OE/EM-0290

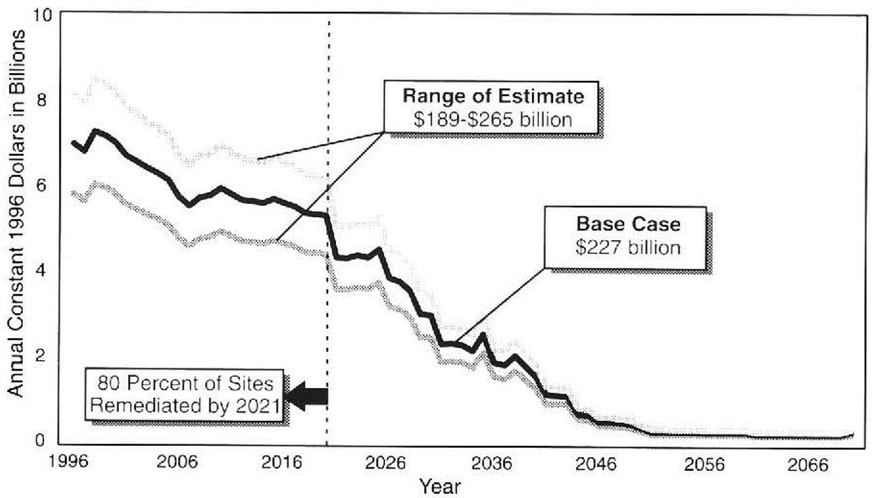
Executive Summary

The 1996 Baseline Environmental Management Report

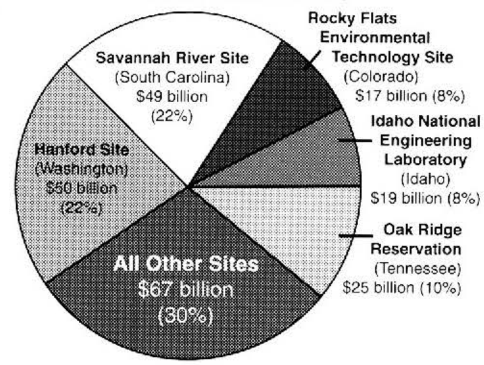
June 1996

U.S. Department of Energy
ce of Environmental Management

THE 1996 BASELINE ENVIRONMENTAL MANAGEMENT REPORT



Five Sites Represent 70 Percent of Base Case Costs



The **BASE CASE** is an estimation of the life-cycle costs and schedules for projects and activities needed to complete the Environmental Management program's mission. The most recent total cost estimate is **$227 BILLION.**

Cost Estimate Assumes:

- Compliance with existing requirements and regulations (as of October 1995).
- Use of available technologies.
- Current land use decisions and plans.

Technical and productivity assumptions were developed by field officials.

WHAT WE LEARNED:
Differences from 1995 Estimate

Although the total 1996 Base Case estimate ($227 billion) appears similar to the 1995 Base Case estimate ($237 billion, in constant 1996 dollars), it actually reflects a significantly lower cost estimate by field offices.

The 1995 Base Case estimate was derived by subtracting the value of projected efficiency improvements ($123 billion in 1996 constant dollars) from an original total estimate of $360 billion (in 1996 constant dollars) provided by field offices. The 1996 Base Case did not impose such a productivity estimate reduction on cost projections provided by field offices. Instead, productivity is assumed to be included in estimates provided by field offices. The 1996 Base Case is essentially a summary of estimates provided by field offices.

The 1996 estimate is therefore substantially **lower** than original 1995 estimates. The change reflects:

- increased productivity
- slightly reduced scope
- modification in compliance agreements with regulators
- change in technical remedy approaches
- use of commercial facilities and privatization of activities

The proportional distribution of estimated costs is roughly the same as the 1995 estimate across sites and across functional elements of the program.

Alternative Scenarios at Selected Sites

Nine alternative approaches to land use, program schedule and scope were evaluated at the five highest cost sites, representing 70 percent of the estimated costs. Resulting cost estimates ranged from $90 to $284 billion (Base Case estimate for these five sites is $160 billion).

- ***If overall cleanup was slower...***

  ...life-cycle costs would be higher

- ***If only existing risks posed to offsite populations and workers were addressed...***

  ...costs would be roughly half the Base Case estimate but less land and fewer facilities would be available for alternative future use and long-term surveillance and monitoring costs would be higher

- ***If maximum feasible cleanup was sought...***

  ...the cost would be approximately double the Base Case cost projection

- ***If maximum feasible cleanup was also constrained by practical factors such as future site mission, habitat protection, and zoning...***

  ...the cost would be only slightly higher (5%) than the Base Case cost estimate.

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Executive Summary

During World War II and the Cold War, the United States developed a massive industrial complex to research, produce, and test nuclear weapons. This nuclear weapons complex included nuclear reactors, chemical processing buildings, metal machining plants, laboratories, and maintenance facilities that manufactured tens of thousands of nuclear warheads, and conducted more than one thousand nuclear explosion tests.

Weapons production stopped in the late 1980s, initially to correct widespread environmental and safety problems, and was later ended indefinitely because of the end of the Cold War. The work remaining, and the subject of this analysis, is the legacy of thousands of contaminated areas and buildings, and large volumes of "backlog" waste and special nuclear materials requiring treatment, stabilization, and disposal. Approximately one-half million cubic meters of radioactive high-level, mixed, and low-level waste must be stabilized, safeguarded, and dispositioned, including a quantity of plutonium sufficient to fabricate thousands of nuclear weapons.

> **The 1996 Baseline Report serves as an analytical tool, or "compass," helping guide Department decisions regarding future paths for the Environmental Management program.**

In 1989, the Department of Energy established the Environmental Restoration and Waste Management program, now called the Environmental Management program, to consolidate ongoing activities and accelerate efforts to deal with the inactive production facilities and sites and the accumulated waste, contamination, and materials. Six years later, this program is responsible for the maintenance and stabilization as well as the environmental restoration and waste management work at virtually the entire nuclear weapons complex not being used for continued weapons activities. The Environmental Management program is one of the largest environmental stewardship programs in the world, with 150 sites in over 30 states and Puerto Rico.

The 1996 Baseline Environmental Management Report provides a total life-cycle cost estimate and anticipated schedule of the projects and activities necessary to carry out the Environmental Management program's missions for environmental remediation, waste management, science and technology development, the transition of operational facilities to safe shutdown status, and the safeguarding and securing of special nuclear materials.

This report is prepared as an analytical tool to help guide departmental decisions and to provide an accounting of the Department's progress, spending, and plans. In addition, federal law requires the Secretary of Energy to regularly submit Baseline Environmental Management Reports. The 1996 Baseline Environmental Management Report (Baseline Report) is the second of these reports. In addition, the report serves as a benchmark – or starting point – in the development of new "Ten-Year Plans" that are being prepared to define new, near-term cleanup objectives and greatly accelerate the pace and reduce the costs of cleanup over current plans.

The first report, prepared in 1995, estimated that the total cost of the Environmental Management program's mission would be between $200 and $350 billion over a 75-year period. Significant decisions made over the past 12 months have changed the projected scope of the Environmental Management program as presented in the 1995 report. The 1996 Baseline Report highlights these changes, both at the site and national levels. These changes have resulted in a lower total program estimate, which now is between $189 and $265 billion over a 75-year period. Guided by a new ten-year planning process, we are confident that we can further reduce the costs and accelerate the pace of cleanup through better coordination between sites, use of "breakthrough management" and use of new technologies.

The 1996 Baseline Report IS:

- A life-cycle cost estimate for the entire Environmental Management Program
- A policy analysis tool that explores the potential consequences of several policy alternatives
- A description of environmental management activities expected to be necessary to address the Department's legacy and projected future activities

The 1996 Baseline Report IS NOT:

- A definitive basis for planning specific projects
- A budget document
- A funding request

The 1996 Baseline Report is based on current (as of late 1995) national and site-level assumptions regarding the actions or activities that are most likely to occur in the future, and it estimates the costs of these actions or activities. It is expected that these projected activities will change in the future. In fact, one of the principal purposes of this report is to inform a national debate on what the best future course should be.

The Environmental Legacy: Causes and Remedies

The Environmental Management program was established to address the environmental legacy of nuclear weapons production and other sources of waste or contamination such as nuclear research programs. The program encompasses remediation of the environment and facilities that have been contaminated with radioactive materials and hazardous chemicals. The program uses safe and practical strategies to deal with a variety of radioactive and hazardous waste. It also entails deactivating and safekeeping hundreds of facilities that have no similar counterparts in any other government or commercial industrial facilities. Finally, the Environmental Management program accomplishes the stabilization and safe storage of special nuclear materials such as plutonium and highly enriched uranium and the management and storage of spent nuclear fuel. In addition to the legacy mission, the Environmental Management program manages waste produced by ongoing Department missions. (e.g., national laboratories).

The Environmental Management program encompasses six major functional areas: (1) environmental restoration; (2) waste management; (3) nuclear material and facility stabilization; (4) science and technology development; (5) landlord; and (6) national program planning and management. Figure 1 depicts the scope of the

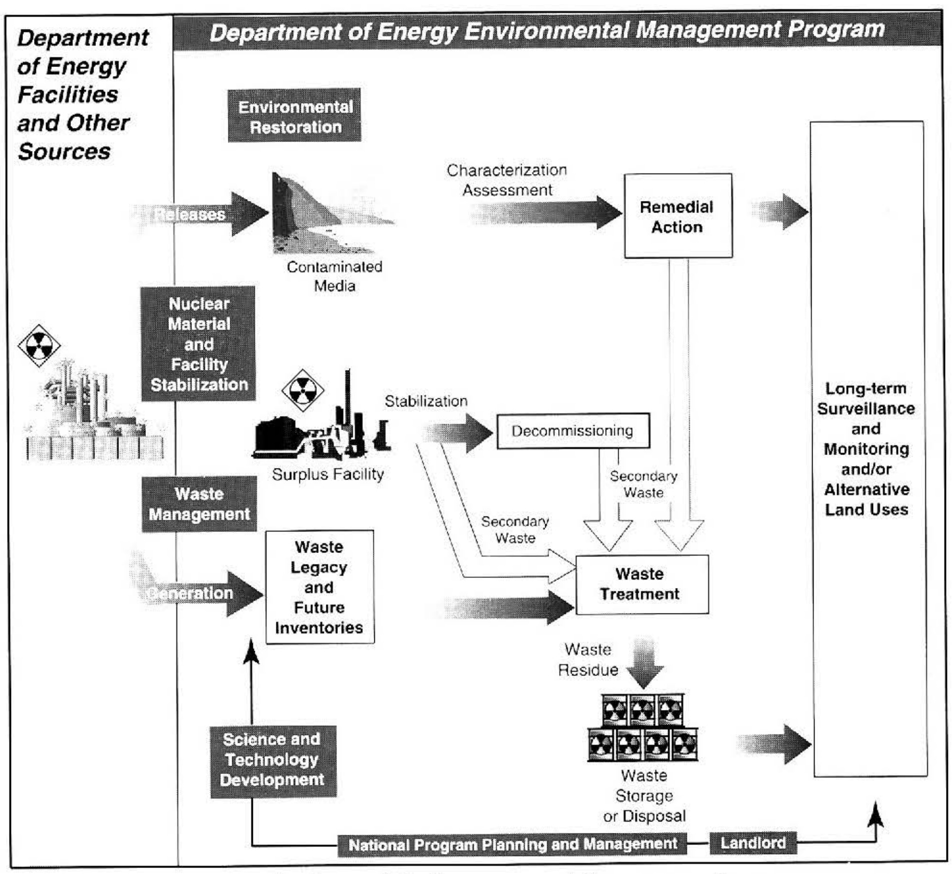

Figure 1. The Scope of the Environmental Management Program

Environmental Management program and the key interrelationships of the six major areas. Primary among these is waste management, which involves safe treatment, storage, and disposal of existing waste and waste yet to be generated. Environmental restoration activities address remediation of contaminated soil and water as well as decommissioning of contaminated surplus facilities. Nuclear material and facility stabilization involves stabilizing and consolidating special nuclear materials such as plutonium and highly enriched uranium and deactivating surplus facilities to a safe, low-maintenance condition while awaiting final decommissioning. Science and technology development includes a variety of basic and applied research activities that explore more effective and less expensive remedies to address the environmental and safety problems of the Environmental Management program. Landlord functions represent crosscutting, site-wide activities such as road maintenance and fire and ambulance services necessary to keep communication, transportation, and security systems operational at large facilities. National program planning and management encompasses Headquarters functions.

What is the Base Case?

The Environmental Management Base Case is a long-range projection of activities, schedules, and associated costs that fully describes the Environmental Management program, as currently projected, from its current state to completion (see "Why Life-Cycle Estimates") based upon compliance with current laws, regulations, and agreements. The Base Case looks to the future, but does so only with the knowledge, information, and assumptions that are available today. Because these inputs are rapidly changing, the 1996 Base Case is essentially a snapshot in time of a dynamic and complex program. The Base Case is not a budget estimate or a program funding request. Nor is it intended to provide details of specific projects.

The information in the Base Case falls into four categories: (1) descriptions of Environmental Management activities; (2) estimates of the annual cost of each Environmental Management activity; (3) estimates of the annual waste volumes generated by each activity; and, (4) initial schedule estimates for each activity, including starting dates and duration. "Activities" are specific sets of actions taken to disposition special nuclear material or contaminated facilities, remediate contaminated areas, manage waste, maintain federal lands and facilities, and manage the programs individually and collectively in an integrated manner.

Why Life-Cycle Estimates?

The purpose of life-cycle cost analysis is to evaluate the total direct, indirect, recurring, nonrecurring, and related costs incurred – or estimated to be incurred – for a project. The life-cycle cost estimate encompasses all costs of a project, including those related to characterization, design, remediation, operation, maintenance, support, deactivation and disposition over the anticipated useful life span of that project.

Life-cycle estimates help identify activities that have the most significant financial impact on a project during its life span and provide information for effective strategic planning, budgeting, execution, and control of project activities. While near-term planning remains critical for budgeting and tasking purposes, it is incapable of identifying the long-term implications of issues and the strategies posed to resolve them. Life-cycle planning is also critical to ensure that issues affecting sites throughout the complex are addressed in a programmatically efficient manner.

Limitations of a Life-Cycle Cost Estimate

Projecting future activities and costs is always fraught with uncertainty. This uncertainty is compounded when projecting the path of an unprecedented program such as stabilizing and remediating the facilities and residues of the nuclear weapons complex. Activities such as these are expected to last decades. They will be affected by unpredictable factors, such as the development of new technologies and laws, and are extremely controversial. Nonetheless, these are also some of the reasons why good program management and good public policy require that such an estimate be compiled. The following is a list of specific limitations of the life-cycle

Base Case for the Environmental Management program:

- The program has a large unknown scope for which the nature and extent of existing problems have not been adequately characterized and an expected remedy has not been defined.
- The program faces challenges resulting from the production of unique radioactive materials. The program must, therefore, develop new approaches and technologies to address unique environmental cleanup problems.
- The program is responsible for environmental management problems for which there are no current effective remedies and no effective remedies on the horizon (defined as "infeasible"). Some are infeasible for technological reasons (no available technology); others are infeasible because addressing them will result in unacceptable levels of ecological damage. (The Base Case does not include the costs for undertaking infeasible projects. However, costs for surveillance and monitoring of these problems are included.)
- The estimate must project how long short-term interim measures will be used to address problems for which no long-term solutions are available.

The Base Case estimates must also address uncertainties that stem from legal and institutional issues. Department of Energy policy requires management of its facilities in compliance with applicable federal, state, and local regulations. Many of these laws, including the Comprehensive Environmental Response, Compensation, and Liability Act, the Clean Water Act, and the Clean Air Act, have been targeted by Congress for reauthorization. Changes to these laws will likely affect the Environmental Management program, although the timing, substance, and extent of the changes are unclear.

Site-specific cleanup and compliance agreements, developed with the U.S. Environmental Protection Agency and states that host Department of Energy facilities, are a primary means for the Department to implement the provisions of federal, state, and local regulations. However, because regulators make final decisions about the choice of remedial action and the satisfactory completion of each action, the decisionmaking process adds complexity and uncertainty to the Department's planning processes. In some cases, final agreements are not yet concluded. In other cases, agreements are signed, but subsequent information and events may require that these agreements be renegotiated.

In other instances, site objectives are not fully defined because the Department cannot define them alone. For example, decisions related to the future configuration of the nuclear weapons complex are dependent on international factors such as arms control treaties. These decisions may dramatically affect continued operations and associated environmental management costs at some installations.

Site-Based Cost Estimates: "Bottom Up" Approach

The 1996 Base Case cost estimates were developed through a "bottom up" estimating approach. Detailed cost estimates developed for specific projects were aggregated into sequentially larger groupings. This resulted in estimates for entire sites, installations, and programs. This approach, in which project and site managers take responsibility for estimating costs, offers several advantages: increased reliability (due to involvement of staff that best understands the work); traceability of summary estimates to detailed data; availability of detailed estimates for Headquarters to analyze issues at a national level; and development of analytical tools that can be used for improved site and program management. This method is in contrast to a "top down" method that uses field data in a centralized cost estimation model. Because of a lack of adequately developed life-cycle cost estimates from the field, this "top down" method was used for roughly half of the cost data in the 1995 Baseline Report.

Base Case Methodology

The Department used a five-step process to develop the cost and schedule estimates for the 1996 Baseline Report.

1) **Define the study:** Establish the scope, framework, and general assumptions for the estimates; seek input from stakeholders.

2) **Gather and Assemble Data:** Collect, verify, and document cost, waste volume, and schedule data.

3) **Perform Site-and Complex-Wide Integration:** Ensure that costs remain within assumed funding limits and that all waste transfers are accounted for.

4) **Estimate Program Improvements:** Evaluate the impacts of technology development, pollution prevention, and productivity improvements.

5) **Develop Documentation:** Prepare the 1996 report.

In developing the Base Case estimate, every effort was made to ensure that personnel at individual sites were fully involved with the data collection and analysis. The overall scope of the Base Case and the national assumptions underlying the estimates were consistent across the program, but each site developed its own, fully integrated, cost and schedule estimates using the most current data. Once these estimates were complete, the Department conducted a complex-wide integration process to ensure that the interdependencies across sites (for example, waste transfers) were fully understood. Volumes II and III of this report present the Base Case for each site.

The Department maintained an active stakeholder involvement process throughout the development of this report. Particular objectives were to ensure public input to the overall scope and framework for the 1996 estimate and the site-specific assumptions and estimating methods. Stakeholder input was also sought to ensure that the Base Case assumptions were consistent with other Departmental initiatives (for example, future land use planning).

Base Case Assumptions

A variety of factors significantly affects the estimated scope, schedule, and total cost of the Environmental Management program. Site personnel developed detailed, site-specific assumptions for each factor to estimate costs. Site-specific assumptions are described in Volumes II and III of the 1996 Baseline Report. Table 1 lists the major assumptions from which the Base Case was developed. The Base Case assumptions reflect program plans and conditions as of October 1995. Any changes since that time are not necessarily reflected in this report.

Environmental Activities Generally Excluded from the Base Case

Although the 1996 Base Case addresses a large number of activities required to clean up and manage newly generated and legacy waste associ-

Table 1. Major Base Case Assumptions

Factor Affecting Estimate	Base Case Assumptions
Land Use	• Explicit assumptions for future use at each site • All Environmental Management activities are consistent with assumed site end-states
Schedule	• National permanent geologic repository available in 2016 • Waste Isolation Pilot Plant available in 1998
Site Completion	• Work assumed complete when the site has been remediated to the extent specified in land-use plans, when all facilities have been properly stabilized and dispositioned and when all waste has been safely disposed • Annual surveillance and monitoring costs will be incurred at sites where restricted areas remain (e.g., waste disposal sites or nuclear materials storage)
Transportation	• Site roadways and railways will be upgraded or replaced as necessary to accommodate higher shipping frequencies and larger/heavier items • No regulatory changes to further restrict the offsite shipments of hazardous and radioactive materials • New waste shipment packaging will be designed. Department of Transportation and Nuclear Regulatory Commission certification will require three years following design
Funding Limitation	• Annual funding sufficient to meet the requirements and milestones of all existing and applicable laws, permits, regulations, and Department of Energy agreements • Funding by site capped at the FY2000 compliance funding levels and held constant thereafter (unless compliance agreements by site extend beyond FY2000)

ated with the nuclear weapons complex, there are several exclusions from the 1996 Base Case cost estimate. These exclusions are:

Table 2. Examples of Contaminated Sites Not Included in the Base Case

Installation	Project	Reason Excluded
Hanford Site	Columbia River, Hanford Reach Ground Water	No feasible remediation approach available Limited pump-and-treat followed by natural attenuation and monitoring
Oak Ridge Reservation (Y-12, K-25, Associated Universities)	Clinch River Watts Bar Reservoir Poplar Creek Embayment White Oak Creek	No feasible remediation approach available
Oak Ridge National Laboratory	Deep Hydrofracture Grout Sheet	No feasible remediation approach available
Savannah River Site	L Lake Savannah River Swamp Par Pond	No feasible remedy without causing collateral ecological damage
Fernald Plant	Great Miami River	No feasible remediation approach available
Idaho National Engineering Laboratory	Snake River Plain Aquifer	Limited pump-and-treat followed by natural attenuation and monitoring
Rocky Flats Environmental Technology Site	Walnut Creek Woman Creek Great Western Reservoir	No feasible remedy without causing collateral ecological damage
Nevada Test Site	Underground Test Areas	No feasible remediation approach available
Sandia National Laboratory/ New Mexico	Chemical Waste Landfill Ground Water	Natural attenuation and monitoring assumed

- Cost estimates for remediation activities that are either not technically possible or not planned. Examples of these activities are further described in Table 2.
- Cost estimates for sites and/or facilities with ongoing missions (i.e., Defense Programs, Nuclear Energy, Energy Research). These exclusions include stabilization, deactivation, and decommissioning of facilities and treatment, storage, and disposal of chemical and radioactive substances associated with ongoing mission activities.
- Cost estimates for annual, long-term, post-closure surveillance and monitoring.
- Costs for the first six years of the Environmental Management program ($28.5 billion).
- Cost estimates for potential liabilities due to natural resources damages claims.
- Cost estimates for disposition of special nuclear materials (e.g., plutonium) or other materials in inventory (e.g., depleted uranium or lithium).

Table 3. Base Case Assumptions for Environmental Restoration Activities

Activity	Media	Base Case Assumption
Remedial Actions	Ground Water	• Sources of contamination addressed by removal or contaminant as high-priority •Pump and treat technologies used if technology is effective • Containment and monitoring emphasized in absence of effective removal technologies • All ground water contained on site
	Surface Water	• Small ponds and streams remediated by removal of sediments • Large bodies of water (e.g., Clinch River, Columbia River) monitored due to lack of effective technology or potential ecological damage
	Soil/Buried Waste	• Contained in place, unless significant contaminant releases are expected
Decommissioning	Large Buildings (e.g., Reactors, Processing Buildings)	• Generally contained by entombment
	Small Buildings (e.g., Laboratories)	• Decontaminated and demolished

Environmental Restoration Assumptions

Environmental restoration costs comprise approximately one-third of the current FY 1996 annual program costs. The Base Case for environmental restoration encompasses environmental remediation or containment activities at nearly all 150 sites included in this Baseline Report. The report addresses 10,500 potential release sites that have been grouped into 295 geographically based units.

Virtually all of the 10,500 potential release sites have been at least partially characterized. Approximately 46 percent have been fully characterized. However, final remedial action and/or regulatory decisions have been made for substantially fewer sites. For this reason, the environmental restoration cost estimate is based largely on two site-specific assumptions: program scope (that is, the amount and type of contamination); and the remediation technologies that will be selected. Table 3 describes the general Base Case Environmental Restoration assumptions for remedial actions and decommissioning.

Waste Management Assumptions

The Base Case estimate for waste management includes costs for: (1) existing inventories of waste, (2) waste streams from environmental restoration activities, (3) waste streams from nuclear material and facility stabilization activities, (4) additional waste generated by waste management activities, and (5) newly generated waste from non-Environmental Management sources. Activities for waste management are defined as treatment, storage (and handling), and disposal of waste. Waste management also includes treatment, storage, and disposal of spent nuclear fuel, which the Department does not consider a waste.

Table 4 highlights the Base Case treatment, storage, and disposal assumptions detailed by

Table 4. Base Case Waste Management Assumptions

Waste Type	Activity		
	Storage	Treatment	Disposal
High-Level Waste	• Continued storage in tanks at Hanford, Savannah River Site, West Valley Demonstration Project, and Idaho National Engineering Laboratory • Continued storage of calcine in bins at Idaho National Engineering Laboratory	• Vitrify at Hanford, Savannah River Site, and West Valley Demonstration Project	• Geologic repository assumed
Transuranic Waste	• Onsite storage	• Treatment to Waste Isolation Pilot Plant waste acceptance criteria	• Waste Isolation Pilot Plant (beginning in 1998)
Low-Level Waste	• Onsite storage at generator sites while awaiting treatment and disposal at six Department of Energy sites	• Treatment to meet transport and disposal criteria	• Disposal at seven sites: Hanford, Oak Ridge, Idaho National Laboratory, Los Alamos National Laboratory, Nevada Test Site, Savannah River, and Rocky Flats Environmental Technology Site and also at commercial facilities
Low-Level Mixed Waste	• Storage at 30 generator sites	• Treatment to meet land disposal restrictions Treatment performed in accordance with the Federal Facility Compliance Act	• Disposal at seven sites: Hanford, Oak Ridge, Idaho National Laboratory, Los Alamos National Laboratory, Nevada Test Site, Savannah River, and Rocky Flats Environmental Technology Site and also at commercial facilities
Hazardous Waste	• Onsite storage for accumulation prior to treatment	• Treatment mostly at commercial facilities	• Commercial facilities
Sanitary Waste	• No storage	• Treatment at point of generation as needed	• Commercial or onsite disposal depending on the site
Special Case Waste	• Onsite storage	• Treatment as required	• Disposal in a national geologic repository

waste type. Table 5 provides these assumptions for spent nuclear fuel.

Table 5. Base Case Assumptions for Spent Nuclear Fuel

Spent Nuclear Fuel Activity		
Storage	**Treatment**	**Disposal**
• Consolidation of storage at the Savannah River Site and Idaho National Engineering Laboratory; continued storage at the Hanford Site • Cost of building new storage facilities included • All spent nuclear fuel assumptions are compatible with the Record of Decision for the Spent Nuclear Fuel Final Environmental Impact Statement	• No reprocessing	• Availability of a geologic repository assumed

Nuclear Material and Facility Stabilization Assumptions

The Base Case estimates for nuclear materials and facility stabilization activities are based upon a defined "universe" of materials and facilities that have been, or will be, declared surplus by the Department. The Base Case development process involved validating a list of facilities scheduled to undergo stabilization and deactivation in the 1995 Baseline Report. This list was based on the Surplus Facility Inventory and Assessment Project conducted in 1994. The assessment identified those facilities that are declared surplus now or expected to be surplus prior to October 1998.

Other facilities are still operating and currently have no scheduled date for shutdown or transfer. These facilities are considered outside the program's planning horizon and are not reflected in the 1996 Base Case. Typically these facilities are associated with ongoing nuclear weapons activities.

Nuclear material and facility stabilization activities include material stabilization, facility deactivation, and surveillance and maintenance. Stabilization entails placing nuclear materials into a condition suitable for long-term storage. In some instances, Base Case stabilization costs include storage costs for nuclear material. For example, at the Rocky Flats Environmental Technology Site, storage costs constitute a significant portion of the stabilization estimate. Deactivation, which usually occurs after completion of stabilization, focuses on removal of material, shutting down facility systems, and removal or de-energizing equipment to reduce potential facility hazards.

Surveillance and maintenance activities encompass all actions required to ensure adequate material and facility requirements for safety and security. Surveillance and maintenance activities are assumed to continue during the stabilization and deactivation phases (as well as before and between these phases). The Base Case captures surveillance and maintenance costs that are incurred before and after stabilization and after deactivation activities. Post-deactivation surveillance and maintenance is assumed to continue for two years. After that, facilities are assumed to be decommissioned. These costs are included as part of environmental restoration activities.

The Base Case estimates were developed by personnel at four sites (Hanford Site, Idaho National Engineering Laboratory, Rocky Flats Environmental Technology Site, and Savannah River Site). Estimates for nuclear material and facility stabilization costs at other sites were generated by Headquarters personnel using parametric cost-estimating techniques and site-specific data.

In instances where parametric cost estimating techniques were used, the following hypothetical scheduling scenario was assumed (in this sequence): seven years of surveillance and maintenance after transfer of a facility to the Environmental Management program, three years of stabilization activities, three years of post-stabilization surveillance and maintenance, three years of deactivation activities, and two years of post-deactivation surveillance and maintenance.

Surplus facilities already in the Environmental Management program were scheduled according to this hypothetical scenario. Surplus facilities not yet in the program were assigned arbitrary transfer dates, typically selected to fit funding constraints assumed in the Base Case. Insufficient data was available to guide scheduling of these facilities according to risk or other priorities.

Science and Technology Development Assumptions

The Environmental Management program's science and technology development activities represent an aggressive national program of basic and applied research, development, demonstration, testing, and evaluation for innovative environmental cleanup solutions. The program seeks to develop technologies that facilitate compliance with applicable laws, regulations, and agreements; minimize generation of waste; and clean up Environmental Management sites in a manner that is safer, faster, and less expensive than baseline technologies. In many cases, the development of new technologies is critical for providing a method of significantly reducing long-term risks to the environment and improving worker/public safety within realistic financial constraints.

The major science and technology assumptions included in the Base Case are as follows:

- Current Base Case cost estimates for Environmental Management activities are based upon the use of existing technologies. This assumption allows one to calculate future savings resulting from the development of emerging technologies against this baseline.
- Funding for science and technology development is currently 6 percent of the Environmental Management Base Case and is assumed to remain at this level until the year 2030.

Landlord Assumptions

Landlord activities support the performance of direct mission activities. In developing landlord cost estimates, site personnel determined FY 1996 costs for landlord activities, then assessed how these levels might change over time as several factors change: maturity of the program, level of annual direct mission activities being performed, cleanup completeness, and other factors relevant to the site.

National Program Planning and Management Assumptions

Headquarters personnel used a simple model to estimate the costs for national program planning and management. As part of this process, independent cost estimates were developed for program direction and program management. Program direction costs include salaries, benefits, travel, and training for federal employees. For the purposes of this report, the Department assumed that program direction costs will remain a constant percentage of total cost over the life-cycle of the program. Hence, as program funding decreases over time, program direction will decrease proportionally. Program management costs fund contractors that support federal employees. The Department assumed that program management costs will also decrease as a percentage of total cost over time as the program matures and becomes better defined. These costs have already dropped 55 percent from FY 1994 to FY 1996.

Support Cost Assumptions

In addition to direct mission activities, the Environmental Management program, like private firms and other public agencies, also must perform "support" activities. These activities fall into six main categories:

- Management;
- Finance and Administrative Services;
- Environment, Safety, and Health;
- Infrastructure;
- Safeguards and Security; and
- Stakeholder and Regulatory Interactions, and Other.

Support activities are not extraneous; they are vital to maintaining site safety and ensuring environmental cleanup progress. For example, it is necessary to conduct environment, safety, and health activities and to provide safeguards and security at all sites, particularly those storing uranium, plutonium, and other nuclear materials.

The benefits of support activities are shared across projects within a functional area. Therefore, the

Baseline Report does not identify support costs as a separate category (except for cost estimating purposes). Rather, support costs in this report are spread across the direct mission activities within each appropriate functional area.

To develop support cost estimates, site personnel first developed a time profile for their direct mission activities. Then, based upon this profile, site personnel estimated the level of support activities that they would need on an annual basis and their costs. Specifically, site personnel determined FY 1996 costs for support activities, then assessed how these levels might change over time based on changes to several factors: maturity of the program, level of annual cleanup activity being performed, completeness of cleanup, and any other factors relevant to the site.

Results

The 1996 Base Case life-cycle cost estimate for completing the Environmental Management program is projected to be between $189 billion and $265 billion, with a mid-range estimate of $227 billion. All estimates are in constant 1996 dollars. The life-cycle cost profiles are graphically depicted in Figure 2.

The mid-range estimate – $227 billion – represents the sum of life-cycle costs for all site-specific activities and projects described in Volumes II and III of the Baseline Report. The upper range ($265 billion) and lower range ($189 billion) are estimated using a probabilistic analysis of each site's evaluation of levels of confidence in their Base Case estimates.

The mid-range estimate of $227 billion is the projected cost for carrying out the currently planned tasks, including existing compliance agreement obligations (as of October 1995), facility maintenance, and general operating requirements using available technology.

The life-cycle activities for the Base Case are estimated to span a 75-year period (1996 to 2070), although most sites will be completed considerably sooner. By 2070, all environmental management sites requiring remediation are assumed to be remediated; only post-closure long-term surveillance and monitoring activities and ongoing waste management activities at active sites will remain. Preliminary estimates indicate these long-term costs would range from $45-$65 million annually for several decades. Figure 3 shows the Base Case schedule for remediating sites.

Reconciling the Base Case Cost Estimate with Budget Projections

The Base Case is not a budget estimate. In fact, with cost projections expected to exceed budget

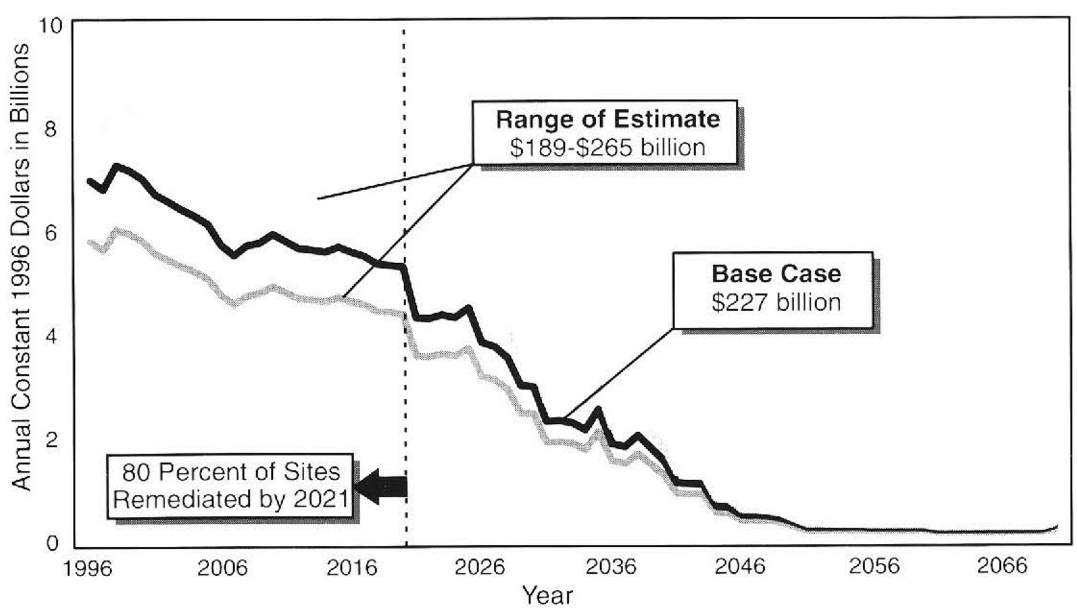

Figure 2. Base Case Life-Cycle Cost Estimate

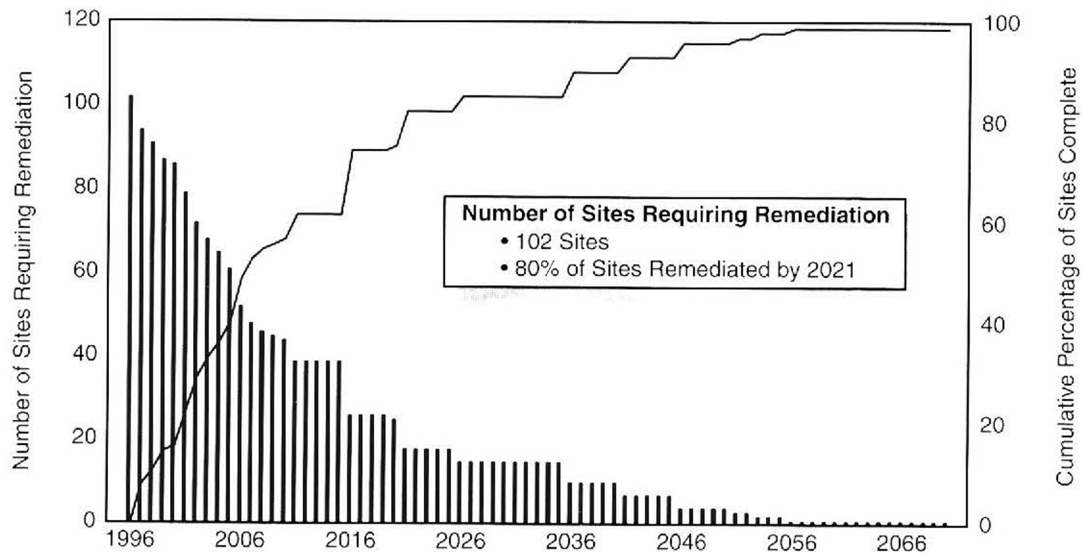

Figure 3. Base Case Schedule for Remediating Sites

availability and priorities continuing to be defined, a clear articulation of the current baseline projection is useful. The projected budget target (as of October 1995), based on larger federal budget realities, indicates that the Environmental Management program will be funded at approximately \$5.5 billion in annual funding (in current dollars) by 2000. After accounting for expected inflation, this number equates to \$4.9 billion in constant 1996 dollars. The difference between the assumed funding for the Base Case estimate and the funding target results in a projected budget shortfall. Figure 4 indicates that this shortfall amounts to \$27 billion over a 25-year period.

This budget shortfall has been anticipated since 1993. During this period, the Department has successfully reconciled this shortfall through a number of management initiatives intended to deliver more results for less money. Specific priorities for the Environmental Management program include:

From 1993-1996

- *Improved Contractor Efficiency* – Reduced contractor employment by 17,000 individuals or 33 percent; initiated performance-based contracting systems at most of the large sites in the complex.
- *Renegotiated Compliance Agreements* – To date, renegotiated agreements have resulted in more than \$1 billion in potential savings for the Hanford Site and Savannah River Site.
- *Involved Stakeholders and Workers* – At Fernald, Ohio, recommendations from the Citizen Task Force on disposal options and future land use at the site are expected to result in over \$2 billion in savings.

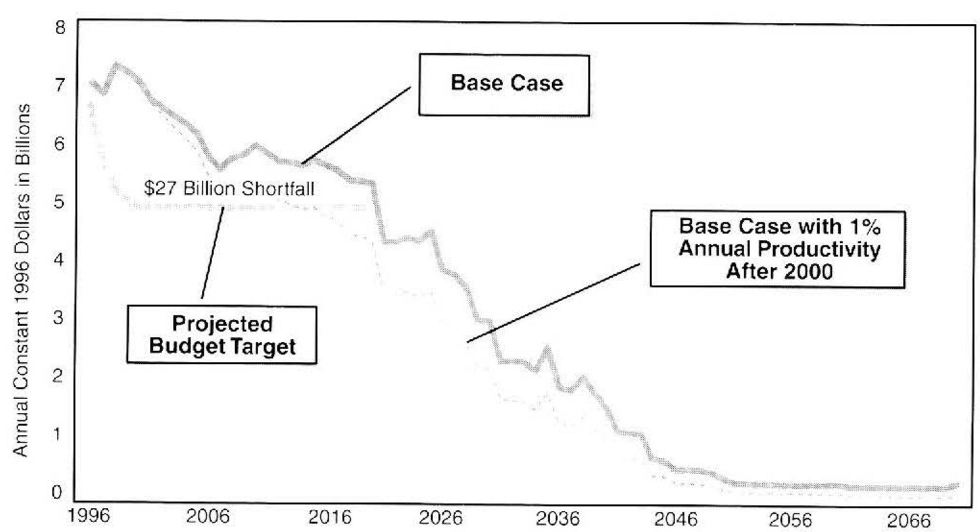

Figure 4. Long-Term Budget Shortfall

From 1997-2000

- *Privatizing Operations* – Improving public sector efficiency with more private sector incentives.
- *Conducting Management "Work Outs"* – Department of Energy, contractors, and regulators coming together to develop common sense reforms.
- *Investing in Science* – Bridging basic science and applied research needs on our most intractable environmental problems.

We believe that these efforts will continue to assist in reconciling estimated Base Case costs to budget realities. Additional changes such as legislative amendments to Superfund will also contribute to helping the program operate more cost effectively. Clearly, however, it is critical to good management to anticipate budget problems through effective life-cycle analysis.

A Closer Look at the Base Case

At the program "end state" (in 2070), all mission-related activities have been completed and most sites have been made available for alternative land uses. Buildings are decommissioned, waste planned for offsite disposal is treated and will have been shipped to a permanent disposal site or commercial facility, and waste being disposed of onsite is capped in pits or trenches or securely enclosed in disposal cells. In 2070, Environmental Management program activities are focused on long-term surveillance and monitoring and waste management for active Department of Energy programs. In other words, sites with ongoing missions outside of the Environmental Management program (for example, national laboratories) will continue to incur ongoing waste management costs.

Many sites complete their Environmental Management mission-related activities before 2070. A closer examination of the life-cycle cost profile in Figure 3 reveals a relatively level estimate after 2050. In fact, 90 percent of the total life-cycle cost is expected to be expended by 2037.

The Base Case includes site-based productivity estimates that produce a total life-cycle cost reduction of $14 billion, resulting in a total life-cycle cost estimate of $227 billion. With no productivity savings, completion of the Environmental Management program is estimated to cost $241 billion.

A Geographical View of the Environmental Management Program

The Department's Environmental Management program currently is operating in approximately 30 states and territories. By 2020, this number is expected to drop to 21 states. (See Figure 5 for the estimated annual spending level for environmental management activities in each state and a

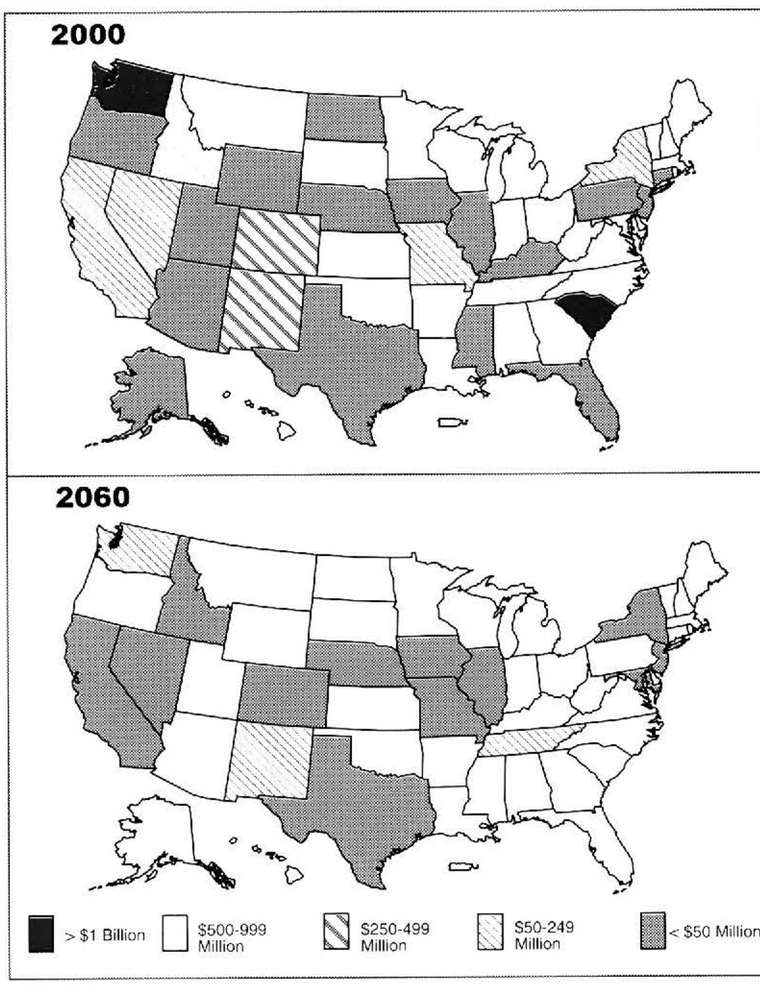

Figure 5. Annual Estimated Costs by State

depiction of cleanup progress over time.) In 2060, this number drops to 15 states, with almost all of the expenditures for long-term surveillance and monitoring and management of waste generated by programs with ongoing missions. Significant findings include:

- Activities in two states, Washington (Hanford Site) and South Carolina (Savannah River Site), dominate the life-cycle cost estimate. They account for approximately $100 billion (or 44 percent) of projected life-cycle costs. Figure 6 shows life-cycle cost percentage by site.
- The expected end dates for the five highest-cost sites are as follows: Hanford Site (2070), Idaho National Engineering Laboratory (2045), Oak Ridge Reservation (2070), Rocky Flats Environmental Technology Site (2055), and Savannah River Site (2050). Surveillance and monitoring activities will continue beyond these dates. All sites will be complete by 2070.
- At Hanford, Idaho National Engineering Laboratory, and the Savannah River Site, waste management constitutes the largest portion of program costs.
- At the Oak Ridge Reservation, environmental restoration activities are the highest proportion of the total cost estimate; and at the Rocky Flats Environmental Technology Site, nuclear material and facility stabilization activities represent the largest percentage of total estimated cost.

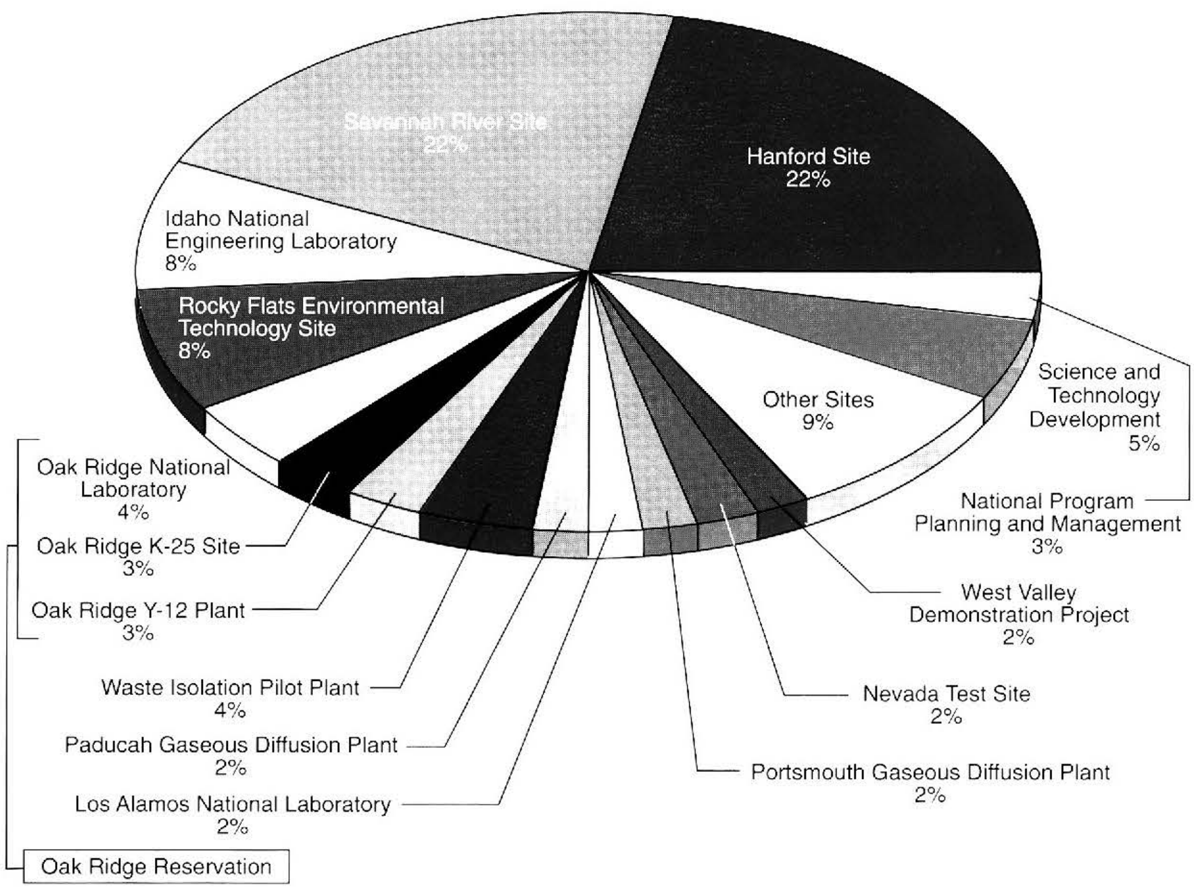

Figure 6. Distribution of Environmental Management Life-Cycle Estimate

Base Case Results for Major Functional Elements of the Environmental Management Program

The program is divided into six major functional elements: waste management, environmental restoration, nuclear material and facility stabilization, science and technology development, landlord, and national program planning and management. Figure 7 shows the life-cycle cost estimate by major functional element. Table 6 lists the highest life-cycle cost projects in the Environmental Management program. Specific results include:

- The life-cycle cost estimate of waste management activities is $111 billion. This represents nearly half of estimated life-cycle Environmental Management program costs. The largest portion of estimated waste management cost ($53 billion or 48 percent) is associated with the management of high-level radioactive waste.
- Environmental restoration activities constitute the second highest proportion of estimated Environmental Management program costs ($63 billion or 28 percent). Remedial actions,

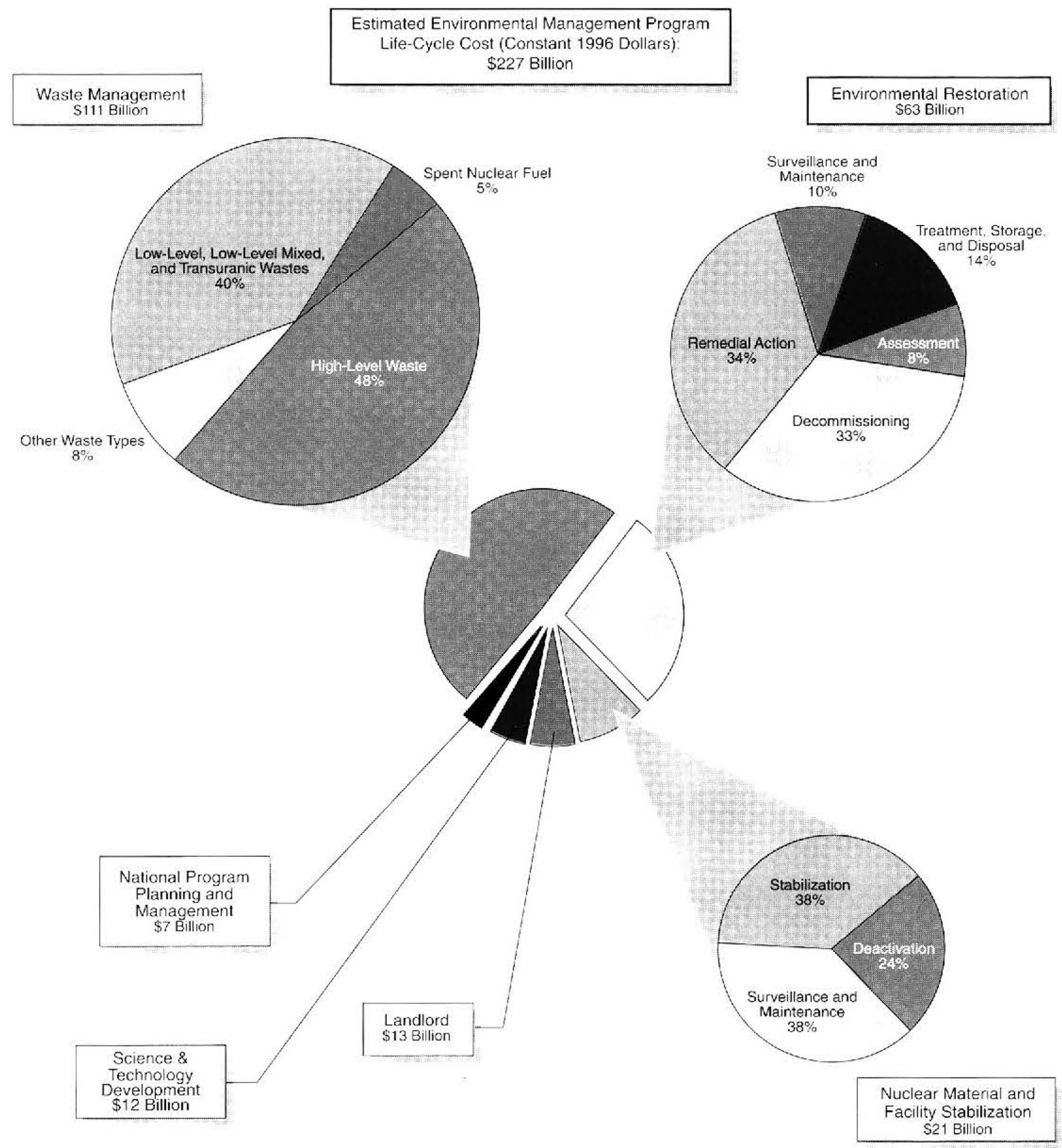

Figure 7. Estimated Life-Cycle Cost By Major Functional Element

Table 6. Activities with Highest Projected Costs in the Environmental Management Program

Program	Site	Project	Millions
Waste Management	Hanford Site	High-Level and Low-Level Vitrification	$15,500
	Waste Isolation Pilot Plant	Waste Isolation Pilot Plant	$8,300
	Idaho National Engineering Laboratory	Chemical Processing Plant	$4,800
	Savannah River Site	Defense Waste Processing Facility	$3,800
	Hanford Site	Single- and Double-Shell Tanks	$3,700
	West Valley Demonstration Project	High-Level Waste Vitrification Facility	$3,700
	Savannah River Site	H Tank Farm	$2,100
	Savannah River Site	F Tank Farm	$1,500
	Savannah River Site	High-Level Waste In-Tank Precipitation	$1,500
	Hanford Site	T Plant	$1,000
Environmental Restoration	Idaho National Engineering Laboratory	Radioactive Waste Management Complex Buried Waste (Remediation)	$1,385
	Savannah River Site	R Reactor Entombment/Removal (Decommissioning)	$699
	Rocky Flats Environmental Technology Site	771 Plutonium Recovery Decontamination/Containment (Decommissioning)	$430
	Lawrence Livermore National Laboratory	Main Site-Ground Water (Remediation)	$334
	Oak Ridge Y-12 Plant	Building 9201-4 Removal (Decommissioning)	$256
	Hanford Site	100-NR Soils (Remediation)	$209
Nuclear Material and Facility Stabilization	Hanford Site	Plutonium Finishing Plant Facilities	$2,200
	Rocky Flats Environmental Technology Site	371 Plutonium Recovery Buildings	$1.100
	Savannah River Site	F Canyon	$1,100
	Savannah River Site	H Canyon	$600
	Savannah River Site	Actinide Packaging Facility	$600
	Nevada Test Site	Area 15 Facilities	$500
	Rocky Flats Environmental Technology Site	707 Production Building	$500
	Rocky Flats Environmental Technology Site	771 Plutonium Recovery Facility	$500
	Savannah River Site	L Reactor and Supporting Facilities	$300
	Rocky Flats Environmental Technology Site	776/777 Manufacturing/Assembly Facility	$300

which involve cleanup of soil, ground water, and surface water, represent the greatest proportion of estimated environmental restoration costs ($22 billion or 35 percent).

- The life-cycle cost estimate for nuclear material and facility stabilization activities is $21 billion, or 9 percent of estimated Environmental Management program costs. Facility stabilization activities account for the largest proportion of these estimated costs. Stabilization, which entails placing nuclear materials in a condition suitable for long-term storage, also includes storage costs at some sites (for example, storage of plutonium at the Rocky Flats Environmental Technology Site). A small number of large projects make up the majority of the estimated nuclear material and facility stabilization costs (see Table 6).

- Science and technology development activities represent $12 billion or 5 percent of the total life-cycle cost estimate. Projected cost savings from a $3 billion investment in the first decade of technology development activities are estimated in the range of $15 to $20 billion for the Base Case. Because these estimated cost savings are related to the baseline treatment and remediation systems and their scheduled implementation, most of the savings are expected to be realized from 2000 to 2030.
- Landlord activities are expected to cost $13 billion, or 6 percent of the total program estimate.
- National program planning and management activities are expected to cost $7 billion, or 3 percent of the total program estimate.
- Support costs across functional elements make up approximately 25 percent of estimated total cost until 2020. After 2020, support costs begin to make up a larger percentage of direct mission costs. By 2050, when most remedial actions are complete, support costs (for activities such as monitoring and laboratory support) account for about half of the program's estimated costs. Support costs over time are presented in Figure 8.

Comparison of Results to the 1995 Baseline Environmental Management Report

The 1996 Base Case estimate is similar to the 1995 Base Case in some respects, and quite different in other respects. The total 1995 Base Case estimate, including productivity estimates, was $237 (constant 1996 dollars). This total appears quite similar to the 1996 Base Case of $227 billion. There are important differences, however, that reflect changes in analytical methods and in the Environmental Management program as a whole.

First, the projected cost savings due to productivity improvements greatly affect the estimates. The 1995 total Base Case estimate was reduced from the sum of estimates provided by field offices ($360 billion in 1996 constant dollars) to reflect a projection of the amount of overall improvement in productivity expected. The 1996 Base Case does not include this type of alteration of cost projections provided by field offices, and, therefore, does not include an explicit productivity estimate. Instead, productivity is assumed to be included in estimates provided by field offices. The 1996 Base Case is essentially an integrated sum of estimates provided by field offices.

To reflect efforts underway to reduce costs, the Environmental Management headquarters office applied substantial improvements in productivity up through the year 2000 to the 1995 Base Case cost estimates provided by field offices. This "top down" change in cost estimates reflected a goal of achieving an approximately 20 percent increase in productivity and efficiency. Beyond the year 2000, the Department assumed a sustained productivity improvement rate of one percent compounded annually. Using these assumptions for projecting costs, the 1995 total life-cycle cost esti-

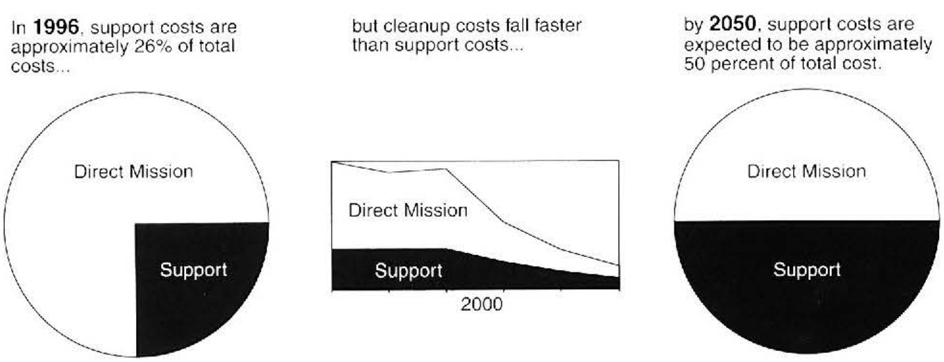

Figure 8. Support Costs Over Time for the Five Highest-Cost Sites

Productivity Improvement

A significant portion of the difference between the 1996 and 1995 cost estimates results from productivity improvements, or the broader concept of performing the program in a more intelligent way.

Figure 9 shows that sites attribute approximately 10 percent of the life-cycle cost difference from 1995 to 1996 directly to productivity improvements. In a broader sense, many other savings from the 1995 to the 1996 Baseline Report can be considered productivity improvements. These savings result from executing the same scope of work in a smarter, more efficient, and less costly manner. For example, personnel at the Oak Ridge K-25 Site have learned that a large amount of money can be saved by using rubble from decommissioning as backfill for the below-grade structure. The result: completing a similar scope of work with the same risk profile at a lower cost.

Adopting explicit productivity improvements and incorporating smarter, more efficient solutions to the problems of implementing the Environmental Management program indicate that the sites have, in effect, assimilated last year's productivity improvement goals, which changed the Base Case estimate from the $350 billion provided by site personnel to $230 billion, into the life-cycle cost estimates in the 1996 Baseline Report.

mate was $237 billion (in constant 1996 dollars). It is worthwhile to note, however, that the site cost estimates reported in Volume II of the 1995 Baseline Report did not include productivity projections, and total cumulatively to $360 billion (in 1996 dollars). If comparable "top down" changes were made to the 1996 Base Case cost estimate provided by the sites in the 1995 Base Case estimate, then an additional one percent compounded annually would be applied to the 1996 Base Case estimate of $227 billion after the year 2000. Imposing this additional productivity change to the cost estimate provided by field offices would result in a 1996 Base Case of approximately $195 billion in constant 1996 dollars.

Another difference between the 1995 and 1996 Base Case estimates is how the range of estimated costs was calculated. In the 1995 report, the range of $200-$350 was developed using different productivity assumptions. Alternatively, the 1996 cost range of $189 billion to $265 billion is based on site confidence in the cost estimates as reported.

Because total estimates submitted by the sites in 1996 ($227 billion) are directly comparable to the total estimates submitted by the sites in 1995 ($360 billion), the 1996 Base Case of $227 billion is compared to the 1995 cost estimate of $360 billion. The 1996 cost estimate is thus approximately one-third lower than the 1995 estimate.

The Benefits of a New Base Case

The 1996 Base Case analysis is significantly more useful than the 1995 analysis for several reasons, all of which result from the "bottom-up" estimating approach. First, the data are generally more reliable at a more detailed level. By moving the estimating process closer to the knowledge base in the field, the Department has built the report on a better quality data base. As a result, the analyses of state, site, and project costs are considerably more rigorous and accurate than those in the 1995 estimate.

Major Differences Between the 1995 and 1996 Estimates

- The 1996 Base Case is $133 billion (36.9 percent) lower than the 1995 Base Case.
- The duration of the 1996 Base Case is shorter than the duration of the 1995 case. Remediation at eighty percent of sites is expected to be complete by 2021 in the 1996 estimate as opposed to 2035 in the 1995 estimate.
- 1996 Base Case waste volume projections are lower than the comparable 1995 projections.
- The 1996 Base Case reflects less costly environmental management strategies (to achieve essentially the same risk reduction goal), particularly for facility decommissioning and waste management, than the 1995 Base Case.

Second, the analysis of cost estimates principally by field personnel (by contrast, approximately half of the 1995 cost estimates were developed by Headquarters personnel), has had a number of collateral benefits that should help improve program management capabilities, thereby helping to reduce costs. As a result of this process of compiling the cost estimates, the Department now has a cadre of experienced life-cycle cost analysts. Field personnel have been encouraged and empowered to define meaningful long-range assumptions and outline long-term strategies for their sites. This capability provides a better basis for integrated site planning and facilitates better communication with regulators and other stakeholders, as well as between sites and program areas.

Sites also were encouraged to develop their Base Case estimates with input from integrated project teams, to identify interdependencies between programs, and to work together to resolve conflicting assumptions. The integration effort enhanced the quality and usefulness of the final product.

1995 Versus 1996 Estimate - Reasons for Differences

Two major factors underlie the differences between the 1995 and 1996 estimates. For the 1996 report, the Environmental Management program has better knowledge of the scope of the program and a better understanding of how to achieve this scope cost-effectively. A detailed analysis indicates that more accurate information results in a different 1996 life-cycle cost estimate for four reasons: change in scope of the estimate, change in technical assumptions for addressing environmental problems, change in anticipated productivity improvements, and change in the analytical model used to estimate costs. Table 7 provides definitions and examples for each reason.

Although Table 7 presents four main categories for changes in cost estimates, there is not always a clear delineation between the categories. Some cost differences are caused solely by one factor. For example, a decrease in spent nuclear fuel disposal costs from the 1995 estimate to the 1996 estimate is due to a change in the cost estimating model – site models were used in 1996 rather than the national model used in 1995. Other cost differences cannot be classified so simply. For

Table 7. Example of Differences in the Estimates

Reason	Definition	Representative Example
Change in Scope	Change in the nature of magnitude of environmental problems being addressed.	• Since preparing cost estimates for the 1995 report, Hanford Site waste management personnel have gained a clearer understanding of the volume of waste that will be generated by the Environmental Restoration Program. This understanding translated into lower volumes in the 1996 estimate than the 1995 projections.
Change in Technical Assumptions for Addressing Environmental Problems	Change in technical approach, strategy, or schedule for addressing and environmental problem.	• In late 1995, the Department of Energy signed an agreement with the State of Idaho that accelerates the cleanup of the Idaho National Engineering Laboratory. The acceleration reduces storage and surveillance and maintenance costs that depend on the pace of the cleanup. • At Oak Ridge Reservation, the 1996 report reflects commercial management of waste. By contrast, Oak Ridge Reservation assumed government management of this waste in 1995. Oak Ridge Reservation personnel anticipate that commercial waste management will be less costly than government waste management.
Change in Anticipated Productivity Improvements	Change in amount of work that can be performed by a given input.	• The Savannah River Site is undergoing several restructuring efforts, including business re-engineering, consolidation, and fixed-price subcontracting, that are leading to productivity increases. • The Pantex Plant is increasing productivity through waste minimization efforts.
Change in Estimating Models	Use of different unit cost estimates, cost estimating algorithms, or models.	• For the 1995 report, Headquarters modeled all nuclear material and facility stabilization direct mission costs using a standard scheduling scenario. In 1996, large sites estimated these costs based upon realistic scenarios.

example, success in waste minimization can be described as both a reduction in scope and an improvement in productivity.

The scope of the estimate is smaller (i.e., fewer activities to be estimated) in the 1996 estimate than in 1995. Technical assumptions for addressing environmental problems have changed from 1995 to 1996. In general, the 1996 estimate reflects less costly technical approaches to facility decommissioning and waste management.

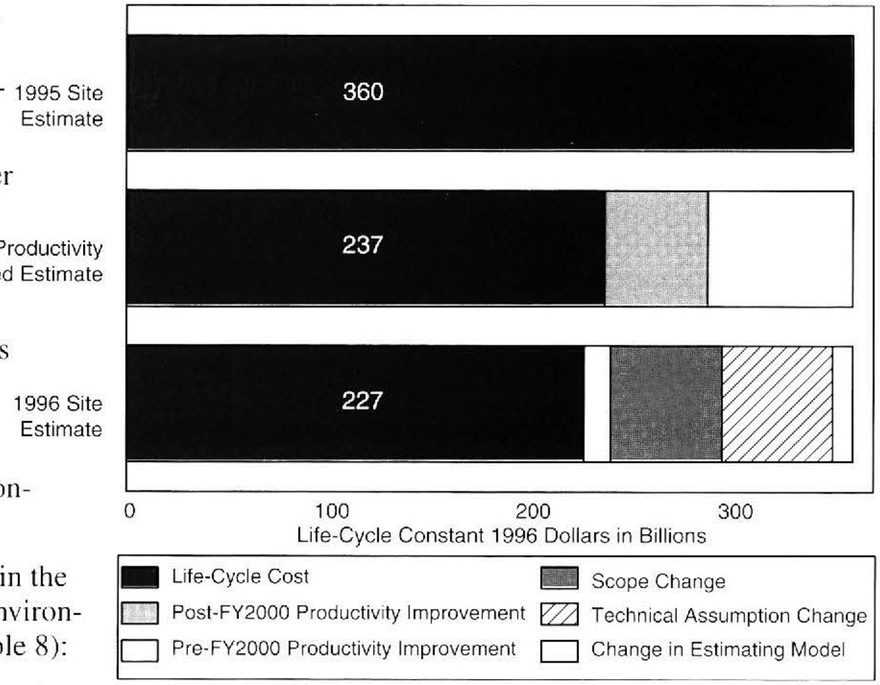

Figure 9. Comparison of 1995 and 1996 Baseline Report Cost Estimates

The majority of the cost reduction in the 1996 report occurs in five major Environmental Management activities (Table 8):

- Facility decommissioning cost estimates dropped primarily due to a change in technical approach. In the 1996 report, site plans reflect a better understanding of the scope of decontamination activities required prior to facility demolition.
- To treat and store low-level, low-level mixed, and transuranic waste, sites assume the use of less costly commercial waste management facilities rather than more costly government facilities. Sites also plan to reuse existing government facilities instead of building new ones. Other cost reduction factors include better estimates of waste volume and more aggressive waste minimization and recycling efforts.

Table 8. Overview of Activities with Large Reductions in Cost Estimates from 1995 to 1996

Activity Area	1995 Estimate	1996 Estimate	Difference	Primary Driver
Facility Decommissioning	$47.2 billion	$18.2 billion	$29.0 billion (63 percent)	• Sites plan to perform less decontamination before demolition because of a better understanding of the scope of decontamination that is necessary before facility demolition.
Low-Level Waste, Low-Level Mixed Waste, and Transuranic Waste Treatment and Disposal	$54.9 billion	$32.0 billion	$22.9 billion (42 percent)	• Sites plan to use less costly commercial waste management facilities rather than more costly government facilities. Sites also plan to reuse existing government facilities instead of building new ones. • Better waste volume estimates and aggressive waste minimization and recycling efforts.
Spent Nuclear Fuel Disposal	$11.8 billion	$4.1 billion	$7.7 billion (65 percent)	• Acceleration of spent nuclear fuel disposal at a national geologic repository and use of better estimation models.
Remedial Activities	$24.4 billion	$17.5 billion	$6.9 billion (28 percent)	• New agreements with regulators and more accurate predictions of the results of future agreements.
Program Management and Other Support Activities	$87.2 billion	$57.2 billion	$30.0 billion (34 percent)	• Support and program management cost estimates are lower because less management and support is necessary for mission activities.

- Sites plan to accelerate spent nuclear fuel disposal at a national geologic repository. A reduction in cost also stems from the use of better methods to estimate disposal costs.
- Some sites have reduced required the scope of remedial activities based on the results of recent negotiations with regulators. These estimates also reflect more insight to the potential results of future agreements.
- Program management and other support cost estimates are lower because the estimates for direct mission activities are lower.

Although cost estimates generally are lower in 1996 than in 1995, life-cycle estimates for several Environmental Management activities did not change significantly. These include high-level waste management, surveillance and maintenance of facilities, and support/landlord activities for the nuclear material and facility stabilization program. Note that the 1995 estimates have been inflated to constant 1996 dollars for this comparison.

Differences By Site

Almost all of the $133 billion reduction in estimated costs from the 1995 Baseline Report occurs at the five highest-cost sites (Figure 10).

- At the Hanford site, the estimate for waste management support costs dropped from $15 billion in the 1995 report to $7 billion in 1996. This reflects the overall lower estimates for direct mission costs in the 1996 estimate. Also, low-level and low-level mixed waste management cost estimates dropped from $10 billion in the 1995 report to $3 billion in 1996 due to lower expected waste volumes.
- At the Idaho National Engineering Laboratory, a change in schedule accounts for the major difference between the 1995 and 1996 estimates. An agreement signed by the Department of Energy and the State of Idaho requires the Department to remove all spent nuclear fuel from the state by 2035 (15 years earlier than previously planned); to prepare all high-level waste for disposal by 2035 (15 years earlier than previous estimates); and to begin transuranic waste shipments to the Waste Isolation Pilot Plant in 1999.
- At the Oak Ridge Reservation, the majority of the cost difference ($14 billion) is due to changes in the technical approach for waste management and decommissioning. The 1996 report emphasizes commercial rather than government treatment and disposal, a less costly strategy. The decrease in decommissioning estimates reflects a change in decom-

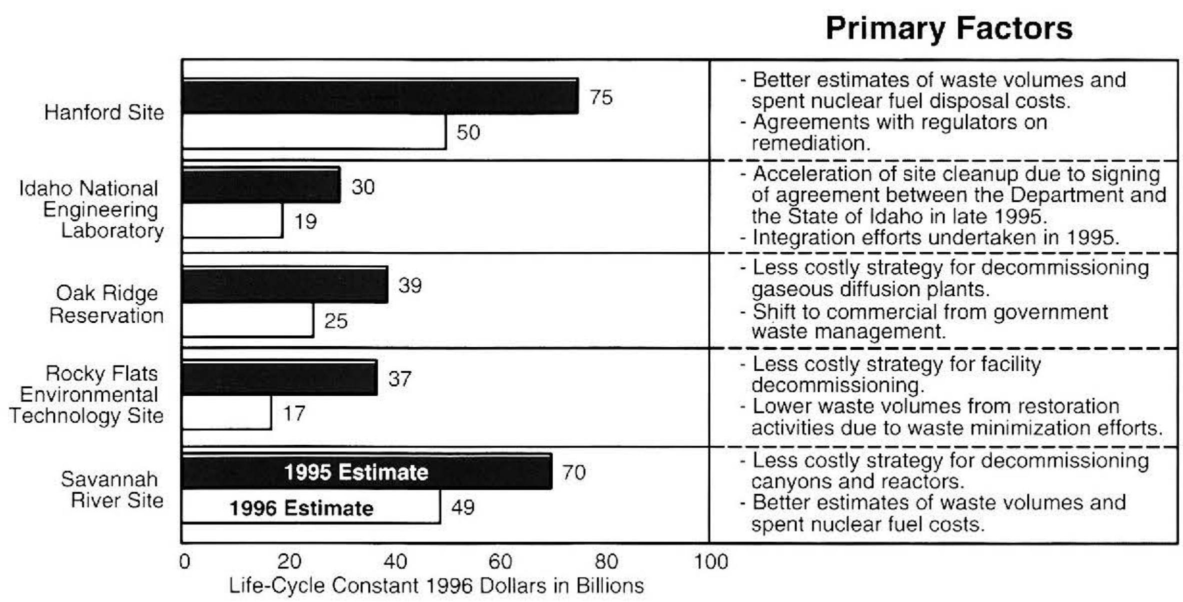

Figure 10. Comparison of the 1995 and 1996 Cost Estimates for the Five Highest-Cost Sites

missioning strategies for the gaseous diffusion plants.

- At the Rocky Flats Environmental Technology Site, facility decommissioning cost estimates dropped from $11 billion in 1995 to $4 billion in 1996 due to a decrease in the amount of decontamination activities anticipated to be performed prior to demolition. Low-level and low-level mixed waste management cost estimates decreased from $5.5 billion to $1.2 billion reflecting a reduction in expected waste volumes and a shift from offsite disposal strategy to a mixture of onsite and offsite disposal.
- At the Savannah River Site, the facility decommissioning cost estimate dropped from $12 billion in 1995 to $7 billion in 1996 primarily due to the assumption of a less costly technical approach to decommissioning reactors and canyons. In addition, support cost estimates for waste management and nuclear material and facility stabilization activities dropped from $20 billion in 1995 to $10 billion in 1996 because the 1996 estimate reflects a smaller program and fewer direct mission costs.

Alternative Scenarios

A number of significant assumptions underlie the Base Case estimate. Varying these assumptions can often influence the overall life-cycle cost estimate. To help inform national policymaking and local decisionmaking processes, the 1996 Baseline Report provides a more rigorous analysis of alternative program scenarios. By changing certain key assumptions we are able to examine the influence of each factor on the life-cycle cost and schedule of the Environmental Management program. The analyses varied assumptions regarding the following three factors expected to influence program costs:

- **Land Use** – What effect do future land-use decisions have on the overall scope, cost, and schedule of cleanup for Environmental Management sites? What factors limit consideration of land uses?
- **Program and Project Scheduling** – What are the cost consequences of delaying and accelerating programs and projects? What is the relationship between program pace, schedule, funding levels, and total life-cycle cost?
- **A "Minimal Action" Scenario** – What is the minimum funding required for preventing risks to human health and the environment from increasing for 75 years without the constraints of current legal requirements?

The approach for estimating life-cycle costs for the alternative scenarios mirrors the basic methodology employed for the Base Case estimate. Site estimates and assumptions provided the basis for these analyses. The land-use analysis varies from the Base Case in that the analysis assumes different end states suitable for various uses, and measures the cost and waste volume consequences of cleaning up to these alternative end states. The program and project scheduling analysis assumes the same actions and subsequent end states for programs and projects as described in the Base Case, but applies funding and scheduling constraints to better analyze the cost consequences of accelerating or delaying programs and projects. The minimal action scenario uses methods developed by site personnel to re-scope projects and activities to meet a set of minimal action assumptions. Therefore, the minimal action case diverges dramatically from the Base Case. No scenario examines the impact of changing existing regulatory requirements.

The three alternative scenario analyses focus on the five sites in the Environmental Management program estimated to have the highest life-cycle costs - Hanford Site, Washington; Idaho National Engineering Laboratory, Idaho; Oak Ridge Reservation, Tennessee; Rocky Flats Environmental Technology Site, Colorado; and, Savannah River Site, South Carolina. Together, these sites account for approximately 70 percent of the Environmental Management total program cost estimate.

Land Use

One of the primary difficulties in estimating the total cost of the Environmental Management program is that future land use (e.g., the ultimate disposition of lands currently managed by the Department) generally has not been determined. Until the future land uses are decided there is a considerable amount of uncertainty regarding the degree of cleanup required and the resulting program cost.

The land-use analysis in the 1995 Baseline Report indicated that decisions affecting future land use could affect total program cost by billions of dollars. It was a broad analysis, without site-specific data. The analysis in the 1996 report provides site-specific data and focuses more narrowly on how land-use decisions may affect environmental restoration activities and associated waste management costs. The analysis also quantifies the amount of land achieving various uses under a set of alternative assumptions. The 1996 analysis also considers real-world constraints on the future uses that can be achieved. Such constraints include ongoing program missions, legal commitments, the presence of unique or sensitive ecological systems, and the limits of current technology.

Using the underlying land-use assumptions in the Base Case as the point of reference, this analysis examines the effect of the following five alternative land-use scenarios on the estimated life-cycle costs of the Environmental Management program: Maximum Feasible Green Fields, Modified Green Fields, Recreational, Industrial, and Iron Fence.

These five scenarios were chosen to represent varying land-use outcomes (and differing levels of cleanup). The "Maximum Feasible Green Fields" and "Iron Fence" scenarios were chosen to represent the two endpoints of the land-use continuum reasonably attained at the five highest-cost sites. The "Recreational" scenario represents an intermediate land-use end state without access restrictions, while the "Industrial" scenario represents an intermediate land-use end state with access restrictions. The "Modified Green Fields" represents a special scenario that illustrates how an aggressive clean up strategy might be tempered

Table 9. Land-Use Case Assumptions

Land-Use Scenario	Land-Use Category	Assumption	Life-Cycle Cost Estimate (Constant 1996 Dollars In Billions)	Change from Base Case
Maximum Feasible Green Fields	Residential or Agricultural	• Aggressive cleanup goals to support residential and agricultural uses • Ignore most site-specific constraints • Removal of all contaminated media or materials	$284	77%
Modified Green Fields	Residential or Agricultural	• Aggressive cleanup goals to support residential and agricultural uses • Consider all site-specific constraints • Combine removal and containment strategies	$166	6%
Recreational	Recreational	• Contaminated areas remediated to support recreational uses • Consider all site-specific constraints • Combine removal and containment remediation strategies	$162	1%
Industrial	Industrial	• Contaminated areas remediated to support recreational uses • Consider all site-specific constraints • Emphasize containment rather than removal strategies	$155	(3)%
Iron Fence	Disposal/ Storage Area	• Contaminated areas remediated to support disposal/storage land uses (i.e., controlled access) • Consider all site-specific constraints • Containment and monitoring of all contaminated media or material (unless removal was less expensive)	$150	(6)%

> ### *Scenarios Are Not Decisions*
> Scenario analyses attempt to identify a set of possible futures, each of which is plausible, but not assured. These analyses are intended to foster and help inform local and national debate regarding potential policy strategies for the Environmental Management program. Each scenario provides an explicit framework for further discussion and reaction. The analyses were developed using assumptions that are hypothetical in nature, assumptions that do not reflect plans or proposals by the Department of Energy or the Environmental Management program.

when considering continued Department of Energy missions at these five large sites.

Each of the three scenarios is a combination of three variables that significantly impact environmental restoration activities: (1) level of existing contamination, (2) future use assumption, and (3) site-specific constraints. Future use assumptions (goals) determine the types of activities that are assumed to occur in the future, the possible pathways of exposure, and the type and extent of environmental restoration activities that may be required. Site-specific constraints place limits on the land-use goals such as: technology limitations, unacceptable risks to remediation workers, ongoing Department of Energy activities, legal commitments, and ecological sensitivity. The level of existing contamination and the remedial action required to meet a specific land-use goal further affects environmental restoration activities. In most cases some remedial action will be required, even to meet disposal/storage area standards. In some areas, however, existing contamination is sufficiently low that remedial action may be required under some future use assumptions (e.g., Residential) but not others (e.g., Open Space). The estimated cost is based on performing enough clean up to allow for the intended land use, but no more. As a consequence, the postulated remedy for a plot of contaminated soil might be *containment* (capping) under the Iron Fence, Industrial, and Recreational scenarios but *removal* under the two Green Fields scenarios. For areas with site-specific constraints, the Base Case remedial strategy was generally left unchanged across all scenarios. The only exception was the Maximum Feasible Green Fields scenario, in which all site-specific constraints were lifted except for technology constraints, and certain waste disposal areas at the Hanford Site, Idaho National Engineering Laboratory, and the Savannah River Site. Table 9 summarizes the assumptions and life-cycle cost estimates for each of the land-use scenarios.

Estimated costs for the Environmental Management program at the five highest-cost sites range from $150 billion for the Iron Fence scenario to $284 billion for the Maximum Feasible Green Fields scenario (Figure 11). These estimated costs are respectively 6 percent lower and 77 percent greater than the Base Case estimate of $160

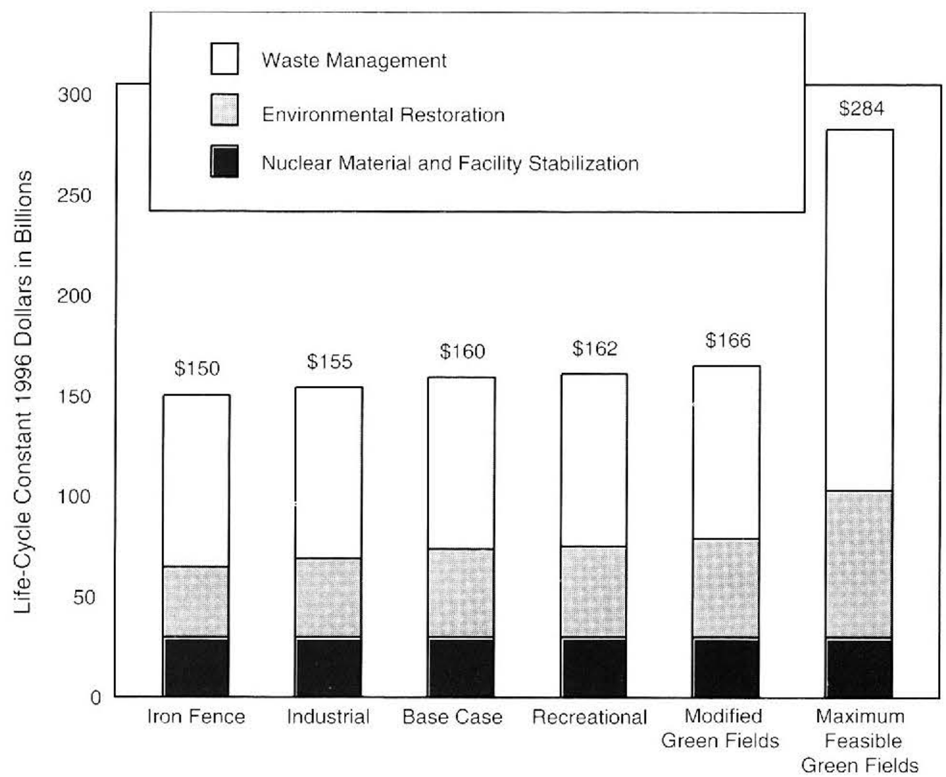

Figure 11. Cost by Land-Use Scenario

billion for these five sites. When site-specific constraints are considered (i.e., Iron Fence through Modified Green Fields), there is little difference in estimated cost among the alternative scenarios. The estimate for the Modified Green Fields scenario ($166 billion) is only 10 percent greater than the estimate for the Iron Fence scenario and 6 percent greater than the Base Case estimate. The Base Case estimate falls between that of the Industrial scenario ($155 billion) and the Recreational scenario ($162 billion). It is important to remember that these are generalized findings, and that actual land use will likely vary significantly among different sites.

The land-use analysis shows that the effect of land-use decisions, after considering site-specific constraints, is relatively narrow. This result is vividly illustrated when one compares the Maximum Feasible Green Fields to the Modified Green Fields scenario. Both scenarios employ the same aggressive clean up standards, but yet yield dramatically different results. The reason is that consideration of the constraints outside of technological limitations yields an additional 141,000 hectares (350,000 acres) of Residential and Agricultural use at an increased cost of approximately $118 billion. This difference in results leads to the conclusion that site-specific considerations are of critical importance in land-use planning.

Many of the site-specific constraints examined in this analysis stem from federal and local policies or priorities. For example, legal commitments and local regulations limit future use options for approximately 295,000 hectares (730,000 acres) (63 percent) of the uncontaminated land at the five highest-cost sites. In addition, the presence of endangered species and ecologically unique habitats may limit future use of approximately 57,000 hectares (140,000 acres) (12 percent) of uncontaminated land and some contaminated land at these sites. It will be necessary to consider these constraints, along with stakeholder and regulator preferences, in order to make ultimate decisions regarding future use. Near-term resolution of these issues is important, because the decisionmaking processes that govern environmental restoration activities will continue in the absence of coherent integrated site planning. Land-use options may become limited after deployment of certain remedial strategies, or remedies designed to meet residential standards may be applied inappropriately, resulting in higher than necessary costs.

The siting of disposal/storage areas and continuing Department missions have implications beyond the land directly around these structures. The implications of these future missions on land-use alternatives underscores the importance of clarifying overall Department goals and developing integrated, complex-wide, multimission facilities plans.

Technological challenges relating to ground water and surface water will continue to limit land-use alternatives in the near term. Information relating to technological limits and costs of aggressive remediation strategies should be integral to all decisionmaking activities regarding land use and remedial strategies.

Program and Project Scheduling

Many observers have speculated that the pacing of the Environmental Management program has a significant impact on life-cycle cost. In very simple terms, there is an expectation that costs will increase if the program is extended and decrease if cleanup activities are completed more rapidly. Given the scale of Environmental Management projects, their cost, and the long-term commitment required, it is important to fully understand the relationship between cost and schedule. A clear understanding of how these two factors interact provides a basis for effective long-term planning and greater integration of the component activities of the program.

The Department developed three alternative scheduling scenarios for the analysis. (Note: all scenarios were developed independent of compliance agreements and potential fines and penalties.) Two of these scenarios are highlighted.

Funding Reduction – The current Base Case projects that annual funding requirements will increase to $7.5 billion in FY 2000. The National Defense Authorization Act, which mandates the Baseline Report, requires the Department to provide a cost estimate associated with complying with existing compliance agreements regardless of budget targets. Because the Base Case cost estimate clearly exceeds expected funding availability, it is prudent to analyze the long-term impacts of reduced funding using a scenario that constrains the overall program spending. This is exactly what is analyzed through the Funding Reduction case, which constrains the Environmental Management program's annual budget to $4.9 billion ($5.5 billion for FY 2000 when converted into constant 1996 dollars). The results of this analysis are shown in Figure 12 and indicate:

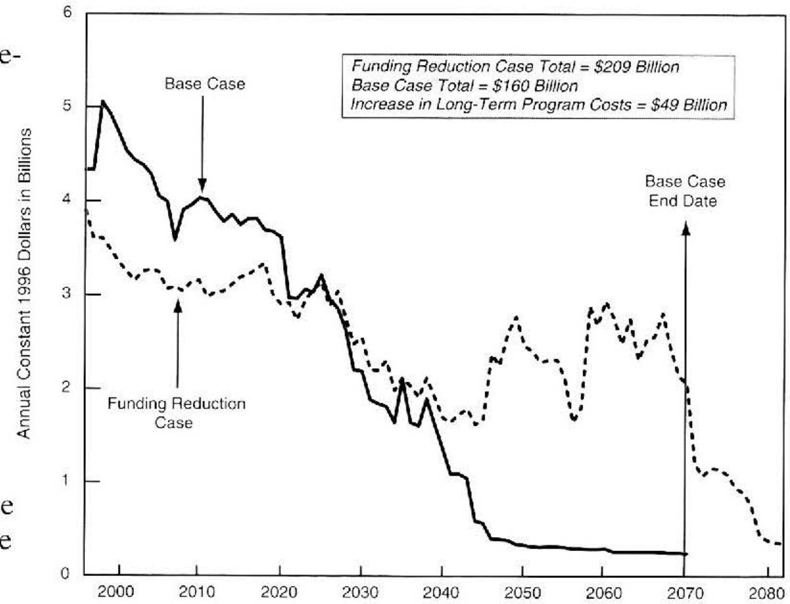

Figure 12. Annual Comparisons of the Funding Reduction for the Five Highest-Cost Sites

- There is a $49 billion increase in life-cycle cost largely due to increased pretreatment storage for high-level waste, increased surveillance and maintenance for plutonium storage buildings and chemical separations facilities, and support costs. Support costs account for roughly half of the life-cycle cost increase.
- Support costs do not decrease proportionately as the Environmental Management budget is reduced. Many support activities such as safeguards and security cannot be reduced below a certain minimum as long as any amount of special nuclear material is present at a facility. Consequently, reduced funding, combined with relatively constant support costs, result in fewer resources available for cleanup activities. In the Funding Reduction scenario, cleanup activities are delayed, thereby stretching out the duration of the Environmental Management program about 20 years.

Delaying Waste Disposal – Base Case costs are based on the availability, beginning in 2016, of a national geologic repository for high-level waste. This scenario analyzes the impact of a 30-year delay in disposal at this repository on the life-cycle costs of the Environmental Management program.

The results of this scenario:

- A 30-year delay increases total life-cycle costs by about one percent ($1 billion).
- The increase in total life-cycle cost above the Base Case is due to longer durations in waste storage and support cost durations.

Figure 13 provides life-cycle cost comparisons of the Base Case and two alternative scheduling scenarios.

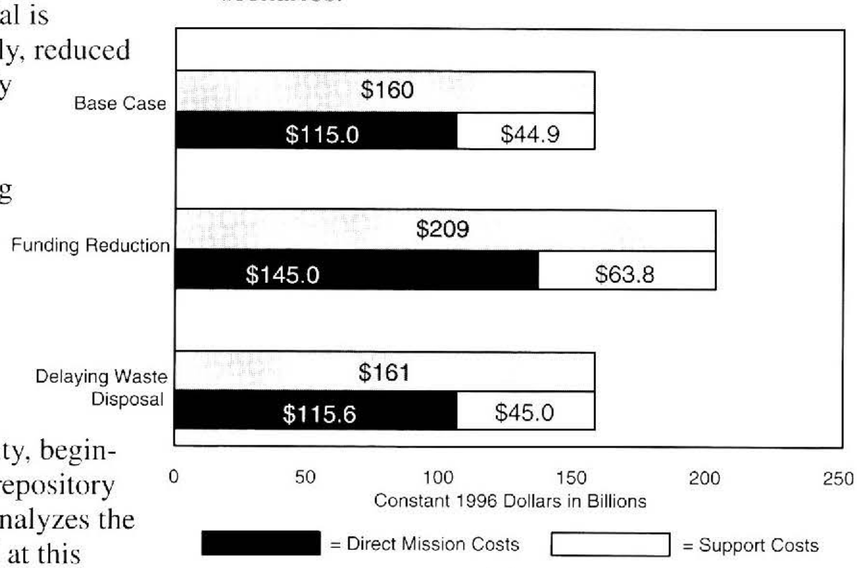

Figure 13. Comparison of Alternative Scheduling Scenarios Life-Cycle Cost Estimates for the Five Highest-Cost Sites

Note: The costs incurred by a delay in waste shipments to a repository for this analysis represent only those direct costs to the Environmental Management program. This analysis does not account for any costs incurred by the Department's Civilian Radioactive Waste Management program. The results of this analysis are not to be applied to the commercial nuclear industry or to costs associated with the disposal of commercial nuclear waste.

A "Minimal Action" Scenario

The current budget deficit and the growing need to reassess national priorities lead to a controversial yet pragmatic question: What is the minimum funding required for maintaining the Environmental Management program without jeopardizing human health or the environment and without the constraints of current environmental regulations and compliance agreements? The interest in this "minimal action" scenario is driven by a number of diverse perspectives on the program. Some observers, especially supporters of the current program, have speculated that the cost of a minimal action scenario is not significantly different from current program expenditures (especially in the short term). This view is based on the fact that a large amount of funding currently is required simply for the program to serve as the landlord at Environmental Management sites and to monitor the storage of highly radioactive waste and special nuclear materials. Other observers, especially critics of the current regulatory system, believe that current requirements can be relaxed, generating a substantial cost savings without negative human health and environmental consequences. Finally, policymakers express interest in this minimal action case because it provides a lower boundary for the range of alternatives available to the program. With this information in hand, policymakers and stakeholders can better understand what tasks are truly necessary for short- and long-term risk and cost reduction.

The Minimal Action scenario examines the costs necessary for preventing human health and environmental risks from increasing from current levels to workers and offsite individuals, and minimizing costs during a period comparable to the Base Case period (i.e., 75 years). Costs devoted solely to meeting compliance agreements and regulatory requirements were not included.

Personnel at each site developed a site-specific minimal action scenario. Using the 1996 Base Case data as a foundation, each site developed site-specific assumptions and 75-year cost estimates. From the Base Case, site personnel modified their project and activity schedules and assumed scopes of work based on minimal action assumptions. Table 10 depicts these minimal action assumptions.

After identifying the projects and activities that would fulfill this minimal action case, each site

Table 10. Cross-Site Assumptions for Minimal Action Scenario

Waste Type/ Program Area	Base Case Assumption	Minimal Action Case Assumption
High-Level Waste	To be disposed of in a geologic repository.	Onsite storage. Differing treatment and stabilization practices across sites.
Spent Nuclear Fuel	To be disposed of in a geologic repository.	Onsite storage in concrete or stainless steel "dry storage" casks.
Low-Level, Low-Level Mixed, and Transuranic Waste	Some treatment of low-level and low-level mixed waste; dispose of offsite. Treat transuranic waste and ship to Waste Isolation Pilot Plant.	Storage and disposal onsite with minimal treatment.
Environmental Restoration	Remediate (clean up) all areas required by environmental regulations/compliance agreements. Buildings will be demolished.	Remediate only areas with urgent environmental or human risk implications. Buildings will remain in place.
Nuclear Material and Facility Stabilization	Nuclear materials stabilized. Deactivation activities to minimize surveillance and maintenance.	Same as Base Case.
Support	All costs to support mission activities.	Re-estimation based on minimal action activities. Support activities extended through 2070 at all sites.

evaluated cost differences through 2070, described the resulting situation in 2070, and analyzed what additional costs and risks might be incurred beyond 2070.

The results of this analysis indicate that:

- Costs during the 75-year Minimal Action period would be more than 40 percent less than the Base Case.
- Eliminating most environmental restoration activities reduces estimated environmental restoration costs by 70 percent.
- Minimum onsite treatment and disposal of low-level, low-level mixed, and transuranic waste reduces the cost estimate by 54 percent for those waste types.
- Eliminating offsite shipping and disposal activities at the Hanford Site, Idaho National Engineering Laboratory, and the Savannah River Site reduce high-level waste cost estimates by 43 percent.
- Although estimated costs *during* the 75-year period decrease by more than 40 percent, estimated costs for these activities *after* the 75-year period are significantly higher than the Base Case.

The general cost differences under this scenario analysis compared to the 75-year Base Case cost estimate are presented in Figure 14 (total costs) and Figure 15 (cost by functional area).

The difference in the estimated costs between the Base Case and the Minimal Action case reflects the costs of buying very different "end states" at the end of the 75-year period. Unlike most situations in the Base Case, the Minimal Action case leaves waste inventories onsite. This requires not only continual surveillance and monitoring activities, but also increases long-term risk of contamination to onsite and offsite receptors. Under the Minimal Action case, buildings left standing require long-term surveillance and monitoring, which may pose a potential risk to workers as these facilities continue to deteriorate. Therefore, reducing costs during the Minimal Action period may actually produce greater costs beyond 2070.

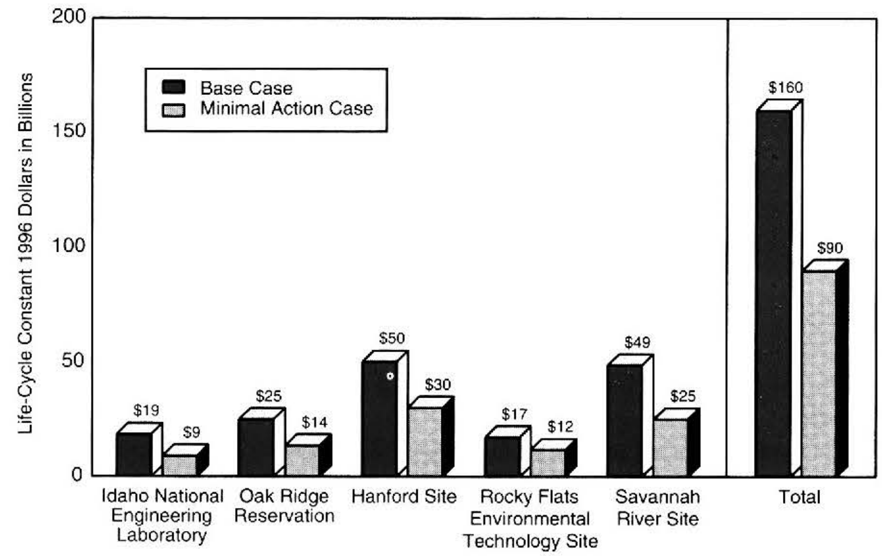

Figure 14. Base Case and Minimal Action Case 75-Year Cost Estimate for the Five Highest-Cost Sites

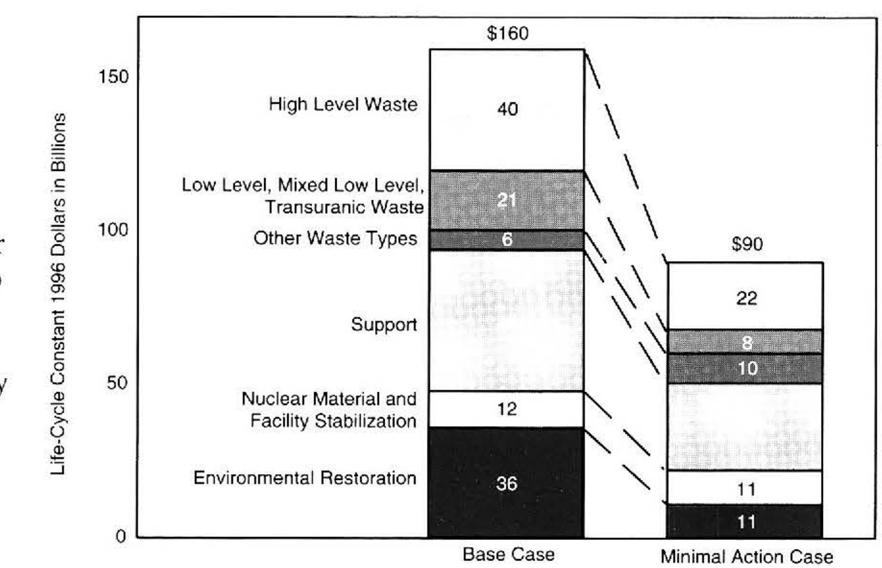

Figure 15. 75-Year Cost Estimate by Functional Area for the Five Highest-Cost Sites

In addition to analyzing a lower cost end state, the Minimal Action case suggests a third alternative scenario: any savings gained from a minimal action case approach could be used to develop and use new technologies to address any post-life cycle remediation activities or other end-state risks. Under this strategy, a comparable end state might be achieved with new technologies developed using savings that result from initially focusing activities on risks to workers, offsite populations, and mortgage cost reduction. Increased funding of new technologies also could be directed at long-term waste storage and disposal strategies, which could alleviate the need for sites to continue repackaging stored waste.

Comparison of Alternative Cases

Because the Environmental Management program is only seven years into a projected life cycle period that could span over 75 years, decisions yet to be made may dramatically change the direction of the program. The results of the alternative cases provide an understanding of how changes in scope and schedule can influence program costs and end states – a first step toward assessing program options.

To accurately compare these alternative cases to the Base Case, all cost estimates are presented for the 75-year Base Case life-cycle period (1996-2070). In three of the alternative cases (Maximum Feasible Green Fields, Funding Reduction, and Minimal Action), the change in scope and schedule require the program to extend beyond 2070. Both the Maximum Feasible Green Fields case and the Funding Reduction case estimate the program to complete around 2080. In the Minimal Action case, the length of time required to complete the program was not determined but is assumed to continue past 2070 for purposes of comparison to the Base Case.

The 75-year cost estimates of the Base Case and alternative cases for the five highest-cost sites range from less than $90 billion (Minimal Action) to more than $272 billion (Modified Feasible Green Fields). Figure 16 shows the range of 75-year cost estimates for each of the nine alternative cases and the Base Case.

Each alternative scenario has cost and benefit implications, as Table 11 illustrates. Through an evaluation of these alternative cases, Department of Energy personnel, regulators, and other stakeholders can better understand the potential implications of various policy options and thus participate more effectively in the policymaking and decisionmaking processes.

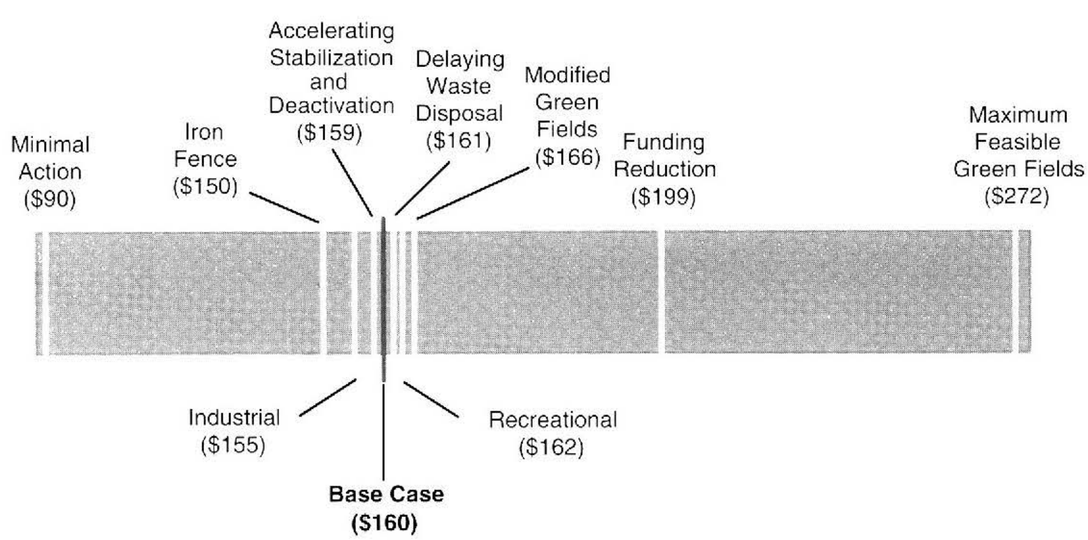

Figure 16. 75-Year Cost Estimate for the Five Highest-Cost Sites (Constant 1996 Dollars in Billions)

Table 11. Benefits and Losses of the Alternative Cases

Alternative (75-Year Cost Difference from Base Case)		Benefits	Losses
Land Use	**Iron Fence** (-$10 billion)	• Less cost over period of analysis • Maintains minimum protection of public and site workers	• More land retained as controlled access for waste disposal
	Industrial (-$5 billion)		• Reduces potential Recreational and Residential use of land outside controlled areas
	Recreational (+$2 billion)	• Similar cost over period of analysis • Increase in land clean enough for Recreational uses	• Reduces potential Residential use of land outside controlled areas
	Modified Green Fields (+$6 billion)	• Land clean enough to support Residential and Agricultural uses • Maintain potential for continued federal activities with reuse of site facilities	• More expensive over period of analysis
	Maximum Feasible Green Fields (+$112 billion)	• Land clean enough to support Residential and Agricultural uses • All land at Rocky Flats and Oak Ridge is cleaned to residential use standards. • Minimal long-term surveillance and monitoring • Activities exceed compliance and regulatory requirements	• Significantly more expensive over period of analysis • Extensive cleanup activities may damage sensitive habitat • Reduces potential for reuse of site facilities • Program duration exceeds Base Case
Scheduling	**Accelerating Stabilization & Deactivation** (-$1 billion)	• Similar cost over period of analysis • Complete high-mortgage projects faster	• Requires additional resources for Nuclear Material and Facility Stabilization program in early years
	Delaying Waste Disposal (+$1 billion	• Similar cost over period of analysis • Little future risk as cleanup is complete	• Additional funding required for Waste Management program • Violates compliance agreements
	Funding Reduction (+$39 billion)	• Less cost in early years	• More expensive over period of analysis • Program duration exceeds Base Case • Violates compliance agreements • Limits flexibility to accomplish efficient scheduling
Minimal Action (-$70 billion)		• Less cost over period of analysis	• Program duration exceeds Base Case • Violates compliance agreements and regulatory requirements • Increase risk after period of analysis • Delays cleanup problems and includes the scope of contamination

Conclusion

Like all recently formed organizations, the Environmental Management program spent the first several years of its life building a foundation: defining its mission, gauging its scope, identifying key issues and priorities, and assembling an infrastructure to support successful planning and management. Since 1989, the program has introduced many planning initiatives focused on gathering programmatic data and providing a basis for strategic planning and program analysis. However, most of these initiatives failed to evaluate the Environmental Management program from a life-cycle perspective.

The program has matured in seven years. The Department has now identified the program's basic scope and where the greatest risks lie. In addition, the baseline process has established a capability for projecting future costs and schedules, analyzing changes in assumptions and potential scenarios, and accounting for the interconnections between distinct sites and programs. This analytical foundation for sound program management is summarized in the 1996 Baseline Report. Using the foundation provided by the Baseline Report, program managers and policy makers can make more informed decisions regarding the direction of the Environmental Management program and of the programs that affect the Environmental Management program.

The purpose of the Baseline Report is to articulate clearly two elements of the Department of Energy's Environmental Management program: projected life-cycle costs and schedules. The report describes the program, with Base Case results, from a variety of perspectives. Because of the uncertainties inherent in estimating environmental management costs and schedules, the overall results are presented with a cost range rather than a single figure. The program's overall life-cycle cost is based on Base Case estimates developed by site personnel for the mid-range estimate, with upper and lower bounds. This range spans from $189 to $265 billion.

The Environmental Management program now has improved information available to analyze policy decisions and set a future course. The program is in a critical transition period; it faces near- and midterm decisions that will have important long-term ramifications. Some of these decisions can be made now and adjusted later (if new information calls for a different course); others will require long-term commitment to a specific path.

An important conclusion of the Baseline Report is that changes to the scope and schedule of the program can significantly affect Base Case costs. By understanding the impacts of various policy decisions, decisionmakers and stakeholders can direct the program in a manner that minimizes life-cycle costs, reduces program schedules, optimizes program end states, and achieves maximum reduction of risks. However, a great deal remains to be done to ensure that issues highlighted in this Baseline Report are framed effectively; data and methodologies supporting subsequent analyses are continually improved; and interested stakeholders have a voice in the debate. Specific steps include the following:

- **Improve Life-Cycle Cost and Schedule Estimates:** The 1996 Baseline Report is the program's second attempt to develop a comprehensive life-cycle cost estimate. This report improves upon the estimates and analyses developed last year based on a better methodology (that is, a bottom-up approach that emphasizes estimates developed by field personnel); better information in areas such as program scope and outyear costs; and improved integration across programs and sites. Because the program is constantly changing, however, these estimates will need to be adjusted and improved. In addition, the program must continue to address uncertainties and information gaps with ongoing data gathering and refined methodologies.
- **Use the Baseline Report to Address Ongoing Issues, Analyze Program Options, Provide Input to Strategic Decisions, and Develop Ties to Program Budgets:** The analyses included in the 1996 Baseline Report are examples of what can be done with baseline informati n and site input. Other alternative scenario analyses would also benefit the program (for example, impacts of various regulatory changes, effects of increased

privatization, effects of greater waste minimization). These analyses can be used to help inform strategic planning decisions, better focus the program's near-term planning and budgeting, and support legislative and regulatory reform.

- **Promote Informed, Broad-based Citizen Involvement in the Debate on the Program's Future:** One of the "next steps" included in the 1995 Baseline Report was to include more stakeholders in the debate and actively seek citizen's views (in subsequent Baseline Report cost estimates). The 1996 Baseline Report achieved the goal of greater stakeholder participation. However, the task of using the information to cultivate more informed debate on the program's future still lies ahead.

Contents

The 1996 Baseline Report consists of three volumes: Volume I – *The 1996 Baseline Environmental Management Report*, and Volumes II and III – *Site Summaries for the 1996 Baseline Environmental Management Report.*

Volume I

Introduction (Chapter 1) outlines the framework of the report by providing a background on the scope and technical complexity of the environmental management program, a description of alternative analyses performed, and an overview of the contents of the Baseline Report.

The Environmental Management Program (Chapter 2) describes the mission and scope for each of the six major functional elements that are encompassed in the Environmental Management program: Environmental Restoration; Waste Management, Nuclear Material and Facility Stabilization; Science and Technology Development; Landlord; and National Program Planning and Management.

What is the Base Case? (Chapter 3) outlines the methodology and key assumptions used to develop the Base Case long-range projections of activities, schedules, and associated costs.

Results (Chapter 4) summarizes the projected life-cycle costs for the Environmental Management program including discussion on the range of estimates, distribution of cost estimates by geographical area, and distribution of cost estimates by functional area.

Comparison of Results to the 1995 Baseline Environmental Management Report (Chapter 5) describes the differences between the 1996 Baseline Report and the 1995 Baseline Report in terms of methodology and assumptions, including highlights of changes at the five highest-cost sites.

Alternative Scenarios (Chapter 6) and **Comparison of Alternative Cases** (Chapter 7) present and evaluate the findings of nine alternative approaches (five land-use cases, three program and project scheduling cases, and one minimal action case) to the Environmental Management program.

Conclusion (Chapter 8) discusses how the Baseline Report can serve as a tool for program decisions and how the report can continue to be improved in the future.

Volumes II and III: Site Summaries

Volumes II and III present the site data and assumptions used to develop the 1996 Baseline Environmental Management Report. Each site summary provides a brief discussion of the site's past, current, and future missions and is followed by discussions of the projects and activities necessary to manage and remediate the site. Volume II covers Alaska through New Jersey and Volume III covers New Mexico through Wyoming.

This executive summary provides a brief, nontechnical overview of the report, which is available in Department of Energy reading rooms and the Center for Environmental Management Information (1-800-736-3282).