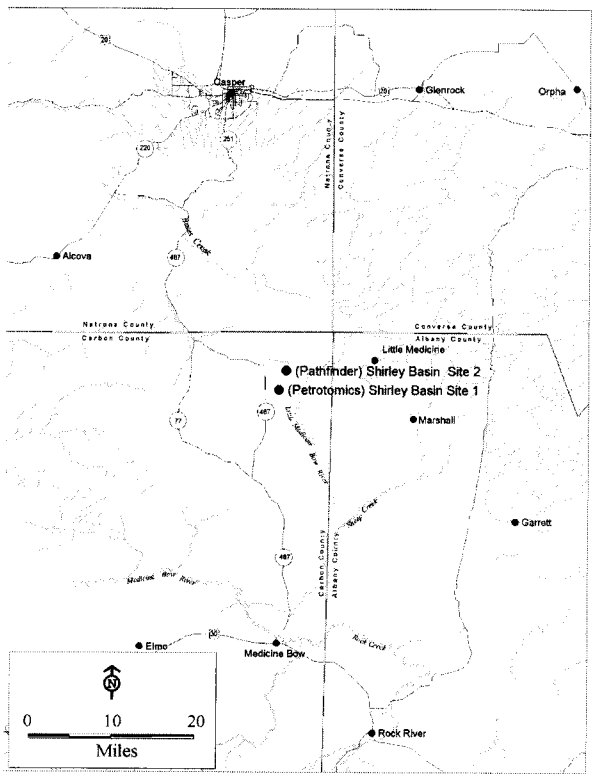
The current mission at the (Petrotomics) Shirley Basin Site 1 is the remediation and disposal of mill tailings and operation of the groundwater compliance monitoring program. The (Petrotomics) Shirley Basin Site 1 is subject to Title II of the *Uranium Mill Tailings Radiation Control Act of 1978* (UMTRCA). UMTRCA Title II sites are privately owned and operated sites that were licensed when UMTRCA was passed, or thereafter. The majority of the mining and milling conducted at these sites was for private sale, but a portion was sold to the U.S. Government. As such, the Department of Energy's (DOE) Grand Junction Office is responsible for performing long-term stewardship activities of the site, but is not responsible for site remediation. DOE expects the site to be transferred to DOE for long-term stewardship in 2002. Once the site is transferred to DOE, the only site mission will be the long-term surveillance and maintenance of the disposal cell and groundwater monitoring. The historic mission of the site was to mine and mill uranium for the U.S. Government and for commercial sale.

1.2 Site Cleanup and Accomplishments

Past mining and milling activities conducted at the site resulted in uranium mill tailings, contaminated debris, and construction debris, which required stabilization and disposal. NRC approved the reclamation plan for the site, and the Petrotomics Company is conducting reclamation and remediation of the site. Reclamation of site areas that were contaminated by windblown tailings and placement of the interim cover on the tailings pile have been completed. Placement of the radon barrier has also been completed, except for a 4.5-hectare (nine-acre) area in the northern portion of the site adjacent to the Stage 1 evaporation pond. Placement of the radon cover over the 4.5-hectare (nine-acre) area and over the area of the tailings pile covered by the evaporation ponds is scheduled to be completed by the end of 2001. Placement of the erosion barrier is scheduled to be completed by the end of 2003. Once the disposal cell is filled, the Petrotomics Company plans to cap the cell with clay and rock. The cap is designed to control radon emanation and prevent erosion, water infiltration, and leaching of the contaminants from the cell. In accordance with U.S. Environmental Protection Agency (EPA) standards, the cover is designed to remain effective for 200 to 1,000 years. Approximately 6.3 million tons of uranium mill tailings are expected to be disposed of in the disposal cell.

As a result of historic mining and milling operations, groundwater on the site is contaminated by radionuclides, including radium and uranium. The areal extent of this contamination is currently unknown, but it will be remediated prior to the site's transfer to DOE for custody and long-term care.

In October 1998, NRC approved Petrotomics' amendment request to allow alternate concentration limits (ACLs), cleanup standards based on site-specific considerations, for groundwater constituents, including cadmium, chromium, nickel, radium-226, radium-228, thorium-230, selenium, and uranium. For the alternate concentrations to be approved, evidence must be provided that the ACLs will not adversely impact human health or the environment. The NRC determined that the use of ACLs would not pose a substantial present or potential future hazard to human health or the environment. Petrotomics applied to reduce the number of groundwater monitoring wells from 27 to eight, and to reduce the frequency of monitoring to semi-annually for all parameters. The Petrotomics Company submitted a revised groundwater compliance monitoring program to NRC on January 18, 2000, and the revised plan was approved.



(Petrotomics) Shirley Basin Site 1

In 1998 and 1999, all concentrations of hazardous constituents of concern to NRC met the proposed groundwater ACLs in the wells at the site. Climatological extremes and sparse vegetation indicate that future use of groundwater is likely to be limited to water for seasonal livestock (e.g., cattle) and wildlife (e.g., pronghorn antelope). Domestic use of groundwater at the site is highly unlikely. However, if a future domestic water source is needed, the Lower Sand aquifer, which has not been affected by site-derived contamination and is suitable for drinking, would be a more reasonable source. Finally, additional corrective actions will have little effect on the net reduction of constituent concentrations of concern and, therefore, will have little impact on the groundwater quality.

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

Because of the nature of the contaminants present on the site, residual contamination will remain after remediation is complete. Upon transfer to DOE, the DOE Grand Junction Office will be responsible for providing stewardship for the groundwater and disposal cell at the (Petrotomics) Shirley Basin Site 1. Long-term stewardship activities include maintaining and repairing the fence that surrounds the disposal cell to restrict access. Drilling and other intrusive activities are restricted across the entire property to prevent the inadvertent release of contaminants on the site. Wildlife grazing will be permitted on the site.

Prior to transfer, DOE will prepare a draft long-term surveillance plan for the site. NRC approval is required prior to termination of the site license and transfer of the site to DOE. Site records will be maintained in

permanent storage at the DOE Grand Junction Office. The types of records to be maintained include the characterization data, remedial action design, completion report, long-term monitoring plan, annual inspection reports, and monitoring data. In addition, DOE will submit an annual report that summarizes, describes, and evaluates all surveillance and maintenance actions as required by NRC regulations (Title 10 of the *Code of Federal Regulations*, Part 40) and as specified in the approved long-term surveillance plan.

2.2 Specific Long-Term Stewardship Activities

Groundwater

DOE will continue to monitor groundwater at this site to verify natural attenuation will meet cleanup goals and to demonstrate the integrity of the disposal cells in isolating the encapsulated wastes from the local environment. Groundwater monitoring will occur annually and is expected to continue in perpetuity.

> ***STAKEHOLDER INVOLVEMENT***
>
> When licensed and transferred to DOE, copies of the annual inspection report for the (Petrotomics) Shirley Basin Site 1 will be distributed to the local library and stakeholders requesting them. The annual inspection report will also be published on the DOE Grand Junction Office website at www.doegjpo.com.

Groundwater wells currently are required to be sampled semi-annually for chloride, nitrate, sulfate, acidity/alkalinity, total dissolved solids, cadmium, chromium, lead, nickel, radium-226, radium-228, selenium, thorium-230, and uranium. Groundwater monitoring reports are required to be submitted to the NRC annually, and these include groundwater contour maps and historic trends in groundwater concentrations.

Engineered Units

One 65-hectare (160-acre) disposal cell is present on the 243-hectare (600-acre) site. The disposal cell is not lined, but is located on top of compacted clay. DOE estimates the volume of uranium mill tailings; soil contaminated with uranium, radium, and thorium; and construction debris contained in the cell to be 3.6 million cubic meters (4.7 million cubic yards). Once remediation is completed, the disposal cell will be capped with a clay and rock cap. The cap will require annual inspections to evaluate the condition of surface features. In addition, DOE will be responsible for performing maintenance and vegetation control, as necessary. A fence will surround the cell to restrict access in perpetuity.

2.3 Regulatory Regime

The (Petrotomics) Shirley Basin Site 1 is completing reclamation under the provisions of Title II of the *Uranium Mill Tailings Radiation Control Act of 1978* (UMTRCA). DOE is required under UMTRCA to provide long-term stewardship for this site after completion of remedial action or reclamation activities in the event the host state does not exercise its authority. Requirements for NRC licensing of closed UMTRCA Title II sites are defined under NRC regulations (Title 10 of the *Code of Federal Regulations*, Part 40.28). UMTRCA sites are remediated to EPA standards (Title 40 of the *Code of Federal Regulations*, Part 192).

Following remediation, the site will be transferred under general license by NRC to DOE for custody and long-term care. The NRC general license is in accordance with Title 10 of the *Code of Federal Regulations* Part 40.28, *General License for Custody and Long-Term Care of Uranium or Thorium Byproduct Materials Disposal Sites*. The purpose of the license is to ensure that the site will be cared for in a manner that protects human health and safety and the environment. The license also means the NRC formally accepts the site's long-term surveillance plan as prepared by DOE.

Once the site is transferred to DOE under general license to the NRC, long-term stewardship of the site will be governed by several requirements in the following regulations: UMTRCA; the *Atomic Energy Act of 1954,* as amended; and EPA standards, including Subparts D and E of Title 40 of the *Code of Federal Regulations*, Part 192; a cooperative agreement between DOE and the State of Wyoming; and the *National Environmental Policy Act of 1969,* as amended.

2.4 Assumptions and Uncertainties

DOE expects the (Petrotomics) Shirley Basin Site 1 to be transferred to DOE in 2002. However, the exact date of the transfer depends on completion of the remedial activities being conducted by the Petrotomics Company. Cleanup levels will be achieved before the site is transferred to DOE for long-term stewardship. Groundwater monitoring will be conducted to verify continued compliance with cleanup levels. Groundwater monitoring may or may not continue indefinitely, depending upon site-specific circumstances and hydrology, and whether or not the cell demonstrates infiltration control.

3.0 Estimated Long-Term Stewardship Costs

For the site to be transferred to DOE, the Petrotomics Company must make a one-time payment to the U.S. Treasury that fully funds inspections and anticipated future maintenance at the site. Therefore, there will be no additional cost to the U.S. Government for the site for long-term stewardship activities. DOE assumes the site will be transferred in 2002. Cost estimates identified in the table below, are based on comparisons of the actual costs of long-term stewardship activities at other, similar sites that are currently being managed by DOE. The small fluctuations in the cost estimates are due to estimated changes in the overhead rates. Actual costs for groundwater monitoring will vary depending upon the results of groundwater sampling, frequency, number of analyses sampled, and the number of sampling points (e.g., wells) that will be identified in the long-term surveillance plan.

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	*Amount*	*Year(s)*	*Amount*	*Year(s)*	*Amount*
FY 2000	$0	**FY 2008**	$35,100	**FY 2036-2040**	$170,500
FY 2001	$0	**FY 2009**	$35,100	**FY 2041-2045**	$170,400
FY 2002	$36,100	**FY 2010**	$34,300	**FY 2046-2050**	$170,500
FY 2003	$34,900	**FY 2011-2015**	$163,500	**FY 2051-2055**	$170,400
FY 2004	$35,300	**FY 2016-2020**	$159,200	**FY 2056-2060**	$170,500
FY 2005	$35,500	**FY 2021-2025**	$159,700	**FY 2061-2065**	$170,400
FY 2006	$34,800	**FY 2026-2030**	$168,700	**FY 2066-2070**	$170,500
FY 2007	$35,300	**FY 2031-2035**	$170,400		

4.0 FUTURE USES

The (Petrotomics) Shirley Basin Site 1 will be a permanent uranium mill tailings repository. Public access to the disposal cell will be restricted indefinitely.

For more information about the (Petrotomics) Shirley Basin Site 1, please contact:

Art Kleinrath, Long-Term Surveillance and Maintenance Program Manager
U.S. Department of Energy, Grand Junction Office
2597 B3/4 Road, Grand Junction, CO 81503
Phone: 970-248-6037
or visit the Internet website at http://www.doegjpo.com

RIVERTON SITE

1.0 SITE SUMMARY

1.1 Site Description and Mission

The Riverton Site is the location of a former uranium and vanadium mill that operated from 1958 to 1963. The site is located on a 57-hectare (140-acre) tract of land in Fremont County, Wyoming, four kilometers (2.5 miles) southwest of the center of Riverton, north of State Highway 789. As a result of past milling operations, the site is contaminated with uranium and vanadium mill tailings and radium, thorium, and uranium in soils and construction debris. Initially, the tailings pile covered approximately 29 hectares (72 acres) and had an average depth of one meter (four feet). In 1988, approximately 1.0 million cubic meters (1.8 million cubic yards) of the contaminated materials were relocated to the UMETCO Gas Hills Disposal Site, 72 kilometers (45 miles) away. The U.S. Department of Energy (DOE) completed surface remediation activities at the site in November 1989.

LONG-TERM STEWARDSHIP HIGHLIGHTS

Major Long-Term Stewardship Activities - groundwater monitoring; institutional controls
Total Site Area - 57 hectares (140 acres)
Estimated Volume of Residual Contaminants - groundwater 1.9 million cubic meters (2.5 million cubic yards)
Long-Term Stewardship Start-End Years - 1989-2070
Average Annual Long-Term Stewardship Cost FY 2003-2006 - $6,000
Landlord - U.S. Department of Energy, Grand Junction Office

The current mission of the Riverton Site is to perform long-term stewardship activities, including groundwater monitoring, which is conducted by DOE's Grand Junction Office. The former mill site is subject to Title I of the *Uranium Mill Tailings Radiation Control Act of 1978* (UMTRCA). As such, DOE is responsible for remediation and long-term stewardship activities. The land is privately owned and lies within the boundaries of the Wind River Indiana Reservation, but funding for long-term stewardship activities is provided by DOE.

The historic mission of the site was to process uranium and vanadium for the U.S. national defense program. The mill operations ceased in 1963. No other activities were conducted at the site until 1988, at which time DOE began remedial action on the surface contamination.

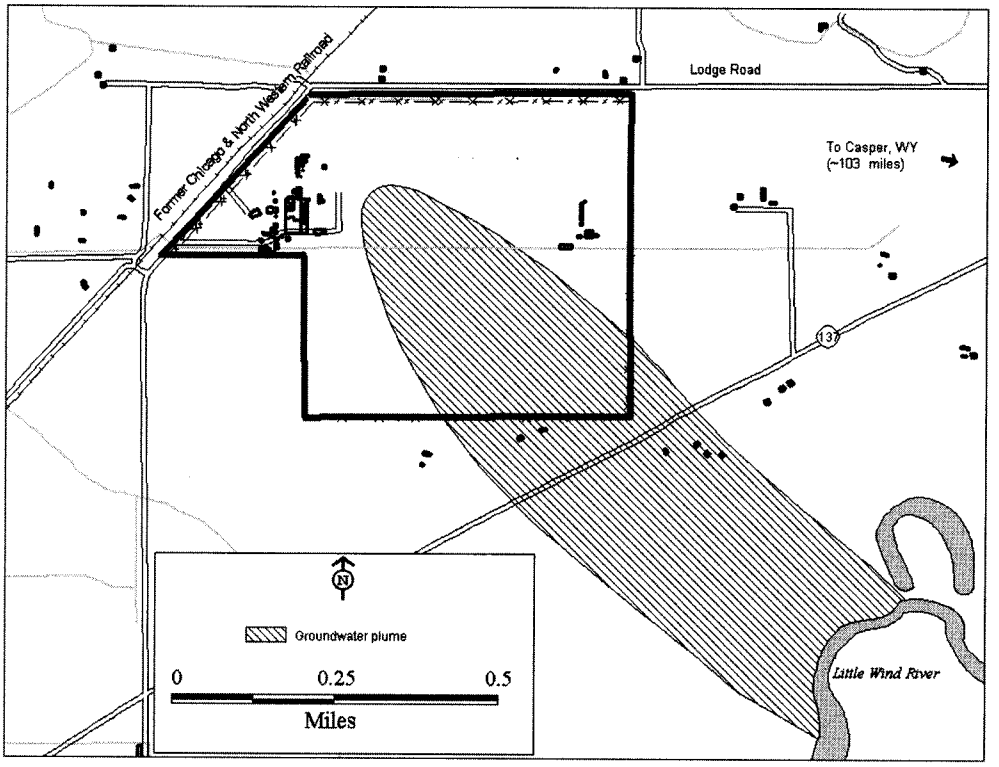
1.2 Site Cleanup and Accomplishments

The milling operations at the Riverton Site caused both surface and subsurface (groundwater) contamination. Residual uranium mill tailings, which typically contain toxic heavy metals and radioactive thorium and radium, were the source of the contamination.

After excavation and relocation of the contaminated materials to the (UMETCO) Gas Hills Site in 1989, the disturbed areas at the Riverton Site were graded and revegetated. The soil was remediated to U.S. Environmental Protection Agency (EPA) standards.

Approximately 1.9 million cubic meters (2.5 million cubic yards) of groundwater are contaminated with materials from processing ores to recover vanadium and uranium. Specifically, the identified contaminants of concern include chromium, molybdenum, net gross alpha, selenium, radium, and uranium. The groundwater plume is approximately 70 hectares (160 acres) and extends into the shallow alluvial and bedrock aquifers beneath the former mill site. Water in the adjacent Wind River and Little Wind River has not been degraded by site contaminants. A permanent municipal water supply was extended to local residences so that contamination does not threaten local populations. The U.S. Nuclear Regulatory Commission (NRC) has approved natural flushing

as the groundwater compliance strategy. Active groundwater remediation will not be required, but monitoring will be necessary until the site groundwater complies with water quality standards.



Riverton Site

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

DOE's Grand Junction Office is responsible for long-term stewardship activities at the Riverton Site. These activities include monitoring the groundwater and ensuring that institutional controls, such as restricting groundwater use, remain effective. There are no permanent surveillance features the Riverton Site.

DOE maintains and updates the specific records and reports required to document long-term stewardship activities at the Riverton Site. The site records are kept in permanent storage at the DOE Grand Junction Office in Colorado. The types of records maintained include site characterization data, remedial action design information, the site completion report, long-term monitoring plans, the groundwater compliance plan, annual inspection reports, and current and historic monitoring data.

STAKEHOLDER INVOLVEMENT

Community interaction has been minimal since the surface remedial action was completed. Copies of the annual inspection report for the Riverton Site are distributed to the local library and to any stakeholders requesting them. In addition, the report can also be accessed on the DOE Grand Junction Office website at www.doegjpo.com.

2.2 Specific Long-Term Stewardship Activities

Groundwater

Groundwater monitoring is necessary to ensure that natural flushing is removing contamination in accordance with the EPA's limit of remediation within 100 years. DOE will conduct groundwater monitoring annually until 2008, and then once every four years. Once NRC certifies compliance with Subpart B of the EPA Groundwater Protection Standards (Title 40 of the *Code of Federal Regulations*, Part 192), the site will be released for unrestricted use to its owner.

2.3 Regulatory Regime

The *Uranium Mill Tailings Radiation Control Act of 1978* (UMTRCA) authorized DOE to care for the uranium mill tailings sites under a general license issued by NRC for the long-term care of residual radioactive material disposal cells. However, for the actual processing site where the residual radioactive materials were originally located, NRC will not license the site. Compliance with EPA groundwater standards will require NRC concurrence.

Several requirements in the following regulations govern long-term stewardship activities of the Riverton site: UMTRCA; the *Atomic Energy Act of 1954,* as amended; EPA groundwater protection standards, including Subparts B and C of Title 40 of the *Code of Federal Regulations,* Part 192 - *Standards for Cleanup of Land and Buildings Contaminated with Residual Radioactive Materials from Inactive Uranium Processing Sites*; a cooperative agreement between DOE and the State of Wyoming; and the *National Environmental Policy Act of 1969,* as amended.

2.4 Assumptions and Uncertainties

After 2008, groundwater monitoring will occur at four year intervals until EPA water quality standards are met. DOE assumes that groundwater compliance will be achieved through natural flushing and that active remediation will not be required.

DOE also assumes that no further surface remediation activities will be needed since known contaminated materials and soils were disposed at the (UMETCO) Gas Hills Site in 1989.

3.0 Estimated Long-Term Stewardship Costs

Estimated long-term stewardship costs identified in the table below, are based on the current site agreements and monitoring frequencies. The estimated costs for fiscal years (FY) 2003 through 2008 include costs associated with annual groundwater monitoring; estimated costs in FY 2009 represent minor administrative costs. After FY 2008, cost estimates reflect groundwater monitoring that will occur at four-year intervals until EPA water quality standards are met. Contingency costs, such as groundwater monitoring well replacement, have not been incorporated into the cost estimates. For purposes of this report, long-term stewardship costs are shown until FY 2070; however, it is anticipated that long-term stewardship will be required in perpetuity.

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	***Amount***	***Year(s)***	***Amount***	***Year(s)***	***Amount***
FY 2000	$0	**FY 2008**	$5,700	**FY 2036-2040**	$6,400
FY 2001	$0	**FY 2009**	$200	**FY 2041-2045**	$6,300
FY 2002	$0	**FY 2010**	$0	**FY 2046-2050**	$6,400
FY 2003	$5,700	**FY 2011-2015**	$5,600	**FY 2051-2055**	$6,300
FY 2004	$5,700	**FY 2016-2020**	$5,600	**FY 2056-2060**	$6,400
FY 2005	$5,700	**FY 2021-2025**	$5,700	**FY 2061-2065**	$6,300
FY 2006	$5,700	**FY 2026-2030**	$6,400	**FY 2066-2070**	$6,400
FY 2007	$5,700	**FY 2031-2035**	$6,300		

4.0 FUTURE USES

Once the groundwater standards are met, the site will be released for unrestricted use to its owner.

For more information about the Riverton Site, please contact:

Art Kleinrath, Long-Term Surveillance and Maintenance Program Manager
U.S. Department of Energy, Grand Junction Office
2597 B3/4 Road, Grand Junction, CO 81503
Phone: 970-248-6037
or visit the Internet website at http://www.doegjpo.com

ROCK SPRINGS OIL SHALE RETORT SITE

1.0 SITE SUMMARY

1.1 Site Description and Mission

The Rock Springs Oil Shale Retort site is located seven miles west of Rock Springs in Sweetwater County, Wyoming. The site was used by DOE (and its predecessors) for in-situ oil shale retorting experiments in the late 1960s and 1970s. Experiments were performed on approximately 14 hectares (35 acres) of the leased 130 hectares (320 acres). The retorting experiment included hydro and explosive fracturing tests to enhance retrieval of oil from the shale geology.

The site's current mission is to complete environmental remediation of groundwater, which was contaminated as a result of previous experiments conducted at the site, and long-term stewardship.

LONG-TERM STEWARDSHIP HIGHLIGHTS

Major Long-Term Stewardship Activities - groundwater and surface vegetation monitoring; institutional controls
Total Site Area -130 hectares (320 acres)
Estimated Volume of Residual Contaminants - groundwater unknown
Long-Term Stewardship Start-End Years - 2005-2010
Total Long-Term Stewardship Cost FY 2005-2010 - $2,000,000
Landlord - U.S. Department of Energy, Office of Fossil Energy

1.2 Site Cleanup and Accomplishments

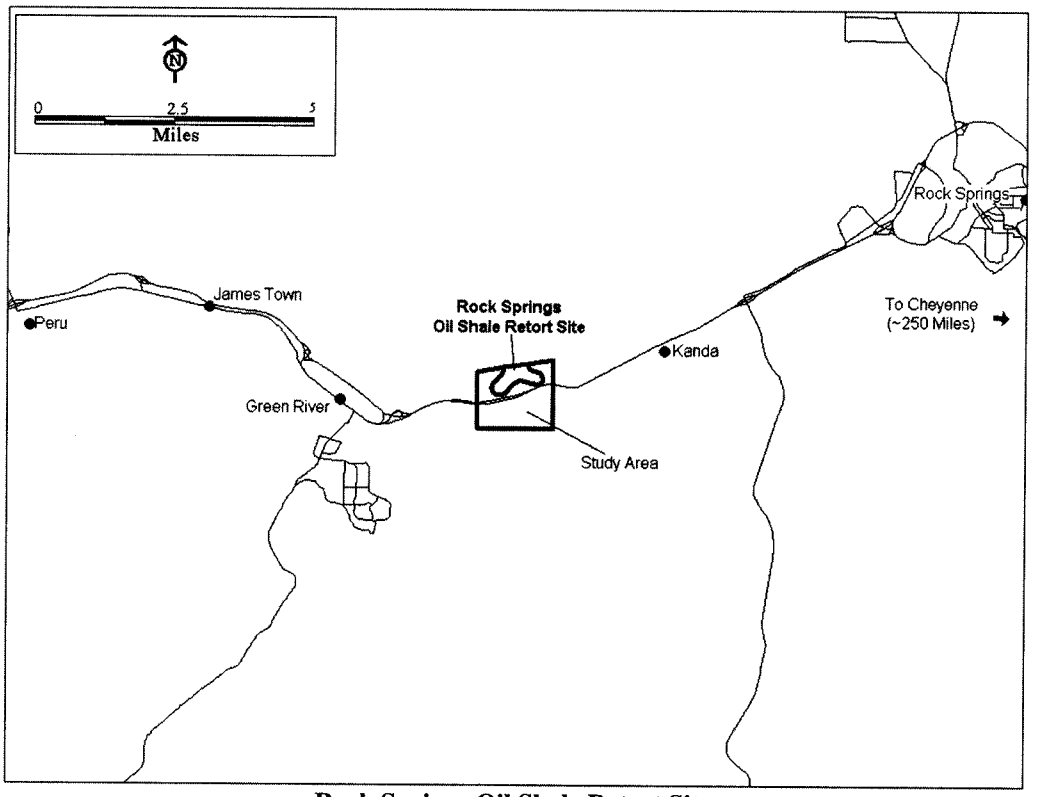
Groundwater at the site is contaminated with petroleum hydrocarbons (including shale oil, retort gas, and residual organic carbon) and organic compounds (including benzene, toluene, ethyl benzene, xylene, and phenols). DOE's Office of Fossil Energy (FE) has conducted pilot demonstration projects indicating that an in-situ aeration system, operated in conjunction with periods of inactivity, will be the most effective method of remediating groundwater contamination at the site. The Wyoming Department of Environmental Quality has approved this preferred remedial action, and construction of an in-situ aeration system is expected to be completed in January 2001. The in-situ aeration system will operate through 2003, then will be shut down for one year to determine if the contaminants in the groundwater have been removed. If the contamination remains, the system will resume operation for another year or until levels of contaminants are acceptable to the Wyoming Department of Environmental Quality.

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

After remediation is complete in 2005, DOE is responsible for surveillance and maintenance activities at the Rock Springs Oil Shale Retort Site through 2010. Anticipated site-wide long-term stewardship activities include groundwater and surface vegetation monitoring, record-keeping, and institutional controls. Institutional controls will consist of well drilling restrictions in the affected areas of groundwater contamination. This action will be conducted through the Wyoming State Engineer's Office.

3.0 ESTIMATED LONG-TERM STEWARDSHIP COSTS

The total estimated long-term stewardship costs for the five-year period between 2005 and 2010 are approximately $2 million dollars. These costs incorporate all anticipated long-term stewardship activities, including monitoring, record-keeping activities, and institutional controls.



Rock Springs Oil Shale Retort Site

4.0 FUTURE USES

This property is privately owned, but DOE has a lease and authority to be on the property until cleanup is completed. After remediation, the property owner will continue to utilize the land for livestock grazing. DOE is responsible for long-term stewardship activities at this site until released from liability by the Wyoming Department of Environmental Quality. Following release of liability, DOE will have no further involvement at the property.

For additional information about the Rock Springs Oil Shale Retort Site, please contact:

Mr. Craig Zamuda
U.S. Department of Energy, Office of Fossil Energy
1000 Independence Avenue
Washington, DC 20585
Phone: 202-586-6367
craig.zamuda@hq.doe.gov

SPOOK SITE

1.0 SITE SUMMARY

1.1 Site Description and Mission

The Spook Site is the location of a former uranium mill that operated from 1962 until 1965. The site contains a disposal cell for the uranium mill tailings and other contaminated materials generated during mill construction and operations. The site is located on a seven-hectare (14-acre) tract of land in Converse County, approximately 77 kilometers (48 miles) northeast of the town of Casper and 51 kilometers (32 miles) northeast of Glenrock, Wyoming.

LONG-TERM STEWARDSHIP HIGHLIGHTS

Major Long-Term Stewardship Activities - disposal cell monitoring; institutional controls; access restrictions
Total Site Area - 7 hectares (14 acres)
Estimated Volume of Residual Contaminants - disposal cell 241,000 cubic meters (315,000 cubic yards); groundwater 4 million cubic meters (5 million cubic yards)
Long-Term Stewardship Start-End Years - 1993-in perpetuity for disposal cell
Average Annual Long-Term Stewardship Cost FY 2000-2006 - $28,000
Landlord - U.S. Department of Energy, Grand Junction Office

As a result of past milling operations, contamination at the site consisted of approximately 241,000 cubic meters (315,000 cubic yards) of uranium mill tailings, radium and thorium in soils, and construction debris. Initially, the uranium tailings were placed on the surface at the mill site or into an open pit mine. The solutions used in the milling process were disposed of on the tailings pile and in an acid pond located 500 meters (1,500 feet) south of the mill site.

In November 1989, the U.S. Department of Energy (DOE) and the Wyoming Abandoned Mine Lands Program together completed surface remediation activities at the site. Currently, the site contains a two-hectare (five-acre) disposal cell with a radon barrier and thick soil layer on top for erosion control. The State of Wyoming acquired the land and transferred it to DOE for long-term care.

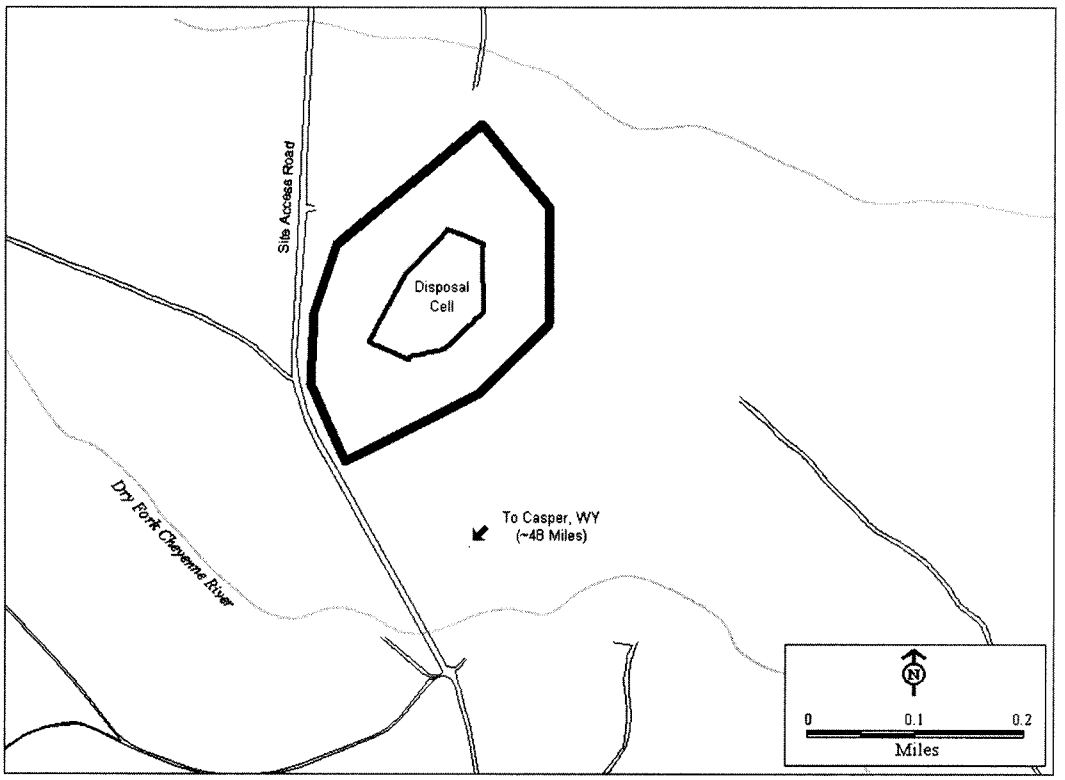
The current mission of the Spook Site is to perform long-term stewardship activities, including monitoring and maintaining the disposal cell. The former mill site is subject to Title I of the *Uranium Mill Tailings Radiation Control Act of 1978* (UMTRCA). As such, DOE remediated the site and is responsible for conducting long-term stewardship activities, which began in 1993.

The historic mission of the Spook Site was to provide uranium for the U.S. national defense program. Wyoming Mining and Milling Company operated a facility on the site from 1962 until 1965 to upgrade uranium to concentrated uranium ore before shipment to the Western Nuclear Mill at Jeffrey City, Wyoming.

1.2 Site Cleanup and Accomplishments

The milling operations at the Spook Site caused both surface and groundwater contamination. Residual uranium mill tailings, which typically contain toxic heavy metals and radioactive thorium and radium, were the source of the contamination. DOE stabilized approximately 241,000 cubic meters (315,000 cubic yards) of these contaminated materials in an inactive open pit mine (i.e., a disposal cell) on the site, backfilled the pit with uncontaminated soil and restored the disturbed area to pre-mining conditions. Specifically, the pit mine was covered with a low-permeability radon barrier consisting of compacted soil and overlaid with a layer of high-permeability granular material. In accordance with U.S. Environmental Protection Agency (EPA) standards, the cover is designed to remain effective for 200 to 1,000 years. After completing surface remedial actions at the

site in 1989, DOE received concurrence in March 1992 from the U.S. Nuclear Regulatory Commission (NRC) that the site conformed to cleanup standards (Title 40 of the *Code of Federal Regulations,* Part 192).



Spook Site

Approximately 4 million cubic meters (5 million cubic yards) of groundwater are contaminated with materials from processing ores to recover uranium. Specifically, the identified constituents of concern include uranium, selenium, cadmium, chromium, molybdenum, net gross alpha, nitrate, radium, and silver. The groundwater plume is located in the upper aquifer and extends 762 meters (2,500 feet) downgradient of the pit. The upper aquifer is also contaminated by widespread, naturally occurring mineralization and associated exploration and mining activities. Consequently, the upper aquifer is not a current or potential source of drinking water for the Spook Site vicinity. As such, the groundwater in the upper aquifer is classified as limited use and, therefore, remediation will not be required.

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

In September 1993, DOE's Grand Junction Office was assigned the long-term care of the Spook Site. Under the provisions of the site-specific long-term surveillance plan, DOE conducts annual inspections of the site to evaluate the condition of surface features, performs site maintenance, as necessary, maintains institutional controls, and monitors the disposal cell. Annual inspections of the Spook Site are conducted to detect progressive change caused by slow-acting natural processes and to identify potential problems before extensive maintenance, repairs, or corrective actions are needed. DOE does not plan to conduct routine maintenance at

the Spook Site. However, DOE will perform custodial maintenance or repair, as needed or determined from site inspections.

The disposal site is not fenced, so it is always accessible. Because the disposal cell has been contoured to match the surrounding topography, the site is rather inconspicuous and security measures are not expected to be necessary. The permanent surveillance features at the Spook Site include survey and boundary monuments, site markers, an entrance sign, and perimeter signs. In addition, DOE staffs a 24-hour phone line for reporting any site concerns. No drilling or other intrusive activities are allowed within the property unless authorized by DOE.

DOE maintains and updates the specific records and reports required to document long-term stewardship activities at the Spook Site. DOE submits an annual report to the NRC that documents the results of the long-term surveillance plan, as required by NRC regulations in Title 10 of the *Code of Federal Regulations*, Part 27, Appendix A, Criterion 12. Site records are kept in permanent storage at the DOE Grand Junction Office in Colorado, and real property records are retained at the DOE Albuquerque Operations Office in New Mexico. The types of records maintained include site characterization data, remedial action design information, the site completion report, long-term monitoring plans, annual inspection reports, and current and historic monitoring data.

2.2 Specific Long-Term Stewardship Activities

Engineered Units

The site has one disposal cell, which contains residual radioactive material. The Spook Site is unique among DOE uranium mill tailings disposal sites because the disposal cell is completely buried, whereas the other disposal cells are surface impoundments. However, the Spook Site disposal cell still requires long-term surveillance and maintenance to ensure continued protection of human health and the environment. Long-term surveillance and maintenance activities at the disposal cell include annual surface inspections, vegetation control, and sign replacements, as necessary. No significant repairs of the disposal cell are anticipated.

> ***STAKEHOLDER INVOLVEMENT***
>
> Since the remedial action was completed, community interaction has been minimal. Copies of the annual inspection report for the Spook Site are distributed to the local library and to stakeholders that request them. The report is also published on the DOE Grand Junction Office website at www.doegjpo.com.

Groundwater

No long-term groundwater monitoring is necessary.

2.3 Regulatory Regime

In September 1993, the Spook Site came under a general license issued by NRC for custody and long-term care of residual radioactive disposal sites (contained at Title 10 of the *Code of Federal Regulations,* Section 40.27). The purpose of the general license is to ensure that such sites will be cared for in a manner that protects human health and safety and the environment. The general license went into effect when NRC concurred that the site conformed to cleanup standards and formally accepted the site-specific long-term surveillance plan.

Long-term stewardship activities at the Spook Site is governed by several other regulations, including the *Uranium Mill Tailings Radiation Control Act of 1978*; the *Atomic Energy Act of 1954,* as amended; Environmental Protection Agency Groundwater Protection Standards, including Subparts B and C of Title 40

of the *Code of Federal Regulations,* Part 192 - *Standards for Cleanup of Land and Buildings Contaminated with Residual Radioactive Materials from Inactive Uranium Processing Sites*; a cooperative agreement between DOE and the State of Wyoming; and the *National Environmental Policy Act of 1969,* as amended.

2.4 Assumptions and Uncertainties

Because the Spook Site has been monitored since 1993, the long-term stewardship activities at the site are well known and are not expected to change dramatically. Since annual inspections are conducted to detect progressive change caused by slow-acting natural processes, significant repairs of the disposal cell are not anticipated (i.e., cap is not expected to be replaced for a minimum of 200 years). DOE anticipates that public access to the site will be restricted indefinitely, and, thus, long-term stewardship activities will be performed in perpetuity. Sound scope and cost estimates for the long-term stewardship activities at the site have been developed.

3.0 Estimated Long-Term Stewardship Costs

Estimated long-term stewardship costs for the Spook Site are identified in the table below. Cost estimates are based on historical costs incurred while conducting actual surveillance and maintenance activities. Cost estimates reflect the current site agreements and monitoring frequencies. Contingency costs, such as cap replacement, have not been incorporated into the cost estimates. Costs from fiscal years (FY) 2001 through 2006 include prorated costs associated with decommissioning unnecessary monitoring wells at similar sites. For purposes of this report, long-term stewardship costs are shown until FY 2070; however, it is anticipated that long-term stewardship will be required in perpetuity.

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	***Amount***	***Year(s)***	***Amount***	***Year(s)***	***Amount***
FY 2000	$12,500	**FY 2008**	$9,200	**FY 2036-2040**	$48,000
FY 2001	$33,200	**FY 2009**	$9,100	**FY 2041-2045**	$48,000
FY 2002	$35,200	**FY 2010**	$9,200	**FY 2046-2050**	$48,000
FY 2003	$31,400	**FY 2011-2015**	$43,800	**FY 2051-2055**	$48,000
FY 2004	$35,400	**FY 2016-2020**	$43,800	**FY 2056-2060**	$48,000
FY 2005	$23,300	**FY 2021-2025**	$44,900	**FY 2061-2065**	$48,000
FY 2006	$23,700	**FY 2026-2030**	$47,500	**FY 2066-2070**	$48,000
FY 2007	$9,200	**FY 2031-2035**	$48,000		

4.0 Future Uses

The Spook Site will be monitored and maintained in accordance with the long-term surveillance plan approved by the NRC. Public access to the disposal site will be restricted indefinitely.

For more information about the Spook Site, please contact:

Art Kleinrath, Long-Term Surveillance and Maintenance Program Manager
U.S. Department of Energy, Grand Junction Office
2597 B3/4 Road, Grand Junction, CO 81503
Phone: 970-248-6037
or visit the Internet website at http://www.doegjpo.com

(UMETCO) GAS HILLS SITE

1.0 SITE SUMMARY

1.1 Site Description and Mission

The UMETCO Minerals Corporation (UMETCO) Gas Hills Site is the location of a former uranium mill that operated from 1960 until 1979. The site contains disposal cells for the uranium mill tailings and other process-related wastes resulting from mill operations at this site and from the nearby Riverton Site. The site is located in the East Gas Hills area of central Wyoming in western Natrona County, west of the city of Casper and approximately 80.4 kilometers (50 miles) southeast of the town of Riverton. The area is a uranium mining district with subsurface ore zones and numerous former mine sites. UMETCO, which still owns the site under a license by the U.S. Nuclear Regulatory Commission (NRC), is expected to transfer approximately 810 hectares (2,000 acres) of land to DOE for long-term custody in 2002.

LONG-TERM STEWARDSHIP HIGHLIGHTS

Major Long-Term Stewardship Activities - monitoring and maintenance of disposal cells; groundwater monitoring
Total Site Area - 810 hectares (2,000 acres)
Estimated Volume of Residual Contaminants - disposal cell 4.9 million cubic meters (6.5 million cubic yards); groundwater unknown
Long-Term Stewardship Start-End Years - 2002-in perpetuity
Average Annual Long-Term Stewardship Cost FY 2002-2006 - $35,300
Landlord - Currently UMETCO; U.S. Department of Energy, Grand Junction Office (beginning in 2002)

The current mission of the site is remediation, which is the responsibility of UMETCO. Previous uranium milling operations created process-related wastes and uranium mill tailings. These wastes and mill tailings are being disposed in an engineered disposal cell, which encompasses 71 hectares (176 acres). The site also contains a heap leach area (encompassing 25 hectares (63 acres)), two evaporation ponds, and an inactive tailings impoundment. The A-9 pit, encompassing 49 hectares (122 acres), was used for tailings disposal from 1979 until 1984, and is still being used as a disposal cell for tailings and mill waste.

The (UMETCO) Gas Hills Site is subject to Title II of the *Uranium Mill Tailings Radiation Control Act of 1978* (UMTRCA). UMTRCA Title II sites are privately owned and operated sites that were licensed when UMTRCA was passed, or thereafter. The majority of the mining and milling conducted at these sites was for private sale, but a portion was sold to the U.S. Government. As such, the Department of Energy (DOE) is responsible for long-term stewardship activities at the site, but is not responsible for site remediation. Once the site is transferred to DOE, the only ongoing mission will be monitoring and maintenance of disposal cells and groundwater monitoring.

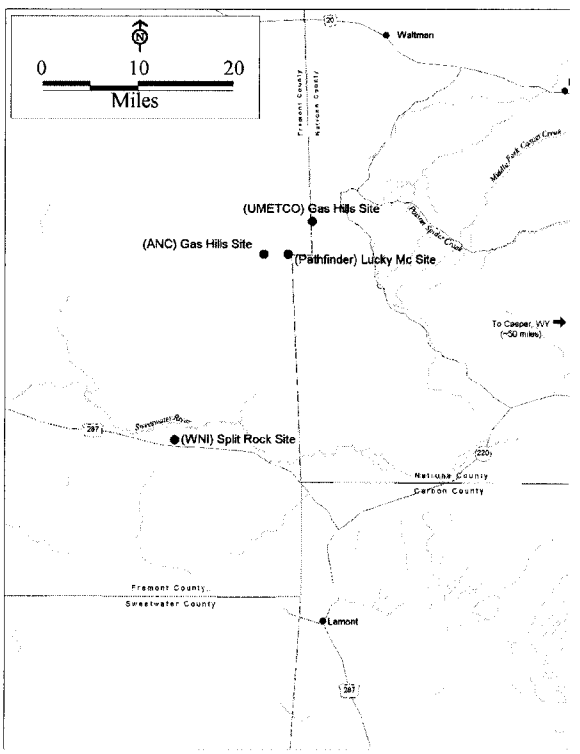
The historic mission of the (UMETCO) Gas Hills Site was to process uranium ore for the U.S. Government and private entities. UMETCO operated the mill from 1960 to 1979, and later dismantled it.

1.2 Site Cleanup and Accomplishments

The source of contamination at the (UMETCO) Gas Hills Site was the residual tailings remaining after the uranium was extracted during the milling process. Current site remediation activities include reclamation of three waste disposal areas, including the inactive tailings impoundment, a heap leach area, and a below-grade solids disposal area. Proposed activities include reclamation of two evaporation ponds. Groundwater monitoring is also continuing. Upon completion of remediation, approximately 8,700,000 tons of uranium mill tailings are expected to be disposed of in engineered disposal cells, including mill tailings and other mill waste generated

at the (UMETCO) Gas Hills site and mill tailings transferred to the (UMETCO) Gas Hills site from the Riverton Site. The current remediation plan for the site requires the cells to be capped with rock upon final closure.

Groundwater at the site is contaminated by radionuclides, including radium-226, uranium, thorium-230, lead-210, and metals (including nickel and selenium). Under UMETCO's materials license from NRC, UMETCO is required to demonstrate compliance with groundwater protection standards for the Lower Wind River and Upper Wind River Formations. UMETCO also is required to implement a groundwater monitoring program for the site and to submit to NRC a semi-annual groundwater monitoring report. The NRC license indicates that UMETCO's projected date for completing groundwater corrective actions is December 31, 2000.



(UMETCO) Gas Hills Site

UMETCO has submitted to NRC an application for alternate concentration limits (ACLs), cleanup standards that are based on site-specific considerations, for the groundwater, and adjustments to background levels for certain constituents, based on the limited use of the groundwater and concerns that the corrective action is importing constituents related to nearby natural and mining activities. For the alternate concentrations to be approved, evidence must be provided that the ACLs will not adversely impact human health or the environment. To date, NRC has not completed activity on this request. DOE also has not yet received information from UMETCO on the area of groundwater contamination.

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

Long-term stewardship activities have not been initiated at the (UMETCO) Gas Hills Site because the site is still under remediation. Contaminated groundwater will remain on the site, but is not expected to leave the site at concentrations above applicable NRC standards. Upon transfer to DOE, the DOE Grand Junction Office will be responsible for performing long-term stewardship activities at the site.

Access will be restricted by fencing and posting warning, as necessary, along the site boundary. DOE maintains a 24-hour phone line for reporting site concerns. Drilling and other intrusive activities will be prevented within site boundaries through management control. Once the site is transferred, DOE will conduct annual inspections to ensure the integrity of cell covers and other engineered features, and to ensure that institutional controls are effective and the site complies with applicable requirements.

Site records will be maintained in permanent storage at the DOE Grand Junction Office in Colorado. Types of records to be maintained include characterization data, remedial action design, the site completion report, long-term monitoring plans, annual inspection reports, and monitoring data.

Under the terms of the existing NRC license, UMETCO is required to conduct an annual survey of land use, including residences, potable water and agricultural wells, grazing areas, and nonresidential structures in the area within 8 kilometers (5 miles) of the restricted boundary of the site. UMETCO also is required to submit an annual report to NRC noting any changes since the previous survey. In addition, UMETCO is required to conduct a cultural resources survey of any property prior to their disturbance, including any borrowed areas used for reclamation cover. Surveys must be submitted to NRC before any work may proceed. UMETCO is required to report all effluent and environmental monitoring required by the NRC license and to report directly to the NRC annually. A copy of the environmental monitoring report is required to be maintained onsite. Some of these requirements also may apply to DOE after the site is transferred.

2.2 Specific Long-Term Stewardship Activities

Groundwater

DOE assumes that some groundwater monitoring will be required during long-term stewardship. However, the extent of groundwater monitoring that will be required will not be known until after remediation is completed. Requirements for groundwater monitoring will be prescribed in the long-term surveillance plan, to be approved by NRC at the time of site transfer and acceptance of the site under the NRC general license (anticipated to be in 2002).

STAKEHOLDER INVOLVEMENT

When licensed and transferred to DOE, copies of the annual inspection report for the (UMETCO) Gas Hills Site will be distributed to the local library and any stakeholders requesting them. The annual inspection report will also be published on the Grand Junction Office website at www.doegjpo.com.

Engineered Units

The reclaimed A-9 disposal cell, heap leach impoundment, and inactive tailings impoundment will be surrounded by fences to control access. The final caps, radon barriers, frost protection soil, and erosion protection soil for the inactive impoundment, A-9 cell, and heap leach impoundment will require monitoring and maintenance to ensure their long-term integrity. The total area covers 146 hectares (361 acres).

After site transfer, DOE's Grand Junction Office will be responsible for conducting long-term surveillance and maintenance, access restrictions, and institutional controls for the reclaimed areas and engineered units. Long-term surveillance and maintenance activities for the disposal cells will include annual surface inspections and vegetation control and may also include radon monitoring. About 4.9 million cubic meters (6.5 million cubic yards) of uranium mill tailings, soil, and construction debris contaminated with uranium, radium, and thorium are expected to be disposed of in engineered, lined disposal cells. The cells will include a final rock cap, radon barrier, and surface layer to control frost and erosion. According to U.S. Environmental Protection Agency (EPA) standards, the cover of the disposal cells must be designed to remain effective for 200 to 1,000 years.

2.3 Regulatory Regime

UMETCO is currently completing site reclamation in accordance with Title II of the *Uranium Mill Tailings Radiation Control Act of 1978* (UMTRCA) and will dispose of the tailings in an NRC-approved disposal cell. Cleanup and reclamation standards were promulgated by NRC in Title 10 of the *Code of Federal Regulations,*

Part 40, Appendix A. These standards conform to EPA standards specified in Title 40 of the *Code of Federal Regulations,* Part 192.

Following remediation, the site will be transferred under general license by NRC for DOE's custody and long-term care of residual radioactive disposal sites (contained at Title 10 of the *Code of Federal Regulations,* Section 40.28). The purpose of the license is to ensure that the site will be cared for in a manner that protects human health and safety and the environment. The license also means the NRC formally accepts the site's long-term surveillance plan, as prepared by DOE.

Once the site is transferred to DOE under general license by NRC, long-term stewardship activities at the (UMETCO) Gas Hills Site will be governed by several other requirements in the following regulations: UMTRCA; the *Atomic Energy Act of 1954,* as amended; EPA groundwater protection standards, including Subparts B and C of the *Code of Federal Regulations*, Title 40, Part 192 - *Standards for Cleanup of Land and Buildings Contaminated with Residual Radioactive Materials from Inactive Uranium Processing Sites;* a cooperative agreement between DOE and the State of Wyoming; and the *National Environmental Policy Act of 1969,* as amended.

2.4 Assumptions and Uncertainties

The (UMETCO) Gas Hills Site is expected to be transferred to DOE in 2002. However, the exact date of transfer is dependent upon the completion of remedial activities, the approval by NRC of the long-term surveillance plan, and NRC acceptance under a general license. Because the site will not be transferred to DOE for two years, DOE has not received the UMETCO documents that will be used to prepare the long-term surveillance plan or the documents for DOE's permanent records. DOE assumes that monitoring the rock-covered disposal cells and groundwater monitoring will be required.

3.0 ESTIMATED LONG-TERM STEWARDSHIP COSTS

Estimated costs for long-term stewardship activities at the (UMETCO) Gas Hills Site are identified in the table below. Cost estimates are based on comparisons of actual costs of long-term stewardship activities at other, similar sites under DOE management. Costs are based on the assumption that engineered controls will not require unexpected maintenance. In addition, cost estimates are based on assumptions that the planned stewardship activities and regulatory agreements will not change.

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	***Amount***	***Year(s)***	***Amount***	***Year(s)***	***Amount***
FY 2000	$0	**FY 2008**	$35,100	**FY 2036-2040**	$170,500
FY 2001	$0	**FY 2009**	$35,100	**FY 2041-2045**	$170,400
FY 2002	$36,100	**FY 2010**	$34,300	**FY 2046-2050**	$170,400
FY 2003	$34,900	**FY 2011-2015**	$163,500	**FY 2051-2055**	$170,400
FY 2004	$35,300	**FY 2016-2020**	$159,200	**FY 2056-2060**	$170,500
FY 2005	$35,500	**FY 2021-2025**	$159,700	**FY 2061-2065**	$170,400
FY 2006	$34,900	**FY 2026-2030**	$168,700	**FY 2066-2070**	$170,500
FY 2007	$35,300	**FY 2031-2035**	$170,400		

4.0 FUTURE USE

The (UMETCO) Gas Hills Site will be used as a permanent uranium mill tailings repository. Groundwater in the area is of limited use. In-situ leach uranium recovery operations are an anticipated future use of the area.

For more information about the (UMETCO) Gas Hills Site, please contact:

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(UNION PACIFIC) BEAR CREEK SITE

1.0 SITE SUMMARY

1.1 Site Description and Mission

The (Union Pacific) Bear Creek Site is the location of a former uranium mine and mill that operated from 1976 until 1985. The site contains a disposal cell for the uranium mill tailings and process-related wastes resulting from mill operations, as well as five reclaimed uranium mine pits. The site occupies approximately 405 hectares (1,000 acres) and is located in rural east-central Wyoming, north of the town of Douglas, which is about 80.5 kilometers (50 miles) east of Casper. The site is owned and was operated by Union Pacific Resources.

LONG-TERM STEWARDSHIP HIGHLIGHTS

Major Long-Term Stewardship Activities - disposal cell monitoring; groundwater monitoring
Total Site Area - approximately 405 hectares (1,000 acres)
Estimated Volume of Residual Contaminants - engineered units 2.7 million cubic meters (3.5 million cubic yards); groundwater unknown
Long-Term Stewardship Start-End Years - 2001-in perpetuity
Average Annual Long-Term Stewardship Cost FY 2000-2006 - $33,900
Landlord - U.S. Department of Energy, Grand Junction Office (beginning in 2000)

Union Pacific Resources just recently (Summer 2000) finished reclaiming the site. However, the U.S. Nuclear Regulatory Commission (NRC) is still reviewing Union Pacific Resources' reclamation document for final concurrence. There is no ongoing mission at the site, except monitoring and maintaining the disposal cell and the reclaimed mine pits. Approximately 2.7 million cubic meters (3.5 million cubic yards) of uranium mill tailings have been disposed of in the engineered 101-hectare (250-acre) disposal cell.

The (Union Pacific) Bear Creek Site is subject to Title II of the *Uranium Mill Tailings Radiation Control Act of 1978* (UMTRCA). UMTRCA Title II sites are privately owned and operated sites that were licensed when UMTRCA was passed, or thereafter. The majority of the mining and milling conducted at these sites was for private sale, but a portion was sold to the U.S. Government. As such, the Department of Energy's (DOE) Grand Junction Office is responsible for performing long-term stewardship activities at the site, but is not responsible for site remediation. When the site is transferred to DOE at the end of 2000, DOE will only be responsible for monitoring and maintaining the disposal cell.

The historic mission of the site was to mine and process uranium ore, and provide uranium concentrate to the U.S. Government for the national defense program. The Bear Creek Uranium Company, a subsidiary of Union Pacific Resources, operated the Bear Creek mine from 1976 until 1985 as an open pit uranium mine. The mine operation consisted of five pits and a tailings disposal area.

1.2 Site Cleanup and Accomplishments

All Wyoming Department of Environmental Quality and U.S. Environmental Protection Agency (EPA) requirements for reclamation of the Bear Creek site have been completed. The disposal cell cover is designed to remain effective for 200 to 1,000 years in accordance with EPA regulations. The vegetated top and sides of the disposal cell will prevent erosion.

Reclamation activities for the Bear Creek site included:

- Retrieval of windblown tailings and placement of them on a tailings pile
- Placement of an interim cover on the tailings pile

- Removal of groundwater evaporation ponds
- Placement of the final radon barrier on the tailings pile
- Placement of the erosion control barrier
- Completion of groundwater corrective actions

Prior mining and milling operations resulted in contamination of the groundwater in the vicinity of the mill. Groundwater was contaminated with radionuclides, including radium and uranium. Alternate concentration limits (ACLs), cleanup standards based on site-specific considerations, for groundwater have been approved by NRC for uranium, radium-226, and nickel. For the alternate concentrations to be approved, evidence must be provided that the ACLs will not adversely impact human health or the environment.

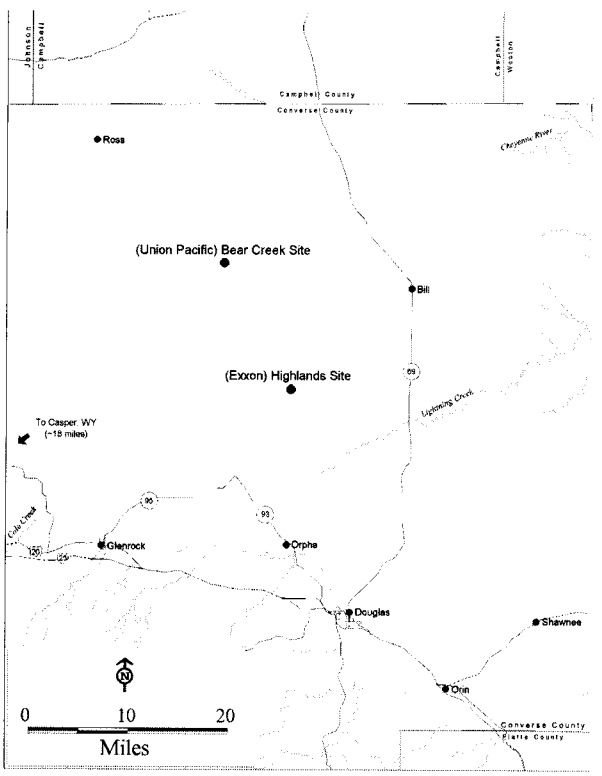
STAKEHOLDER INVOLVEMENT

When the site is transferred and licensed to DOE, copies of the annual inspection report will be distributed to local libraries and to any stakeholders requesting them. The annual inspection report will also be published on the Grand Junction Office website at www.doegjpo.com.

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

Because of the nature of the contaminants present on the site, residual contamination will remain after remediation is complete. Upon transfer to DOE, the DOE Grand Junction Office will be responsible for performing long-term stewardship activities for the groundwater and disposal cell at the site. Annual groundwater monitoring will be required to ensure that contaminants remain within the site's already established ACLs. DOE will not be responsible for long-term surveillance and maintenance of the reclaimed mine pits because they are beyond the jurisdiction of the *Uranium Mill Tailings Radiation Control Act of 1978* (UMTRCA).



(Union Pacific) Bear Creek Site

DOE will control land use within site boundaries and will perform long-term stewardship activities, as required under the NRC general license to maintain protectiveness and regulatory compliance. Access will be restricted by fencing and posting warning signs, as necessary, along the site boundary. DOE maintains a 24-hour phone line for reporting site concerns. Drilling and other intrusive activities will be prevented within site boundaries through institutional controls. DOE will conduct annual inspections to ensure the integrity of cell covers and other engineered features, and to ensure that institutional controls are effective and the site complies with applicable requirements. Prior to transfer, DOE will prepare a long-term surveillance plan for the site. An inspection report will be submitted annually to NRC to summarize, describe, and evaluate all surveillance and maintenance actions, as required under Title 10 of the *Code of Federal Regulations*, Part 40, and as specified in the site's long-term surveillance plan.

Site records will be maintained in permanent storage at the Grand Junction Office. The types of records maintained include characterization data, remedial action design information, the site completion report, long-term monitoring plans, annual inspection reports, and historic data.

2.2 Specific Long-Term Stewardship Activities

Groundwater

The groundwater will likely require annual monitoring for an unspecified time-frame to ensure the effectiveness of the disposal cell. Monitoring requirements will be prescribed in the long-term surveillance plan to be approved by NRC at the time of site transfer to DOE under the NRC general license.

Engineered Units

The site contains one disposal cell. About 2.7 million cubic meters (3.5 million cubic yards) of uranium mill tailings, weighing approximately 4.7 million tons, are encapsulated in the engineered, lined disposal cell. The disposal cell will require long-term surveillance and maintenance to ensure that it continues to meet EPA standards. Long-term surveillance and maintenance activities at the disposal cell will include conducting annual inspections, revegetating the cap, if needed, and posting appropriate warning signs. Public access to the disposal cell will be restricted indefinitely. The pit mine was covered with a radon barrier cover and a rock surface layer to control erosion.

2.3 Regulatory Regime

Groundwater ACLs for uranium, radium-226, and nickel were approved by NRC in accordance with Title 10 of the *Code of Federal Regulations*, Part 40, Appendix A, Criterion 5(B), and NRC Guide, "Staff Technical Review Position, Alternate Concentration Limits for Title II Uranium Mills." Criterion 5(B) requires the groundwater concentration of hazardous constituents at the point of compliance not to exceed background concentration, the maximum concentration limit, or the ACL prior to termination of the site license and transfer of the site to the long-term custodian.

Union Pacific Resources has completed site reclamation at the Bear Creek Site in accordance with Title II of the *Uranium Mill Tailings Radiation Control Act of 1978* (UMTRCA), and has disposed of the tailings in an NRC-approved disposal cell. Cleanup and reclamation standards were promulgated by NRC in Title 10 of the *Code of Federal Regulations,* Part 40, Appendix A. These standards conform to the U.S. Environmental Protection Agency standards specified in Title 40 of the *Code of Federal Regulations,* Part 192. Later this year, the site will be transferred under general license by NRC to DOE for custody and long-term care. The NRC general license is in accordance with Title 10 of the *Code of Federal Regulations* Part 40.28, *General License for Custody and Long-Term Care of Uranium or Thorium Byproduct Materials Disposal Sites*. The purpose of the license is to ensure that the site will be cared for in a manner that protects human health and safety and the environment. The license also means the NRC formally accepts the site's long-term surveillance plan as prepared by DOE.

Once the site is transferred to DOE under general license to NRC, long-term stewardship activities at the (Union Pacific) Bear Creek Site will be governed by several requirements in the following regulations: UMTRCA; the *Atomic Energy Act of 1954,* as amended; EPA groundwater protection standards, including Subparts B and C of the *Code of Federal Regulations*, Title 40, Part 192 - *Standards for Cleanup of Land and Buildings Contaminated with Residual Radioactive Materials from Inactive Uranium Processing Sites;* a cooperative agreement between DOE and the State of Wyoming; and the *National Environmental Policy Act of 1969,* as amended.

2.4 Assumptions and Uncertainties

The exact date of site transfer to DOE for custody and long-term care is uncertain, but DOE assumes that pre-transfer activities (e.g., long-term surveillance plan development, real property transfer) will take place in late 2000, with transfer occurring by 2001. Cleanup levels will be achieved before the site is transferred to DOE to perform long-term stewardship activities. Groundwater monitoring will be conducted to verify continued compliance with cleanup levels. DOE assumes that annual groundwater monitoring will be required for an indefinite period.

3.0 ESTIMATED LONG-TERM STEWARDSHIP COSTS

Estimated costs for long-term stewardship activities at the (Union Pacific) Bear Creek site are identified in the table below. Cost estimates are based on actual costs of long-term stewardship activities at other similar sites. Cost estimates reflect pre-transfer activities in FY 2000 to ensure a smooth process. They also reflect annual groundwater monitoring.

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	***Amount***	***Year(s)***	***Amount***	***Year(s)***	***Amount***
FY 2000	$18,800	**FY 2008**	$35,100	**FY 2036-2040**	$170,500
FY 2001	$41,600	**FY 2009**	$35,100	**FY 2041-2045**	$170,400
FY 2002	$36,100	**FY 2010**	$34,300	**FY 2046-2050**	$170,500
FY 2003	$34,900	**FY 2011-2015**	$163,500	**FY 2051-2055**	$170,400
FY 2004	$35,300	**FY 2016-2020**	$159,200	**FY 2056-2060**	$170,500
FY 2005	$35,500	**FY 2021-2025**	$159,700	**FY 2061-2065**	$170,400
FY 2006	$34,800	**FY 2026-2030**	$168,700	**FY 2066-2070**	$170,500
FY 2007	$35,300	**FY 2031-2035**	$170,400		

4.0 FUTURE USES

The site will be a permanent uranium mill tailings repository. Public access to the site will be restricted to prevent the possibility of someone accessing the contaminated groundwater. However, the site most likely will be open to wildlife, such as pronghorn antelope, mule deer, and other fauna.

For more information about the (Union Pacific) Bear Creek Site, please contact:

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or visit the Internet website at http://www.doegjpo.com

(WNI) SPLIT ROCK SITE

1.0 SITE SUMMARY

1.1 Site Description and Mission

The Western Nuclear, Inc. (WNI) Split Rock Site is the location of a former uranium mill that operated from 1957 until 1981. The site, which is owned by WNI, is located two miles northeast of the town of Jeffrey City, Wyoming. The site currently encompasses 2,104 hectares (5,200 acres). Approximately 7.7 million tons of uranium mill tailings have been disposed of in a 105-hectare (260-acre), rock-covered engineered disposal cell. The current mission of the (WNI) Split Rock Site is remediation, including active groundwater remediation. The owner, WNI, is responsible for the remediation, maintaining the integrity of the disposal cell, and managing the contaminated groundwater at the site.

LONG-TERM STEWARDSHIP HIGHLIGHTS

Major Long-Term Stewardship Activities - disposal cell monitoring and maintenance; groundwater monitoring
Total Site Area - 2,104 hectares (5,200 acres) (acreage to be transferred to DOE for long-term stewardship is unknown)
Estimated Volume of Residual Contaminants - disposal cell 4.4 million cubic meters (5.7 million cubic yards); groundwater unknown
Long-Term Stewardship Start/End Years - 2002-in perpetuity
Average Annual Long-Term Stewardship Cost FY 2002-2006 - $35,300
Landlord - U.S. Department of Energy, Grand Junction Office (when transferred in 2002)

The (WNI) Split Rock Site is subject to Title II of the *Uranium Mill Tailings Radiation Control Act of 1978* (UMTRCA). UMTRCA Title II sites are privately owned and operated sites that were licensed when UMTRCA was passed, or thereafter. The majority of the mining and milling conducted at these sites was for private sale, but a portion was sold to the U.S. Government. As such, the Department of Energy (DOE) is responsible for long-term stewardship activities at the site, but is not responsible for site remediation. Once the site is transferred to DOE, which is expected in 2002, DOE's ongoing mission for the site will be monitoring and maintenance of the disposal cell, and groundwater monitoring. Portions of the site were released for unrestricted use in May 1999 through amendment of the current site license.

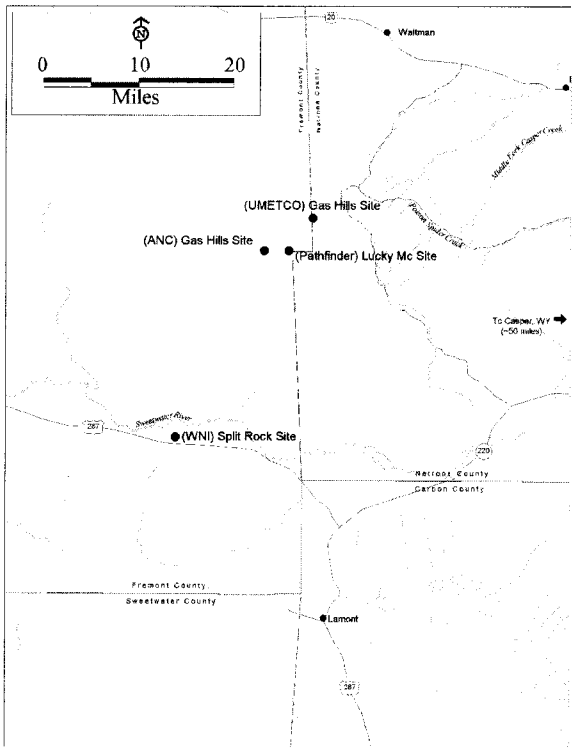
The historic mission of the (WNI) Split Rock Site was to mine and mill uranium ore for private sale and for use in the U.S. Government's nuclear weapons program. Ore was processed at the mill using an acid-leach, ion-exchange, solvent-extraction process. After operating for 24 years, the mill was placed on standby by WNI from 1981 until 1986. In 1986, the site's U.S. Nuclear Regulatory Commission (NRC) license was amended to terminate use of the tailings pond for disposal, and a tailings reclamation plan was submitted to NRC at that time. The mill was decontaminated and decommissioned in 1989, and mill components were buried in onsite areas designated for that purpose, primarily beneath the mill site itself. Process wastes in the form of tailings solids and acidic liquids were discharged to three unlined tailings ponds, referred to as the "main," "alternate," and "old" ponds, from 1957 until 1981. The tailings ponds were located in two alluvial valleys, referred to as the Northwest and Southwest Valleys, which are separated by a granite outcropping. The three ponds cover approximately 73 hectares (180 acres). In addition to the tailings ponds, there were several trenches onsite used for burial of non-radioactive waste. The site contains a 105.2-hectare (260-acre) rock-covered disposal cell.

1.2 Site Cleanup and Accomplishments

The milling operations created uranium mill tailings and process-related wastes, and as a result, site soil and groundwater were contaminated. Tailings reclamation construction, including radon barrier placement and erosion protection, was completed at the site in 1998, with the exception of the groundwater storage ponds. A

construction completion report, final groundwater plan, and site characterization report were submitted to NRC in 1999, and the radon barrier passed confirmatory testing in 1999. Mill decommissioning and reclamation and verification of all areas potentially contaminated by windblown tailings have also been completed.

NRC has indicated that the only technical alternative for the (WNI) Split Rock Site that would restore groundwater to the conditions specified in the site's NRC license is perpetual containment pumping at a cost of $117 million, as estimated by WNI. WNI contends that perpetual containment pumping is not a viable option. WNI has indicated that "supplemental groundwater standards" under U.S. Environmental Protection Agency (EPA) regulations could be applied to the (WNI) Split Rock Site because the groundwater meets the EPA definition of "limited use groundwater." In addition, the perpetual containment pumping could result in greater environmental harm through impacts from surface releases of radionuclides; and the restoration of the groundwater is effectively impractical from an engineering perspective and not reasonably achievable. WNI is attempting to establish land use and institutional controls on and in the vicinity of the site that will "absolutely prohibit a pathway to underground water for human consumptive use," and has estimated that within 200 years, all concentrations of constituents of concern on the privately-owned portions of the (WNI) Split Rock Site will be at or near background levels. It is unclear whether perpetual containment pumping or an alternative groundwater management program, such as institutional controls, will be required by NRC for the (WNI) Split Rock Site.



(WNI) Split Rock Site

WNI submitted a site closure plan for the (WNI) Split Rock Site to NRC on October 29, 1999, proposing to transfer all site lands necessary for disposal of byproduct material to a long-term custodian after NRC approval of the long-term surveillance plan for the site. WNI has had preliminary discussions with DOE and the State of Wyoming regarding long-term custody of the site. Under provisions of the *Uranium Mill Tailings Radiation Control Act of 1978* (UMTRCA), either the host state or DOE may take responsibility for long-term care of these types of sites. DOE is responsible for long-term care if the state does not exercise its authority under this law.

2.0 SITE-WIDE LONG-TERM STEWARDSHIP

2.1 Long-Term Stewardship Activities

Long-term stewardship activities for the site include maintaining the safety and integrity of the disposal cell and to protect human health and the environment by managing radioactive contaminated groundwater through either perpetual containment pumping, institutional controls, or some combination thereof. Once the site is transferred to DOE, expected in 2002, DOE will perform long-term stewardship activities.

WNI has indicated that it will have the ability to transfer 97 percent of the area within the boundaries of the (WNI) Split Rock Site to the long-term steward (eventually DOE) with "durable and enforceable" institutional controls that will prevent human consumption of contaminated groundwater. There are no existing domestic or livestock wells on this area of the site. Of the total site area, 283 hectares (700 acres), approximately 13.5 percent, is Federally owned and administered by the U.S. Department of Interior, Bureau of Land Management (BLM). WNI has indicated that for property owned in fee or with restrictive covenants, the restrictions "run with the land" and are "permanent and endurable" and enforceable by the long-term steward.

For the remaining three percent of the site area, known as the "Red Mule" area where there are existing domestic water wells, WNI has proposed a combination of institutional and engineering controls. These include deeding subsurface interests from private landowners to WNI; a restrictive covenant and agreement prohibiting private landowners from subsurface activities, enforceable by WNI; and a land ownership map detailing fee land, BLM land, land burdened by restrictive covenants, and land to which an alternative water supply can be provided. WNI proposes to transfer 94.5 percent of the total land area of the site to the long-term steward, including the BLM land. An additional 2.5 percent of the land in the control area, owned by third parties, is burdened with restrictive covenants that run with the land and are enforceable by the long-term steward under real property law.

Upon transfer of the site under an NRC general license, DOE's Grand Junction Office will perform long-term stewardship activities as required to maintain protectiveness and regulatory compliance. Access will be restricted through the use of fencing and warning signs posted, as necessary, along the site boundaries. DOE maintains a 24-hour phone line for reporting site concerns. Drilling and other intrusive activities will be prevented within site boundaries through institutional control. Once the site is transferred, DOE will conduct annual inspections to ensure the integrity of the cell covers and other engineered features, and that institutional controls are effective.

When the site is transferred to DOE, site records will be maintained in permanent storage at the DOE Grand Junction Office in Colorado. The types of records to be maintained include the characterization data, remedial action design information, the completion report, the long-term monitoring plan, annual inspection reports, and monitoring data.

2.2 Specific Long-Term Stewardship Activities

Groundwater

DOE does not yet know the specific activities that will be required for long-term stewardship of the groundwater. As stated above, the groundwater management strategy is still being defined between WNI and NRC, and it is currently not clear whether perpetual containment pumping or an alternative groundwater management program, such as institutional controls, will be required by NRC for the (WNI) Split Rock Site. DOE assumes that, at a minimum, routine groundwater monitoring will be required. Specific activities will be defined in the long-term surveillance plan.

STAKEHOLDER INVOLVEMENT

When licensed and transferred to DOE, copies of the annual inspection report for the (WNI) Split Rock Site will be distributed to the local library and any stakeholders requesting them. The annual inspection report will also be published on the DOE Grand Junction Office website at www.doe.gjpo.com.

Engineered Units

This site contains one disposal cell that covers an area of approximately 105 hectares (260 acres). Approximately 4.4 million cubic meters (5.7 million cubic yards) of uranium mill tailings (weighing 7.7 million tons) have been disposed of in the disposal cell, which has a radon barrier and a rock surface layer to control erosion. The cover is designed to be effective for 200 to 1,000 years in accordance with EPA regulations. The disposal cell will

require long-term surveillance and maintenance to ensure that it continues to meet EPA standards. Long-term surveillance and maintenance activities at the disposal cell are anticipated to include annual service inspections, a 10-year revegetation program, and posting of appropriate warning signs. Monitoring requirements will be prescribed in the long-term surveillance plan to be approved by the NRC at the time of licensing.

2.3 Regulatory Regime

WNI will complete site reclamation at the (WNI) Split Rock Site in accordance with Title II of the *Uranium Mill Tailings Radiation Control Act of 1978* (UMTRCA) and will dispose of the tailings in an NRC-approved disposal cell. Cleanup and reclamation standards were promulgated by NRC in Title 10 of the *Code of Federal Regulations,* Part 40, Appendix A. These standards conform to the U.S. Environmental Protection Agency standards specified in Title 40 of the *Code of Federal Regulations,* Part 192. Following remediation, the site will be transferred under general license by the NRC to DOE for long-term custody. The NRC general license is in accordance with Title 10 of the *Code of Federal Regulations* Part 40.28, *General License for Custody and Long-Term Care of Uranium or Thorium Byproduct Materials Disposal Sites*. The purpose of the license is to ensure that the site will be cared for in a manner that protects human health and safety and the environment. The license also means the NRC formally accepts the site's long-term surveillance plan as prepared by DOE.

Once the site is transferred to DOE under general license to the NRC, long-term stewardship of the site will be governed by several requirements in the following regulations: UMTRCA; the *Atomic Energy Act of 1954,* as amended; EPA standards, including Subparts D and E of Title 40 of the *Code of Federal Regulations*, Part 192; a cooperative agreement between DOE and the State of Wyoming; and the *National Environmental Policy Act of 1969*, as amended.

2.4 Assumptions and Uncertainties

The (WNI) Split Rock Site is expected to be transferred to DOE in 2002; however, the exact date of transfer depends on approval of the long-term surveillance plan by NRC at the time of transfer to DOE under the NRC general license. Site transfer depends upon resolution of the groundwater management issue, as NRC will not terminate the existing site license while this issue is unresolved.

3.0 ESTIMATED LONG-TERM STEWARDSHIP COSTS

Site Long-Term Stewardship Costs (Constant Year 2000 Dollars)					
Year(s)	***Amount***	***Year(s)***	***Amount***	***Year(s)***	***Amount***
FY 2000	$0	**FY 2008**	$35,100	**FY 2036-2040**	$170,500
FY 2001	$0	**FY 2009**	$35,100	**FY 2041-2045**	$170,400
FY 2002	$36,100	**FY 2010**	$34,300	**FY 2046-2050**	$170,500
FY 2003	$34,900	**FY 2011-2015**	$163,500	**FY 2051-2055**	$170,400
FY 2004	$35,300	**FY 2016-2020**	$159,200	**FY 2056-2060**	$170,500
FY 2005	$35,500	**FY 2021-2025**	$159,700	**FY 2061-2065**	$170,400
FY 2006	$34,800	**FY 2026-2030**	$168,700	**FY 2066-2070**	$170,500
FY 2007	$35,300	**FY 2031-2035**	$170,400		

Estimated long-term stewardship costs are identified in the table below. Cost estimates are based on comparisons of the actual costs of long-term stewardship activities (such as routine inspections and reporting, normal maintenance, and groundwater monitoring) at other sites currently under the responsibility of DOE.

4.0 FUTURE USE

The (WNI) Split Rock Site's future use is unclear at this time. DOE expects that this site will be a permanent uranium mill tailings repository. Public access to the disposal cell is likely to be restricted indefinitely.

For more information about the (WNI) Split Rock Site, please contact:

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OFFICE OF ENVIRONMENTAL MANAGEMENT OFFICE OF LONG-TERM STEWARDSHIP

UNITED STATES DEPARTMENT OF ENERGY

Washington, DC 20585