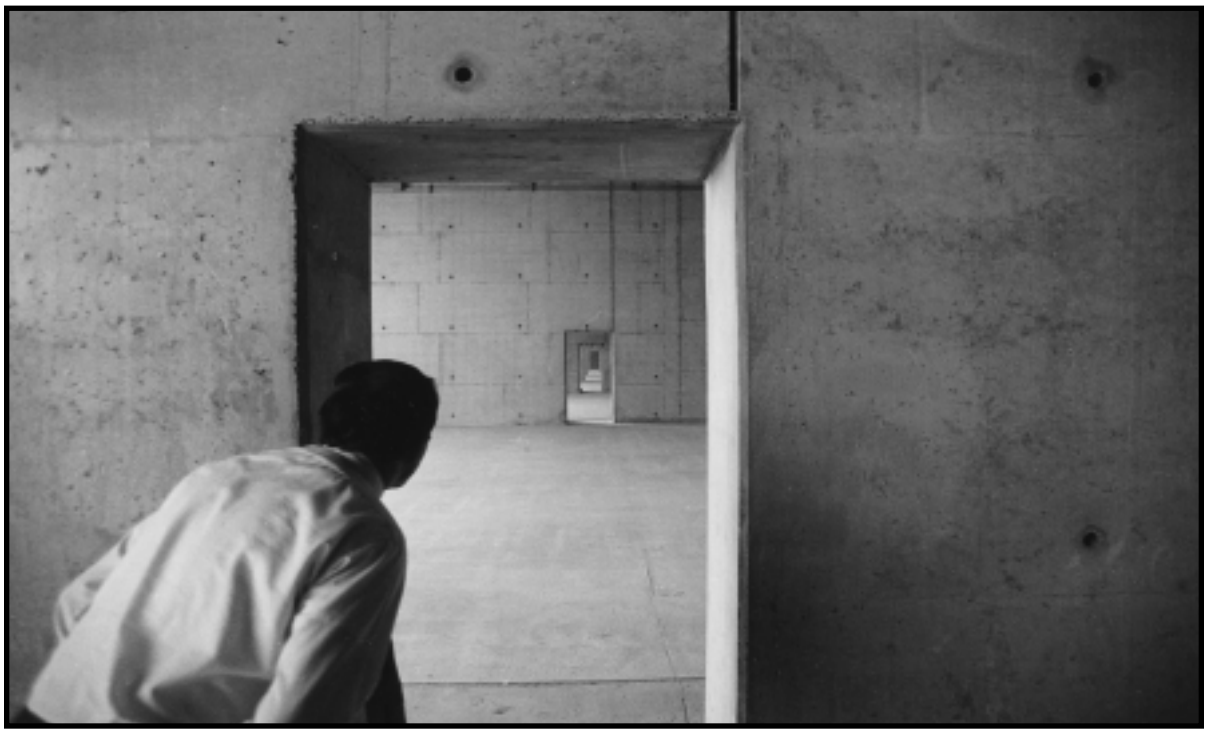
Chapter 2:
Anticipated Long-Term Stewardship at DOE Sites



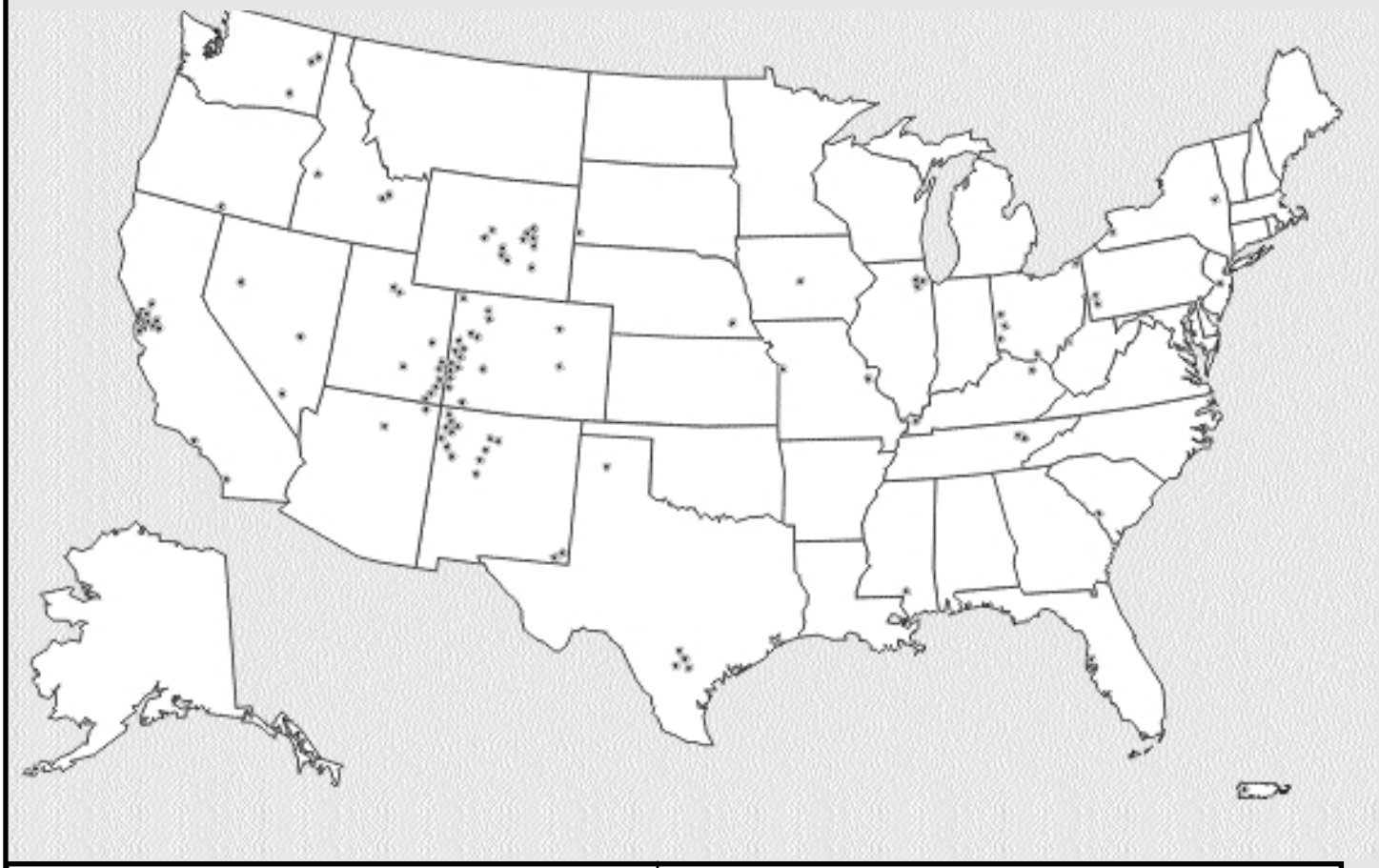
Low-Level Waste Vault. This vault at the Savannah River Site is used for storing low-level waste and contains 12 large cells, each 55 feet long, 150 feet wide, and 30 feet high. This vault replaces the previous waste management practice of burying low-level waste in shallow engineered trenches. Workers 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*.

This chapter summarizes the anticipated long-term stewardship needs at DOE sites, based on an analysis of existing information from field offices. It discusses the residual hazards at sites after cleanup projects are complete and examines the nature and extent of the stewardship activities likely to be needed.

Stewardship Expected at 109 Sites after Cleanup

The Department first analyzed sites that might need stewardship by identifying sites where DOE has remediation, waste management, or nuclear materials and facility stabilization responsibilities. DOE then included in its analysis sites that have been (or will be) transferred to the Department for long-term care. This resulted in the Department's analyzing 144 sites in 31 states and one U.S. territory (see Appendix C). Of the 144 sites, 109 sites are expected to require some degree of long-term stewardship based on completed or planned cleanup strategies (see Exhibit 7). Most cleanup plans have already received some level of regulatory approval. The sites expected to require DOE stewardship range from small sites (approximately the size of a football field) with limited contamination, such as the General Atomics Site in California, to large and complex ones such as the Nevada Test Site (larger than the State of Rhode Island).

Exhibit 7: 109 Sites Are Expected to Require Long-Term Stewardship by DOE



35 Sites Not Expected to Require Stewardship by DOE

Alaska
Project Chariot (Cape Thompson)

California
Geothermal Test Facility
Oxnard Facility
Salton Sea Test Base
University of California
(Completed 98c -096543 site)

Connecticut
Seymour Specialty Wire

Florida
Peak Oil

Hawaii
Kauai Test Facility

Illinois
Granite City Steel
National Guard Armory
University of Chicago

Massachusetts
Chapman Valve
Ventron

Michigan
General Motors

New Jersey
Kellex/Pierpont
Middlesex Municipal Landfill
New Brunswick

New Mexico
Acid/Pueblo Canyons
Chupadera Mesa
Holloman Air Force Base
Pagano Salvage Yard

New York
Baker and Williams
Warehouses
Niagara Falls Storage Site
Vicinity Properties

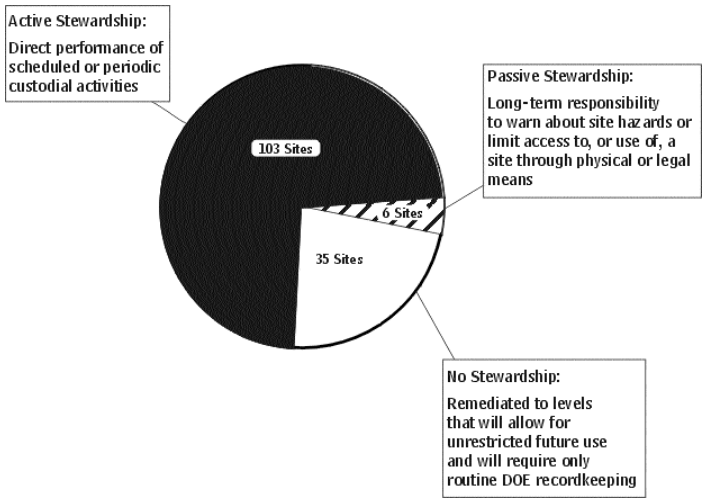
Ohio
Alba Craft
Associated Aircraft
B&T Metals
Baker Brothers
Battelle Columbus Laboratory
King Avenue
Battelle Columbus Laboratory
West Jefferson
Herring-Hall Marvin Safe Co

Oregon
Albany Research Center

Pennsylvania
Aliquippa Forge
C.H. Schnoor
Shippingport

Tennessee
Elza Gate

Type of DOE Stewardship Activities Anticipated at 144 Sites in this Analysis



See Appendix C for details on methodology

Alaska
Amchitka Island
Arizona
Monument Valley[1]
Tuba City[1]
California
Energy Technology Engineering Center
General Atomics
General Electric Vallecitos Nuclear Center
Laboratory for Energy Related Health Research
Lawrence Berkeley Laboratory
Lawrence Livermore National Laboratory - Main Site and Site 300
Sandia National Laboratories
Stanford Linear Accelerator Center
Colorado
Burro Canyon Disposal Site
Cheney Cell
Cotter, Canon City[2]
Durango[1]
Estes Gulch
Grand Junction Office[1]
Gunnison Mill Site[1]
HECLA, Durita[2]
Maybell Mill Site[1]
Naturita Site[1]
New Rifle Site[1]
Old Rifle Site[1]
Project Rio Blanco Site
Project Rulison
Rocky Flats Environmental Technology Site
Slick Rock/Old North Continent[1]
Slick Rock/Union Carbide[1]
UMETCO, Maybell[2]
UMETCO, Uravan[2]
Florida
Pinellas Plant
Idaho
Argonne National Laboratory - West
Idaho National Engineering and Environmental Laboratory
Lowman[1]
Illinois
Argonne National Laboratory - East
Fermi National Accelerator Laboratory
Site A/Plot M, Palos Forest Preserve
Iowa
Ames Laboratory
Kentucky
Maxey Flats Disposal Site
Paducah Gaseous Diffusion Plant
Mississippi
Salmon Test Site
Missouri
Kansas City Plant
Weldon Spring Site Remedial Action Project
Nebraska
Hallam Nuclear Power Facility
Nevada
Central Nevada Test Site
Nevada Test Site
Project Shoal Test Site
New Jersey
Princeton Plasma Physics Laboratory
New Mexico
Ambrosia Lake[1]
Arco Bluewater[2]
Bayo Canyon[3]
Homestake, Grants[2]
Los Alamos National Laboratory
Lovelace Respiratory Research Institute
Project Gas Buggy
Project Gnome-Coach Test Area
Quivera, Ambrosia Lake[2]
Sandia National Laboratories
Shiprock[1]
SOHIO, L-Bar[2]
South Valley Superfund Site
UNC, Church Rock[2]
Waste Isolation Pilot Plant
New York
Brookhaven National Laboratory
Separations Process Research Unit
West Valley Demonstration Project
Ohio
Ashtabula
Fernald Environmental Management Project
Mound Plant
Piqua Nuclear Power Facility
Portsmouth Gaseous Diffusion Plant
Oregon
Lakeview[1]
Pennsylvania
Burrell[1]
Canonsburg [1]
Puerto Rico
Center for Energy and Environmental Research
South Carolina
Savannah River Site
South Dakota
Edgemont Vicinity Properties[2]
Tennessee
Oak Ridge Associated Universities
Oak Ridge Reservation
Texas
Chevron, Panna Maria[2]
Conoco, Conquista[2]
Exxon, Ray Point[2]
Falls City[1]
Pantex Plant
Utah
Atlas, Moab[2]
EFN, White Mesa[2]
Green River[1]
Mexican Hat[1]
Monticello Millsite & Vicinity Properties
Plateau, Shootaring[2]
Rio Algom, Lisbon Valley[2]
Salt Lake City[1]
Salt Lake City, Clive
Washington
Dawn, Ford[2]
Hanford Site
WNI, Sherwood[2]
West Virginia
Amax[4]
Wyoming
ANC, Gas Hills[2]
Exxon, Highlands[2]
Kennecott, Sweetwater[2]
Pathfinder, Lucky Mac[2]
Pathfinder, Shirley Basin[2]
Petrotomics, Shirley Basin[2]
Riverton[1]
Spook[1]
UMETCO, Gas Hills[2]
Union Pacific, Bear Creek[2]
WNI, Split Rock[2]

1. UMTRA Program Title I 2. UMTRA Program Title II 3. FUSRAP 4. NWPA

Stewardship Information

This report represents the Department's first attempt to quantify the likely scope of its stewardship activities. As such, data were not available to adequately address all issues relative to stewardship, such as natural, cultural, ecological, or human health risk.

DOE has used available information from field office personnel to catalogue known end states where cleanup has already been completed and projected end states where cleanup is ongoing. The primary source was data submitted in support of the 1998 *Accelerating Cleanup: Paths to Closure* report. DOE used the known and projected end state information to identify those sites where residual contamination in facilities and/or media (i.e., water, soil, and engineered units) would likely remain and to estimate the scope and duration of stewardship activities needed.

It is important to note that because of the lack of detailed data available for most sites, all information is summarized at the site level, instead of for each waste or contamination area within a site (e.g., Hanford, Fernald, and the Salmon Site are each considered one site, despite the differences in size and complexity) [see Appendix C].

Assumed end states and associated stewardship activities for each site are summarized in Appendix E. Appendix E is not included in the print version of this document due to its length. It is, however, available on the long-term stewardship web site *(www.em.doe.gov/lts)* and, by request, from the EM Information Center (1-800-736-3282).

Nature and Extent of Stewardship Activities

The nature and extent of anticipated long-term stewardship activities at the 109 sites will vary based on the amount and type of residual contamination, the anticipated future site uses, and other factors (e.g., proximity to a river and floodplain). To understand how stewardship activities can vary across sites, DOE analyzed the level of stewardship (e.g., active or passive) as well as the types of activities likely to be needed.

Appendix C presents more detailed information on the methodology used for this report.

Level of Stewardship – Active and Passive

Of the 109 sites currently expected to require stewardship, 103 are expected to require active stewardship (see Exhibit 7). Active stewardship ranges from detection monitoring on a continuous or periodically recurring basis, to enforcing access and use restrictions. Sites expected to require active stewardship vary in size and complexity.

DOE is expected to rely solely on passive stewardship at only 6 of the 109 long-term stewardship sites. Passive stewardship requires less oversight and care. Enduring obligations may include permanent markers or public records to convey information on previous uses or residual contamination. Sites where DOE expects to rely on passive controls include General Atomics and General Electric in California, where excavation and removal of contamination occurred to levels allowing for industrial use, and where NRC has released the site without radiological restrictions, but where DOE will need to maintain records of previous activities or residual contamination.

Long-term stewardship by DOE is not currently anticipated at 35 sites, most of which were remediated under the Formerly Utilized Sites Remedial Action Program (FUSRAP; see Exhibit 8). However, a record of the extent of cleanup will need to be maintained at a central DOE or Federal archiving facility.

The number of sites where DOE has stewardship responsibility may increase over time. Additional sites may be identified and added to DOE's responsibility under existing or new laws. The Uranium Mill Tailings Radiation Control Act (UMTRCA) of 1978 directs DOE to stabilize, dispose of, and control uranium mill tailings at inactive mill sites. Sites included under Title I of UMTRCA are those that operated prior to 1978, and where all uranium was produced for sale to the Federal Government. Title II of UMTRCA includes privately owned sites that were operating under

Exhibit 8: The Formerly Utilized Sites Remedial Action Program (FUSRAP)

From the 1940s through the 1960s, some of the work to support early nuclear weapons and energy programs was done by private companies at hundreds of locations throughout the United States. These companies performed numerous activities, including processing, storing, sampling, assaying, extruding, or machining radioactive materials. After completion of the work, the sites were decontaminated and released for other use under the cleanup guidelines in effect at the time. Because those standards were less stringent than current guidelines, radioactive materials remained at some sites. The waste at these sites consists primarily of low concentrations of uranium, radium, and thorium on building surfaces and in the soil. Over the years, contamination at some sites has spread to vicinity properties, primarily through the soil or air, as the result of releases from operating facilities when buildings were dismantled, or when materials were moved (DOE 1997b).

In the 1970s, the Atomic Energy Commission (a predecessor of the DOE) recognized that some sites did not meet current radiological release standards. In response, the FUSRAP program was established.

The early years of FUSRAP were spent researching the locations of these contract operations and conducting radiological surveys to determine whether the sites were contaminated above current standards. Cleanup work at the sites began in the late 1970s. Over 400 locations were assessed, and 46 sites in 14 states were designated for remediation through the FUSRAP program. Several of these sites are commercial operations that processed radioactive materials for profit and were subsequently designated for remediation by DOE at the request of Congress.

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 the transfer on October 13, 1997, DOE had completed the cleanup of 25 of the 46 FUSRAP sites.

The Department worked in conjunction with the Corps to ensure a smooth transition of the program. 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. The MOU establishes DOE's responsibility for any long-term stewardship required at the 25 FUSRAP sites where the Department completed cleanup activities prior to October 13, 1997. For the remaining 21 sites assigned to the Corps for remediation (see Appendix C for a list of these sites), the MOU assigns responsibility to DOE for any required long-term stewardship. These sites will be transferred to DOE for long-term stewardship two years after the Corps completes remedial actions. However, the cleanup decisions for these sites are not yet final and, therefore, the level of stewardship required for these sites, if any, is not yet known (MOU 1999).

a NRC license in 1978 when the Act was signed. Title II gave NRC the responsibility for transferring these sites to DOE, to another Federal agency, or to a state for long-term care after their licenses are terminated.

According to the Nuclear Waste Policy Act (NWPA), low-level radioactive waste disposal sites (with privately held licenses) can be transferred to DOE upon termination of the site's license (NWPA, Subtitle D, Section 151(b)). DOE is authorized to take title of these sites if NRC determines the transfer to be desirable, of no cost to the government, and necessary in order to protect human health and the environment. The NWPA also states 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 (NWPA, section 151(c)). For example, in 1994, the Secretary of Energy assumed title to the Amax site in West Virginia under this section.

Conversely, some sites may be removed from DOE's long-term stewardship responsibility, or sites may require stewardship for only a finite period. As contaminants decay, or if standards become less restrictive, the number of sites and the level of long-term stewardship required will decrease. In addition some sites may require long-term stewardship, but not by the Department. For example, at the request of the State of North Dakota, DOE revoked the UMTRCA designation of the Belfield and Bowman, North Dakota sites. As a result of the revocation, effective May 18, 1998, the sites will no longer require remediation under UMTRCA, and the State of North Dakota will be responsible for any long-term stewardship required at the sites.

Exhibit 9: Residual Contaminants and Anticipated Stewardship by Site and Media

State	Site Name	Soil					Water					Engineered Units						Facilities				
							VOCs	Metals	Rads	PCBs	Steward	Haz	MW	LLW	San/SW	TRU	Steward	VOCs	Metals	Rads	PCBs	Steward
Alaska	Amchitka Island	●		●		A			●		A						N					N
Arizona	Monument Valley			●		P			●		A						N					N
	Tuba City			●		P			●		A			●			A					N
California	Energy Technology Engineering Center	●			●	P	●		●		A	●					A		●	●		A
	General Atomics		●	●		P					N						N			●		N
	General Electric Vallecitos Nuclear Center					N					N						N			●		P
	Laboratory for Energy Related Health Research			●		A					N						N			●		P
	Lawrence Berkeley Laboratory	●	●			A	●		●		A						N			●	●	P
	Lawrence Livermore National Laboratory - Main Site	●		●		A	●		●		A			●			A			●		P
	Lawrence Livermore National Laboratory - Site 300	●			●	A	●		●		A		●				A					P
	Sandia National Laboratories/ California	●				P	●				A				●		A					N
	Stanford Linear Accelerator Center	●			●	A	●			●	A						N					N
Colorado	Burro Canyon Disposal Site					N					N			●			A					N
	Cheney Cell			●		P			●		A			●			A					N
	Cotter, Canon City					N			●		A			●			A					N
	Durango			●		P		●	●		A			●			A					N
	Estes Gulch			●		P			●		P			●			A					N
	Grand Junction Office			●		P			●		A						N			●		P
	Gunnison Mill Site			●		P			●		A			●			A					N
	HECLA, Durita					N			●		A			●			A					N
	Maybell Mill Site			●		P		●	●		P	●		●			A					N
	Naturita Site			●		P		●	●		A						N					N
	New Rifle Site			●		P		●	●		A						N					N
	Old Rifle Site			●		P		●	●		A						N					N
	Project Rio Blanco Site			●		A			●		A						N					N
	Project Rulison			●		A			●		A						N					N
	Rocky Flats Environmental Technology Site	●	●	●		A	●		●		A	●		●	●		A		●	●		P
	Slick Rock/ Old North Continent			●		P		●	●		A						N					N
	Slick Rock/ Union Carbide			●		P			●		A						N					N
	UMETCO, Maybell					N			●		A			●			A					N
	UMETCO, Uravan					N			●		A			●			A					N
Florida	Pinellas Plant					N	●				A						N					N
Idaho	Argonne National Laboratory - West		●	●		A		●	●		A						N			●		P
	Idaho National Engineering and Environmental Laboratory	●	●	●		A	●	●	●		A	●	●	●		●	A	●	●	●		A
	Lowman			●		P					A			●			A					N
Illinois	Argonne National Laboratory - East	●	●	●	●	A	●	●	●	●	A			●	●		A		●	●		P
	Fermi National Accelerator Laboratory				●	P					N						N					N
	Site A/Plot M, Palos Forest Preserve		●	●		A		●	●		A						N					N
Iowa	Ames Laboratory			●		A	●		●		A						N			●		P
Kentucky	Maxey Flats Disposal Site	●	●	●		A	●	●	●		A						N					N
	Paducah Gaseous Diffusion Plant	●		●	●	A	●		●	●	A	●		●	●	●	A	●	●	●	●	P
Mississippi	Salmon Test Site	●		●		P			●		A						N					N
Missouri	Kansas City Plant	●			●	A	●				A						N					N
	Weldon Spring Site Remedial Action Project			●		P	●		●		A		●				A					N
Nebraska	Hallam Nuclear Power Facility					N		●	●		A						N			●		A
Nevada	Central Nevada Test Site	●				P			●		A						N					N
	Nevada Test Site			●		A			●		A		●	●			A			●		A
	Project Shoal Test			●		P			●		A						N					N
New Jersey	Princeton Plasma Physics Laboratory	●				P	●				A						N					N
New Mexico	Ambrosia Lake			●		P			●		P			●			A					N
	Arco Bluewater					N			●	●	A	●		●			A					N
	Bayo Canyon			●		P					N						N					N
	Homestake, Grants					N			●		A			●			A					N
	Los Alamos National Laboratory	●	●	●		A			●		A		●				A	●	●	●		P
	Lovelace Respiratory Research Institute			●		P	●				A						N					N
	Project Gas Buggy			●		P			●		A						N					N
	Project Gnome-Coach Test Area			●		P			●		A						N					N

KEY:
A=Active Stewardship by DOE
MW=Mixed Waste
Rads=Radionuclides
San/SW=Sanitary/Solid Waste
N=No Stewardship by DOE
PCBs=Polychlorinated Biphenyls
LLW=Low Level Waste
TRU=Transuranic
VOCs=Volatile Organic Compounds
P=Passive Stewardship by DOE
Haz=Hazardous Waste
Steward=Anticipated Stewardship Requirements

Exhibit 9: (Continued)

State	Site Name	Soil					Water					Engineered Units						Facilities				
					PCBs	Steward	VOCs	Metals	Rads	PCBs	Steward	Haz	MW	LLW	San/SW	TRU	Steward	VOCs	Metals	Rads	PCBs	Steward
New Mexico (cont)	Chivera, Ambrosia Lake					N			●		A			●			A					N
	Sandia National Laboratories/New Mexico		●	●	●	P	●	●	●		A	●	●				A					N
	Shiprock			●		P		●	●		A			●			A					N
	SOHIO, L-Bar					N			●		A			●			A					N
	South Valley Superfund Site	●				P	●				A						N					N
	UNC, Church Rock					N			●		A			●			A					N
	Waste Isolation Pilot Plant			●		P			●		A					●	A					N
New York	Brookhaven National Laboratory	●		●		A	●	●	●		A	●		●	●		A			●		A
	Separations Process Research Unit			●		P					N						N			●		N
	West Valley Demonstration Project			●		P			●		P			●			P			●		P
Ohio	Ashtabula	●		●		P	●		●		A						N					P
	Fernald Environmental Management Project			●		P			●		A	●	●	●			A			●		N
	Mound Plant	●	●	●		P	●	●	●		A						N			●		A
	Piqua Nuclear Power Facility					N					N						N		●	●		A
	Portsmouth Gaseous Diffusion Plant	●	●	●	●	A	●	●	●		A	●		●	●		A		●	●	●	A
Oregon	Lakeview			●		P		●	●		A			●			A					N
Pennsylvania	Burrell					N			●		A			●			A					N
	Canonsburg			●		P			●		A			●			A					N
Puerto Rico	Center for Energy and Environmental Research					N					N						N			●		A
South Carolina	Savannah River Site	●	●	●	●	A	●	●	●		A	●		●	●		A	●	●	●	●	A
South Dakota	Edgemont Vicinity Properties					N					N			●			A					N
Tennessee	Oak Ridge Associated Universities					N	●				P						A					N
	Oak Ridge Reservation	●	●	●	●	A	●	●	●	●	A	●	●	●	●		A		●	●	●	A
Texas	Chevron, Panna Maria					N			●		A			●			A					N
	Conoco, Conquista					N			●		A			●			A					N
	Exxon, Ray Point					N			●		A			●			A					N
	Falls City			●		P		●	●		A			●			A					N
	Pantex Plant	●	●	●		P	●	●			A				●		A			●		P
Utah	Atlas, Moab					N			●		A			●			A					N
	ETN, White Mesa					N			●		A			●			A					N
	Green River			●		P		●	●		A			●			A					N
	Mexican Hat			●		P		●	●		A			●			A					N
	Monticello Millsite & Vicinity Properties		●	●		A		●	●		A			●			A					N
	Plateau, Shootaring					N			●		A			●			A					N
	Rio Algom, Lisbon Valley					N			●		A			●			A					N
	Salt Lake City			●		P		●	●		A						N					N
	Salt Lake City, Clive					N			●		A			●			A					N
Washington	Dawn, Ford					N			●		A			●			A					N
	Hanford Site	●	●	●		A	●		●		A		●	●		●	A		●	●		A
	WNI, Sherwood					N			●		A			●			A					N
West Virginia	Amax					N		●	●		A			●			A					N
Wyoming	ANC, Gas Hills					N			●		A			●			A					N
	Exxon, Highlands					N					A			●			A					N
	Kennecott, Sweetwater					N			●		A			●			A					N
	Pathfinder, Lucky Mac					N			●		A			●			A					N
	Pathfinder, Shirley Basin					N			●		A			●			A					N
	Petromics, Shirley Basin					N			●		A			●			A					N
	Riverton			●		P		●	●		A						N					N
	Spook					P		●	●		P			●			A					N
	UMETCO, Gas Hills					N			●		A			●			A					N
	Union Pacific, Bear Creek					N			●		A			●			A					N
	WNI, Split Rock					N			●		A			●			A					N
Total		28	17	60	11		29	29	99	5		12	9	61	9	4		4	11	28	5	

KEY: A=Active Stewardship by DOE; N=No Stewardship by DOE; VOCs=Volatile Organic Compounds; MW=Mixed Waste; PCBs=Polychlorinated Biphenyls; P=Passive Stewardship by DOE; Rads=Radionuclides; LLW=Low Level Waste; Haz=Hazardous Waste; San/SW=Sanitary/Solid Waste; TRU=Transuranic; Steward=Anticipated Stewardship Requirements

Rulison Groundwater Monitoring Well. In September 10, 1969, a 43-kiloton nuclear explosive device was detonated at Rulison, Colorado 8,426 feet below ground surface. Today, subsurface rights to the approximately 40-acre parcel are controlled by the Federal Government to prevent excavation, drilling, or removal of materials below a depth of 6,000 feet. In addition, the U.S. Environmental Protection Agency regularly monitors an existing network of wells, springs, and the adjacent Battlement Creek for the movement of radionuclide contaminants in groundwater. *Project Rulison Site, Colorado, June 1999.*

Stewardship by Media Type: Water, Soil, Engineered Units, and Facilities

The nature and extent of stewardship will vary depending on which media are contaminated. To better understand the magnitude of the challenges, DOE identified for each site four categories of media that will likely remain contaminated: soil, water, engineered units, and facilities (see Exhibit 9 on preceding page).

Water includes groundwater, surface water and sediments. Groundwater at approximately 100 sites is expected to require long-term stewardship. The types of stewardship activities will range from future use restrictions to continuous pumping. In some cases (e.g., South Valley Superfund Site, New Mexico), the Department must supply alternate sources of drinking water to local residents. In other cases, such as many former uranium mill sites, background levels of contaminants are high and/or the natural quality of the aquifer is poor due to brine; however, mining and milling activities resulted in elevated levels of uranium in the groundwater. At those mill sites where groundwater cleanup is neither feasible nor warranted (e.g., Ambrosia Lake, New Mexico), monitored natural attenuation processes will be relied on to reduce contaminant levels. No active groundwater remediation will be performed. At some mill sites where groundwater is contaminated (e.g., Durango, Colorado), the Department is proposing monitored natural attenuation as the most appropriate remedy. In addition, contaminated surface waters (including sediments) also may require attention and long-term care.

N Reactor along the Columbia River. Originally, the river provided cooling water for the reactor. Spent nuclear fuel has been stored in the "wet storage" (water filled) basins in this complex of buildings supporting the reactor, which ceased operations in 1987. Because of corrosion of the cladding of the spent fuel rods, approximately 15 million gallons of water contaminated with strontium-90 has been released into the groundwater. DOE has installed a groundwater pump-and-treat system to control the movement of the contaminated groundwater. Institutional controls will remain in place at the site indefinitely to restrict groundwater use, and the semi-annual monitoring will continue for at least 30 years after closure of the last facilities. *N Reactor, Hanford Site, Washington, July 1994.*

Oak Ridge Waste Pond. This waste pond, in the south-central part of Oak Ridge National Laboratory's main plant area, contains radiologically-contaminated sediments resulting from settling of low-level radioactive liquid wastes generated from experiments and material processing at the laboratory. The radionuclides contained in the sediment include americium, cesium, cobalt, plutonium, and strontium. *Oak Ridge National Laboratory, Tennessee, January 1994.*

Source of Soil Contamination. This exhaust stack was the source of emissions from the Fernald site's enriched uranium materials processing facility. The malfunctioning of systems like this resulted in releases of several hundred tons of uranium dust into the environment. Although remediation of contaminated soil can restore the Fernald site to an "end state" that serves a number of alternative land uses, residential and agricultural uses will not be considered. Institutional controls will be implemented to ensure that these restrictions are upheld. *Plant 9, Fernald Environmental Management Project, Ohio, December 1993.*

Soil includes release sites, burn pits, burial grounds, and areas contaminated from underground utilities, tanks, or surrounding buildings. Stewardship of contaminated soil is anticipated at 71 sites. At some sites, soil stewardship is driven by subsurface rather than surface contamination. At the "Nevada Offsites" (former nuclear test sites in Alaska, Colorado, Nevada, New Mexico, and Mississippi), extensive subsurface contamination exists from conducting underground nuclear tests. Because no cost-effective technology yet exists to remediate these types of subsurface contamination, they will continue to pose hazards over the long-term. Stewardship activities will be required to prevent people from intruding into these areas in the future.

Pit 9 Radioactive Waste Burial Ground. Engineers gather on the edge of Pit 9 to discuss remediation strategies for this burial ground where, from 1967 to 1969, approximately 150,000 cubic feet of transuranic and low-level waste were buried; but poor record-keeping of past disposal practices has made it difficult to calculate what lies beneath the surface here today. The lack of technologies to fully remediate this area will result in long-term stewardship responsibilities. *Radioactive Waste Management Complex, Idaho National Engineering and Environmental Laboratory, Idaho, March 1994.*

The Nevada Test Site. Atmospheric nuclear explosions here resulted in widely dispersed surface soil contamination. The warning sign is an example of passive stewardship; it reads "**Potential Radiation Hazard** Before any major excavation or earth-moving operation contact RAD-SAFE at C.P.2 tel 2571." *Nevada Test Site, near Mercury, Nevada, October 1984.*