CLEAN SITES
INDEPENDENT REVIEW
OF THE

DEPARTMENT OF DEFENSE
ENVIRONMENTAL RESTORATION PROGRAM

REPORT FOR THE DEPUTY UNDERSECRETARY OF DEFENSE (ENVIRONMENTAL SECURITY)

PROGRAM PERFORMANCE REPORT

JUNE 30, 1996

Acknowledgments

We would like to thank the individuals listed below who served on the Clean Sites Advisory Panel for this study and generously provided suggestions, guidance, comments, and reactions to this work. Clean Sites, however, is solely responsible for the report's findings, conclusions, and recommendations.

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Contents

Introduction 1

Program Progress 4
- Preliminary Assessments 8
- Site Inspections 9
- Remedial Investigations/Feasibility Studies 10
- Remedial Design 11
- Remedial Actions 12
- Individual Installations 14
- Non-Linear Site Model 15
- Pipeline Models 17
- Effect of NPL Listing 20
- Conclusions and Recommendations 24

- Appendix: DOD Site Catagories 28

Program Comparisons 31
- Pipeline Comparisons 32
- Speed of Cleanup 36
- Conclusions 38

- Appendix: CERCLIS Listing of DOD Sites 40

Obligation And Outlay Rates 52
- The Defense Environmental Restoration Accounts 53
- The Base Realignment and Closure Accounts 55
- Analysis 56
- Conclusions 62
- Recommendations 63

Relative Risk Reduction 66
- Introduction 68
- The RRSE Framework 70
- Analysis 79
- Comparisons With Other Agencies 80
- Conclusions 79
- Recommendations 82

Conclusions 85

Introduction

During the past several years, the Department of Defense has undertaken a commitment to improve management of the Defense Environmental Restoration Program (DERP). In the spirit of that commitment, Sherri W. Goodman, Deputy Under Secretary of Defense (Environmental Security) asked Clean Sites to perform an independent review of DOD's management of the program to evaluate: 1) how well the Department is progressing in cleaning up sites, 2) how the Department's program compares with similar programs managed by other government agencies and private companies, and 3) how the Department might modify its program to increase its efficiency.

For decades, Department of Defense (DOD) activities and industrial facilities generated, stored, recycled, and disposed of hazardous waste in ways which sooner or later contaminated nearby soil, groundwater, and surface water. In most instances, these activities predated existing environmental laws and regulations as well as modern methods of waste disposal and pollution prevention. In response to these problems, DOD established the Installation Restoration Program in 1975 to study and clean up contaminated sites. In 1984, this program was codified as the Defense Environmental Restoration Program (DERP). The individual services and other components of DOD are responsible for implementing these programs. The Office of the Deputy Under Secretary for Environmental Security is responsible for overseeing this implementation and allocating funds for cleanup activities.

All the federal cleanup programs, DERP included, have received considerable criticism from Congress and the public regarding the slow pace and high cost of cleanup. These criticisms are fueled, in part, by the stark contrast between initial expectations and current reality. The early expectations were that only a few hundred sites would need to be cleaned up and that the cleanup

process could be achieved relatively quickly at a moderate cost. As the cleanup programs have been implemented, however, tens of thousands of sites have been identified. Remediation of the most contaminated sites can take hundreds of millions of dollars and decades to complete. Much of the criticism of cleanup programs has focused on the small number of sites that have been completely "cleaned up" compared to the total universe of sites.

There are many technical, political, and community-driven reasons why progress in the cleanup programs has not been more significant. Finding effective and affordable cleanup technologies has been much more difficult than originally anticipated. Many groundwater cleanup technologies must be operated for many years in order to achieve cleanup levels established by the regulatory agencies. In fact, many sites where construction of remedial systems has taken place will not be considered "clean" for many years, as those systems are working out reduced contaminant levels in groundwater and other environmental media.

Because of these time requirements, agencies have had difficultly in demonstrating that they are implementing the cleanup programs expeditiously. A typical measure of a program's progress -- in both the public and private sector -- is the number of activities that have been completed. In the cleanup program, this measure translates into the number of sites that have been "cleaned up." However, such a measure is not an adequate means of assessing progress or managerial effectiveness during the program's early years when much of the focus is on defining the magnitude of the cleanup problem and determining the most efficient cleanup methods for the complex sites that exist. Indeed, a measure that focuses solely on the number of cleanups completed may seriously interfere with the efficient implementation of the program by focusing attention on those sites that can be cleaned up quickly rather than those that present the greatest risk, and by encouraging project managers to use the most readily available cleanup technologies rather than undertaking the studies required to determine whether there are alternative technologies that can accomplish the job faster, cheaper, or better.

For this reason, Clean Sites has undertaken a more disaggregated analysis of the information regarding the DOD cleanup program, and explored a variety of different tools for assessing how well the Department is doing. However, the assessment has depended upon -- and been limited by -- the available data which were, in many cases, collected for purposes other than evaluating the program's progress and efficiency. As a result, it has been impossible to come up with robust conclusions. Indeed, many of the conclusions relate to the inadequacies of the historical data and the need to improve the collection and analysis of information in order to develop better measures of progress.

In carrying out this study, Clean Sites examined data from the Department of Defense Environmental Restoration Program, the Environmental Protection Agency, and the Department of Energy. However, the analyses are based primarily on data collected in databases maintained by DOD (RMIS) and EPA (CERCLIS). These data only support a macro-level review of the cleanup programs run by these agencies.

This report first analyzes progress in the DOD program relying primarily upon data presented by the Department of Defense in its annual reports to Congress.[1] It then uses the EPA data base to compare the DOD program to other cleanup programs. This is followed by an analysis of obligations and outlays -- another common method of assessing how government programs are progressing, and by an evaluation of the Relative Risk Site Evaluation system recently adopted by the Department. The final section includes some general conclusions and recommendations.

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[1] See "Defense Department Cleanup Program: Annual Report for Fiscal Year 1994" and equivalent reports for the fiscal years 1986 through 1993.

Program Progress

The appearance of overall progress in DERP has been greatly influenced by the dramatically increasing universe of "sites" addressed by the program. Sites identified in 1986 totaled approximately 3,500. As of September 30, 1994, the total number of sites reached approximately 21,400, excluding formerly used defense sites where DOD is also active in investigation and remediation activities. Figure 1 illustrates the growth in the number of sites identified by DOD. This extensive growth has presented DOD with numerous information gathering and management challenges and has caused DOD to expend considerable resources in the site investigation phases.

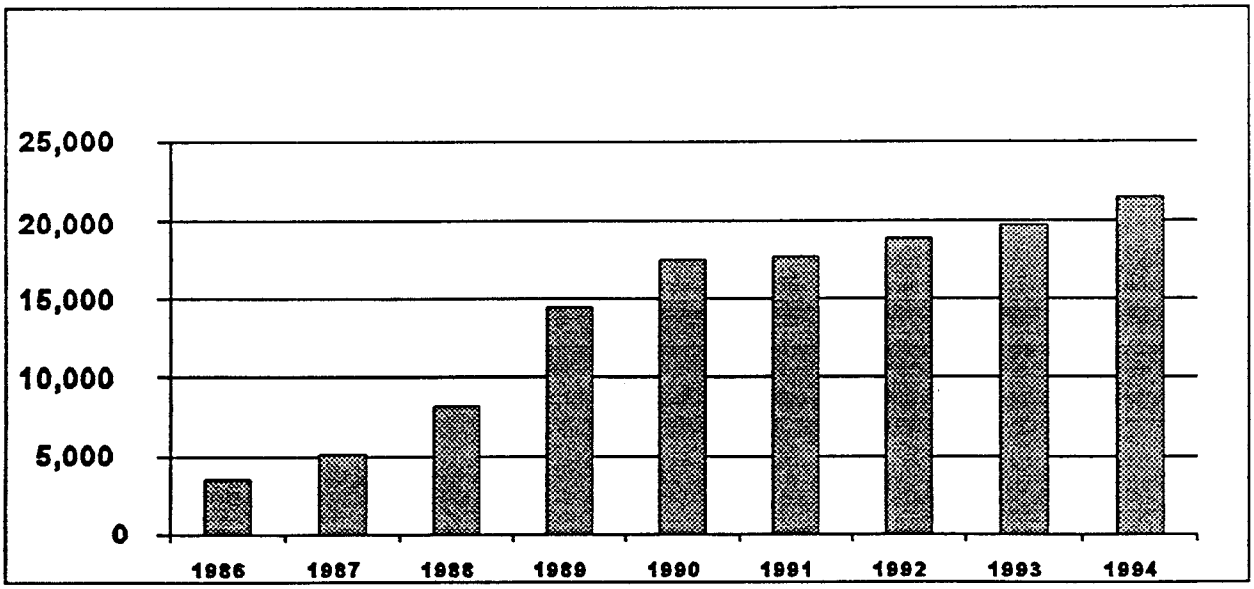

Figure 1
Total Number of Sites

This large number of sites, however, is not necessarily a reflection of the seriousness of the contamination. The DOD program includes many more different types of sites than any other governmental environmental remediation program. DERP "sites" include everything from serious hazardous waste disposal sites to underground storage tanks and areas of suspected but not confirmed contamination (see the appendix to this section for a complete listing of the different types of sites). The different types of sites may be regulated under a variety of different environmental programs including CERCLA, the different parts of RCRA addressing corrective action, hazardous waste disposal, nonhazardous, solid waste disposal, and Underground Storage Tanks (UST), the Clean Water Act, and other pollution control statutes. Some of the sites may not be included under any of the existing programs. Many of these sites have relatively small amounts or areas of contamination. Many have petroleum-related contaminants not regulated under CERCLA. In DERP, all potentially contaminated areas are labeled as "sites" as soon as they are slated for any type of investigative activity, and all levels of contamination are included in the definition. Because the Department has attempted to include any area that might create an environmental problem, many DERP sites require no further action following the initial investigation. Conversely, EPA sites are only listed and brought into the program after significant contamination has been discovered and significant risks identified.

Sites have been continually added to DOD's environmental cleanup program through several avenues including: RCRA facility assessments, environmental baseline studies conducted as a result of base closing under the Base Realignment and Closure (BRAC) program, changes in eligibility for funding under the Defense Environmental Restoration Account (DERA) in the federal budget, RCRA facility investigations, and the reopening of sites as cleanup levels and priorities have changed within the program. Sites are also added at existing facilities as a result of installation personnel discovering areas of previously undocumented contamination.

The efforts to identify and investigate all areas of potential contamination may or may not have reduced DOD's ability to move sites through the cleanup process. However, these efforts have been valuable in terms of documenting the magnitude of the Department's problem and removing slightly contaminated and uncontaminated property from further consideration, allowing the program to focus on cleaning up the contaminated sites. In fact, by 1994, nearly half of all DOD sites had been completed based on limited cleanup activities or designation as "no further action" sites following initial investigation.

This review indicates that, historically, DOD has not consistently identified or tracked sites. The primary focus during the beginning of the program appears to have been on defining the sites that potentially required cleanup and the expected cost of these cleanups. These annual snapshots were summarized in annual reports to Congress, and little effort was apparently made to determine whether the information was consistent from one year to the next. In many cases, as this report indicates, it was not.

The Department has been making a significant effort since 1992 to improve the information collection and analysis system to eliminate many of these problems. Thus, information for the more recent years appears to suffer much less from such problems, although eliminating all the data problems is extremely difficult, if not impossible, in such a large, diverse, decentralized, and complex program as the Defense Environmental Restoration Program (DERP). Some of the apparent inconsistencies in the historic data relate to changes in how "sites" have been defined and managed in the system over the years. In some cases these "inconsistencies" may be reasonable, and may well continue in the future. Some of the reasons for these inconsistencies include:

- Placement of an installation on the NPL generally results in EPA assuming oversight responsibilities for the entire installation. EPA's involvement typically

causes a significant number of new "sites" to be identified or "old" sites, thought to require no further action, to be "reopened";

- Similarly, designation of an installation on the BRAC (base closing) list can result in new sites being identified and old sites reopened out of concern for potential risks to human health or the environment after the installations are turned over to the public, because such public use may involve more exposure, or exposure to more susceptible populations than military uses;

- Data are tracked differently within the different components of DOD and within different installations;

- In some cases, sites have been counted without knowledge of whether any contamination is present, and the tendency to report such sites may depend upon such variables as guidance issued by the Department and the individual services, and the inclination of individuals at the installation level;

- The data for "response complete" designations have been interpreted and reported differently over the years;

- Changes in data bases and reporting systems have affected the consistency and accuracy of the data;

- The volume of data is unwieldy, and there has been limited incentive for project managers to ensure that data are reported consistently and accurately;

- Only sites that are eligible for funding under DERA are supposed to be included in the system, but the eligibility criteria have changed, and generally expanded over the life of the program;

The following sections examine specific phases in the Remediation process. These data illustrate the problems and inconsistencies listed above. In many cases, it appears that changes made in definitions or data reporting methodologies have resulted in substantial shifts in apparent programs from year to year. These inconsistencies not only affect the way progress from the reporting period is accounted for, but in many cases also affect the reporting of all program data collected to date.

Preliminary Assessments

Data on the number of Preliminary Assessments (PA) performed annually is relatively

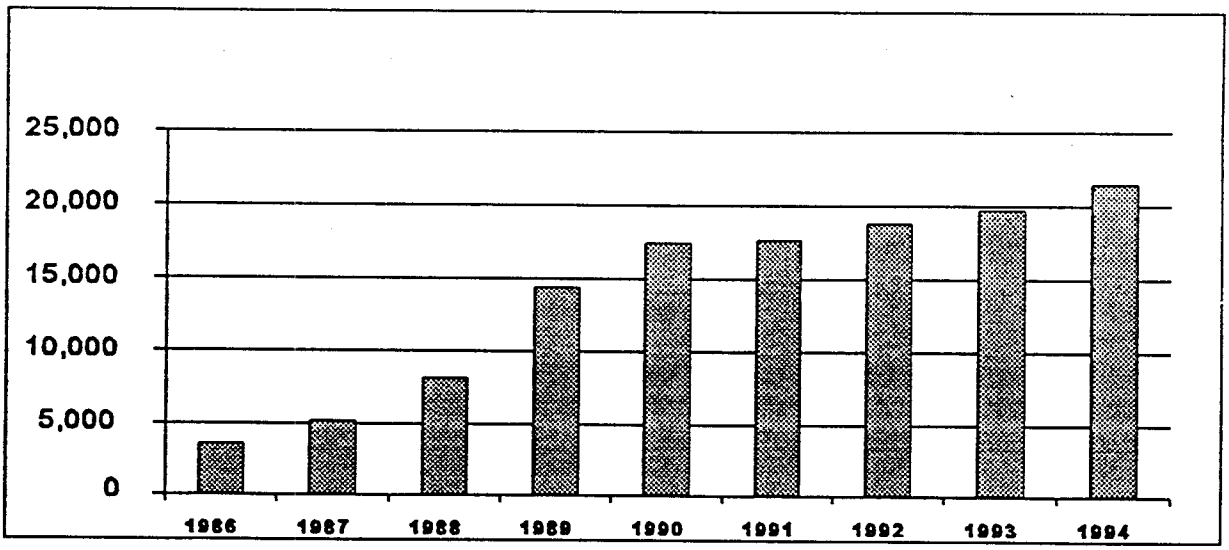

Figure 2
Preliminary Assessments

consistent with the number of sites added to the program annually. The number of sites having completed the PA process has climbed consistently between 1986 and 1994. Data depicting the cumulative number of PAs complete versus the number in progress, indicate that PAs are generally completed in the year in which they are initiated. Figure 2 presents PA data as reported in DOD's Annual Reports to Congress.

Site Inspections

Data regarding the number of Site Inspections (SI) for the years 1986 through 1994 (complete and underway) display a general upward trend that is roughly consistent with the number of sites entering the process and completing the PA stage. However, the data on the number of site inspections completed do not display a consistent upward trend. The number of cumulative SI's completed dropped considerably from 1989 to 1990, dropped more gradually from 1990 through 1992, and then rose significantly through 1994. In spite of this recent growth, more site inspections were reported as having been completed in 1989 than in any other year.

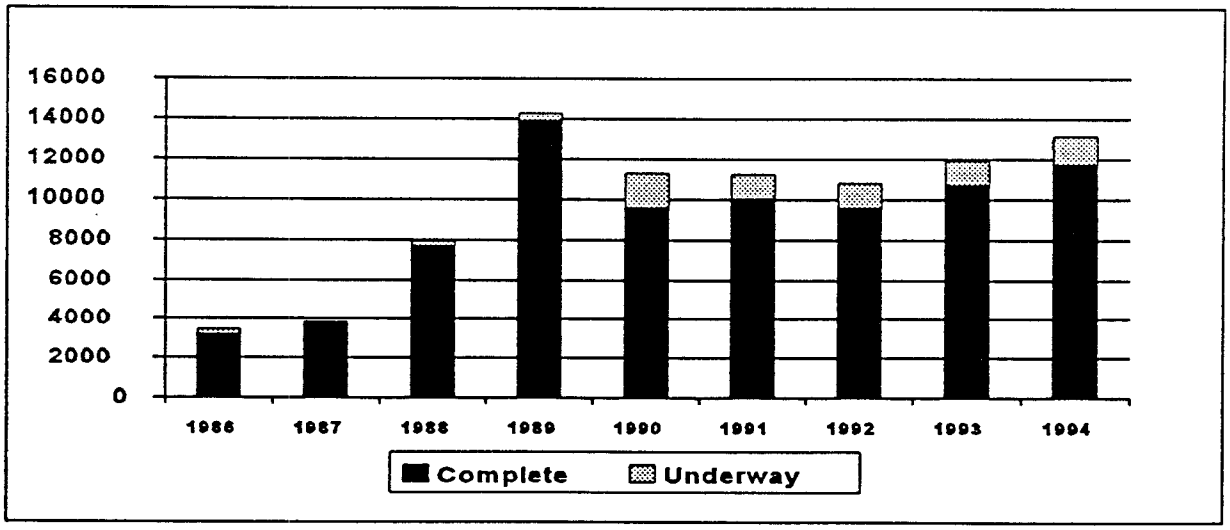

Figure 3
Site Inspections

These results suggest serious inaccuracies in data reporting, or more likely, changes in the definition of what constitutes a site investigation.[2] Figure 3 displays the SI data as reported in DOD's Annual Reports to Congress.

Remedial Investigations/Feasibility Studies

Similar to the SI data, the number of RI/FSs complete drops from the years 1988 through 1990, and then begins to climb. Unlike the SIs, however, the number of RI/FSs complete drops again from 1993 to 1994 (See Figure 4). The number of RI/FSs underway also shows departures

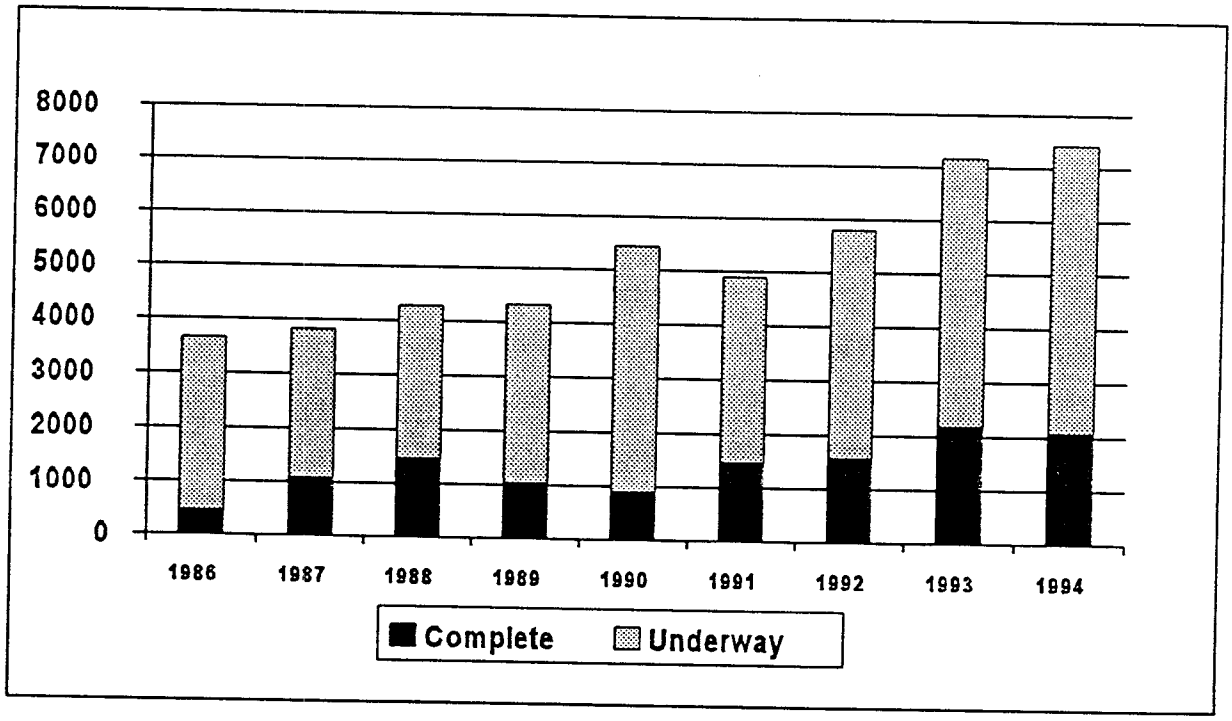

Figure 4
RI/FSs

[2] Some inaccuracies may have resulted from changes in data collection, which prior to 1992, would credit a site as having completed an SI even though the site proceeded directly from the PA to RI/FS. Post-1992 data collection has corrected this inaccuracy according to DOD. Additionally, when EPA promulgated HRS II, DOD was required to reinvestigate a number of sites.

from the general upward trend. The number of RI/FSs underway rose significantly in 1990, fell in 1991, and increased in 1992 and 1993. These fluctuations are not adequately explained by corresponding changes in the number of RI/FSs complete. In fact, many RI/FSs are apparently never recorded as complete. For instance, more than 4000 RI/FSs were reported as complete or underway in 1988. But only 2000 were reported as complete in 1994 -- six years later. This comparison suggests either significant problems with the information collected or significant program inefficiencies in view of the fact that an RI/FS should generally require less than three years to complete if properly scoped and fully funded.[3]

Remedial Design

The trends implied by data on Remedial Design (RD) are even less consistent. The number of RDs complete rises from 1986 through 1989[4], decreases slightly in 1990, rises dramatically in 1991, falls in 1992, and then rises in 1993 and 1994. The number of RDs underway is even more unstable, rising sharply from 1986 through 1988, falling in 1989, rising in 1990, falling sharply from 1990 through 1992, and remaining relatively consistent from 1992 to 1994. As with the RI/FSs, the RD data imply that many designs are never completed. Some 1,500 designs were reported underway in 1988, but only 500 additional designs were reported as complete between that year and 1994. The fluctuation in the Remedial Design stage likely results from sites being reopened following a change in cleanup policy, or from being included in an NPL or BRAC listing.[5] Figure 5 shows the total number of RDs reported as either complete and underway for each year from 1986 through 1994.

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[3] An RI/FS at a particularly complex sites can, however, exceed three years.

[4] Prior to 1990, the annual reports combined remedial designs and remedial actions in the numbers they reported.

[5] In some cases, RDs were conducted concurrently with the RI/FS or during the early stages of RA activities. This also may contribute to the fluctuation in RD numbers.

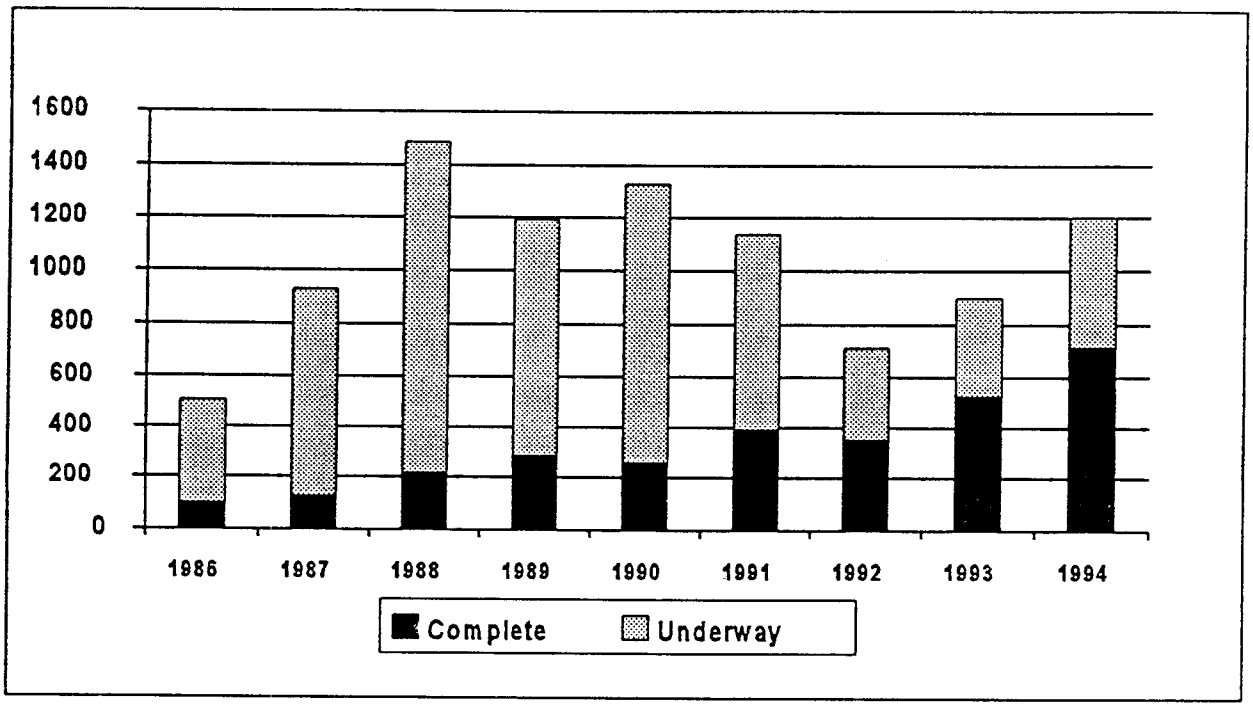


Figure 5
Remedial Designs

Remedial Actions

Data regarding the number of remedial actions that have been completed show a slow, steady, upward trend over time, with the rate of increase accelerating after 1992[6]. As indicated in Figure 6, however, the number of sites reported with a RA underway is much less consistent. The number of sites reported under construction increased roughly 50% from 1987 to 1988. From 1988 to 1989 the number of constructions reported underway dropped dramatically, but rose again in 1990, only to drop dramatically again in 1991 and 1992. Since 1992, the number of sites reported to have remedial actions underway has increased moderately but consistently.

[6] Prior to 1990, the annual reports combined remedial designs and remedial actions in the numbers they reported

The fluctuations in RAs may be partially explained by the way the installations account for interim actions. Interim actions range from installing a fence to restrict access to contaminated areas, to removing and disposing of serious sources of contamination such as drums, to installing full-scale remedial technologies. Such activities do not qualify as "response complete" and have been inconsistently reported across installations in the annual reports under the "remedial actions complete" and "remedial actions underway" categories. These interim actions can significantly reduce risk, and DOD may not have received adequate credit for these reductions of risk to persons on and near where such actions have been undertaken.

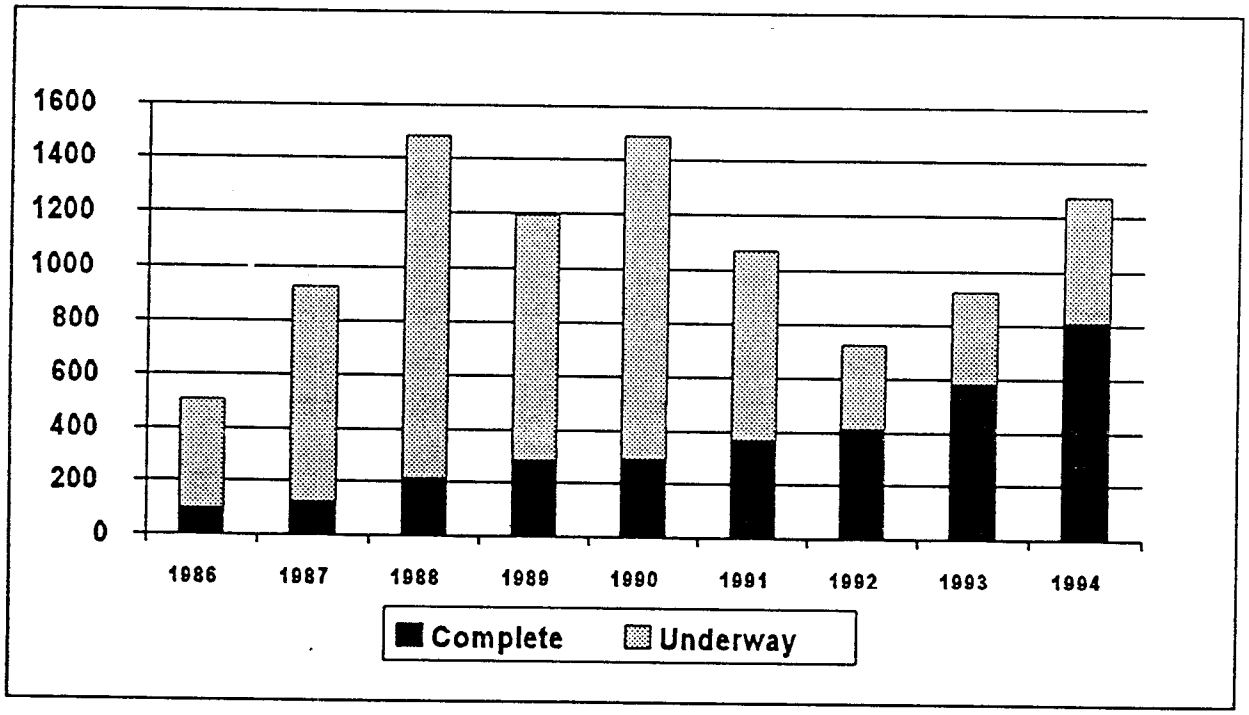


Figure 7
Remedial Actions

Individual Installations

Because of the inconsistencies demonstrated by the aggregate data, Clean Sites reviewed the data pertaining to some individual installations to determine whether they demonstrated similar problems. In some cases the inconsistencies are more pronounced. It is not surprising that the inconsistencies at the installation level are the underlying cause of inconsistencies in the aggregate data. Figure 7, for instance, summarizes the reported information on RI/FSs at two major installations, Aberdeen Proving Ground and McClellan Air Force Base.

At Aberdeen Proving Ground, the number of sites with RI/FSs underway or complete, dropped steadily from 1986 to 1991, and then rose sharply the next three years. No RI/FSs were reported as having been completed in the years 1989 through 1992, although 22 had been reported as completed in previous years.

McClellan Air Force Base also reported widely varying numbers of RI/FSs complete or underway for eight years. The cumulative number completed dropped from approximately 50 to almost zero between 1986 and 1987, increased to 162 in 1988, decreased again in 1989 and 1991, and then increased slowly through 1994. The number of sites underway also displayed radical changes through that time period, implying that many studies were started but never completed. An example of the data accounting problems that plagued efforts to collect accurate data is that, in 1987, 162 RIs were recorded as underway and in 1988 they were recorded as "complete."

These data suggest that definitions and reporting practices changed radically from year to year, even at the installation level and that the data inconsistencies may be even worse at the individual installation level than they appear in the aggregate data. The data also appear to reflect the impact of an installation being listed on the NPL or the signing of a Federal Facility

Agreement. For instance, the number of sites reported underway increased significantly after the facilities were listed on the NPL.[7]

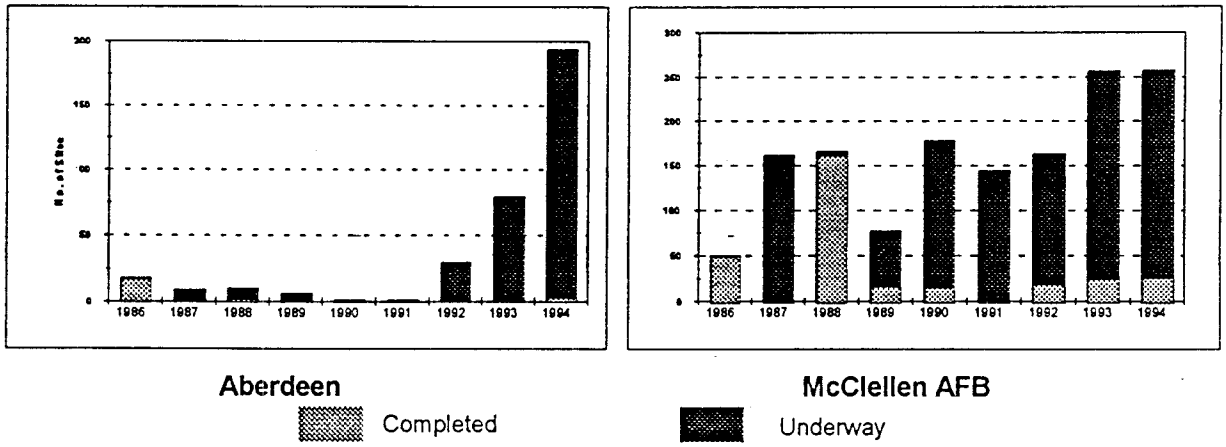


Figure 7
RI/FSs at Individual Facilities

Non-Linear Site Model

One explanation for why the data do not demonstrate a steady progress through the investigation-study-evaluation-design-construction process from year to year is that this is not the process that actually occurs. For a number of reasons, sites may jump steps or return to earlier stages in the process as is illustrated by the nonlinear site progress model in Figure 8.

[7] Aberdeen was listed on the NPL in 1989 with a federal facility agreement signed in 1990, and McClellan was listed on the NPL in 1987 with the agreement signed in 1990.

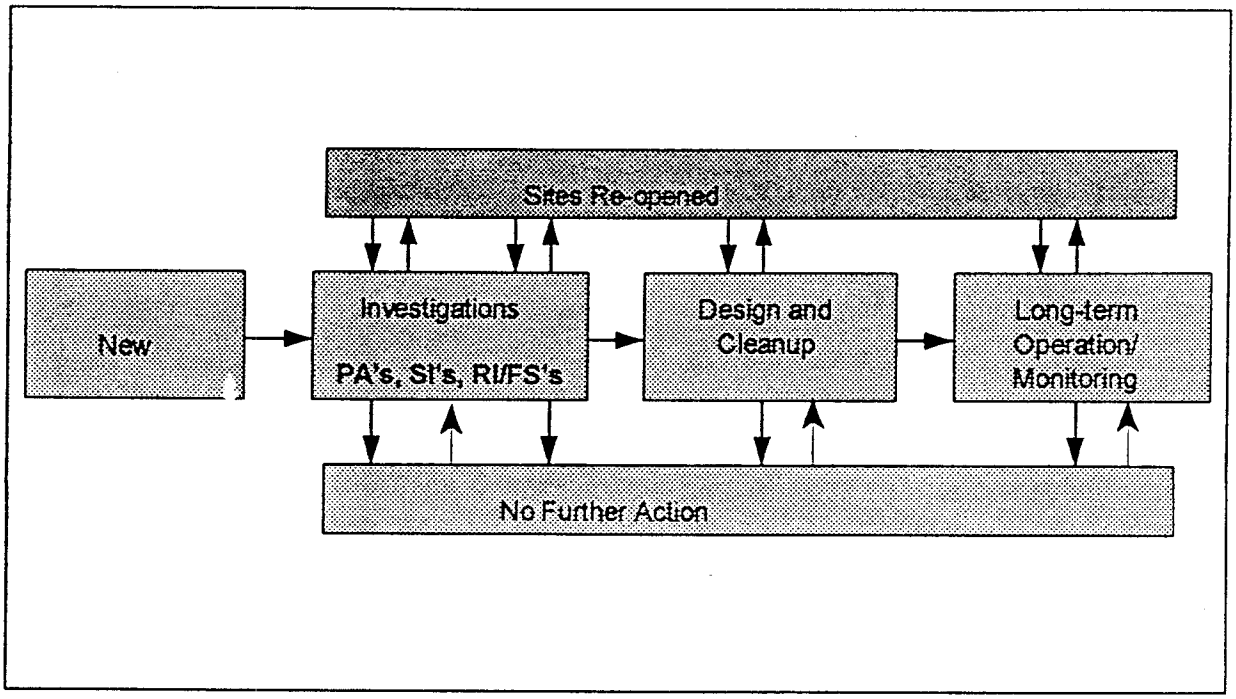


Figure 8
Non-Linear Site Model

Many sites, for instance, drop out of the process after they are investigated and no significant contamination is found. Others drop out after some relatively minor cleanup action is completed. It would be unreasonable and inefficient to require sites to progress lockstep through a preconceived study-evaluation-design-cleanup process. A data system that depends upon annual "snapshots" of sites underway, and that has no explicit mechanism for tracking sites that leave the system, would be expected to lose track of those that leave the system when no further action is required. This is apparently what occurred historically in the DOD system.

Similarly, it appears that individual sites may be divided into several separate sites during the cleanup process for managerial or reporting reasons. Some of the separate sites may subsequently be dropped from the data because no further action is required. Some may return to an earlier process stage to be better characterized and studied. And some may progress to the

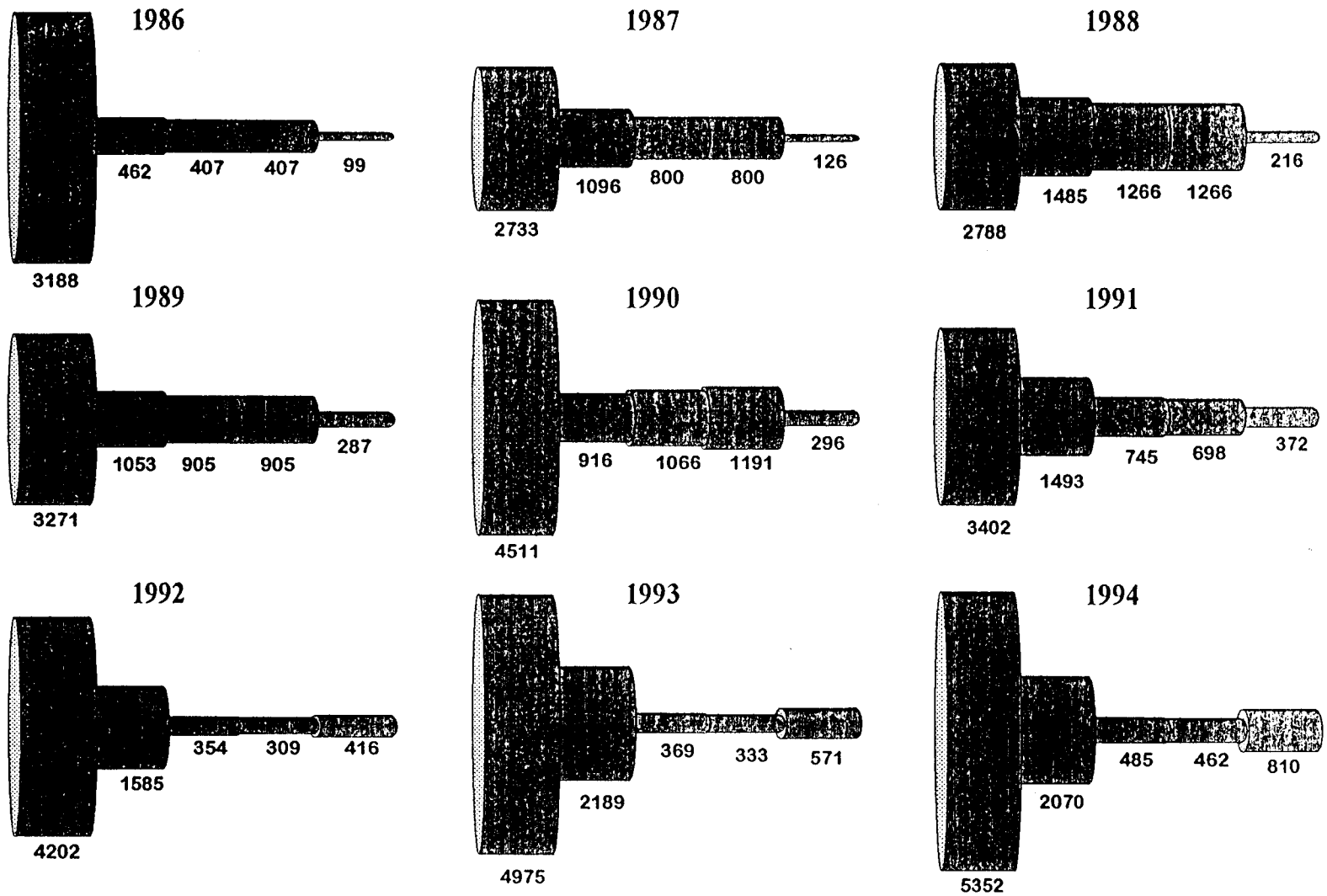
design and cleanup phases. It also appears that some facilities may combine similar sites in order to simplify the management process. Again, these may all be rational and efficient changes, but they cannot be documented in the annual "snapshots."

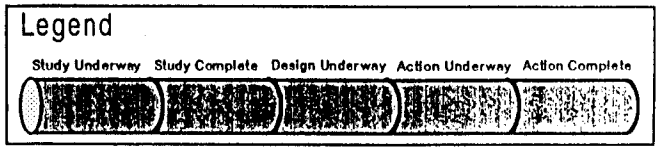
There are other reasons why sites may be "reopened." One is that state and federal regulators may require further investigation, study, or design work after the site manager has designated these steps as complete. This can happen as a result of installations being listed on the NPL, FFA signing, or technical differences of opinion between site managers and regulators. Another is that the site manager discovers unexpected problems in the process of cleaning up the site, and must return the site to an investigation and study phase. Such problems are common in hazardous waste cleanup work, and many experienced private sector project managers believe that, properly managed, integrating the cleanup and assessment processes is an efficient way to address a complex site.

For these and other reasons, the movement of sites back and forth through the remediation process could reflect reasonable and efficient site management. However, the historical information collection system provides little documentation of these adjustments. They appear as anomalies in the data, reducing the credibility of the Department's reports. Since 1992, the Department has made substantial efforts to reduce these types of data problems and improve its site tracking capabilities.

Pipeline Models

To complete the examination of the DOD program progress on a year-by-year basis, Clean Sites developed pipeline models illustrating the number of sites in each stage of the remediation pipeline for the years 1986 through 1994. EPA frequently uses such diagrams to illustrate progress in the Superfund program. These models show how sites are 'flowing' through the remediation process by varying the diameter of the pipeline in proportion to the number of

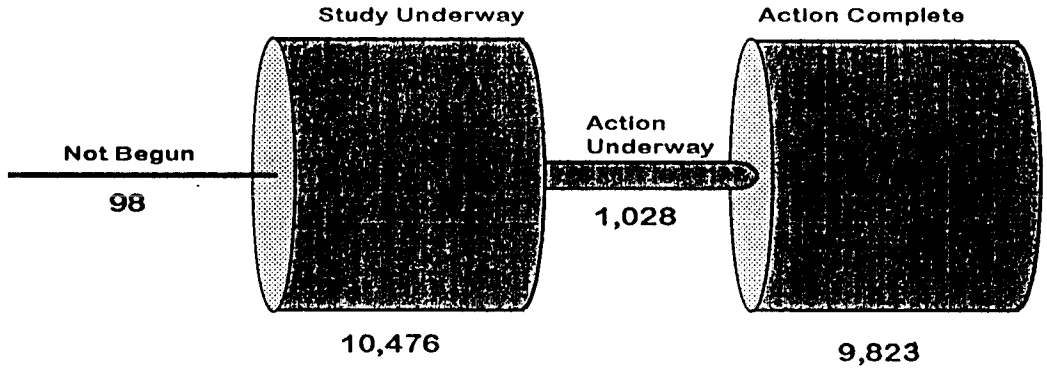




Note: 1. Pipelines do not include no-further-action sites
2. Studies underway and complete refer to Remedial Investigation and Feasibility Studies (RI/FSs).

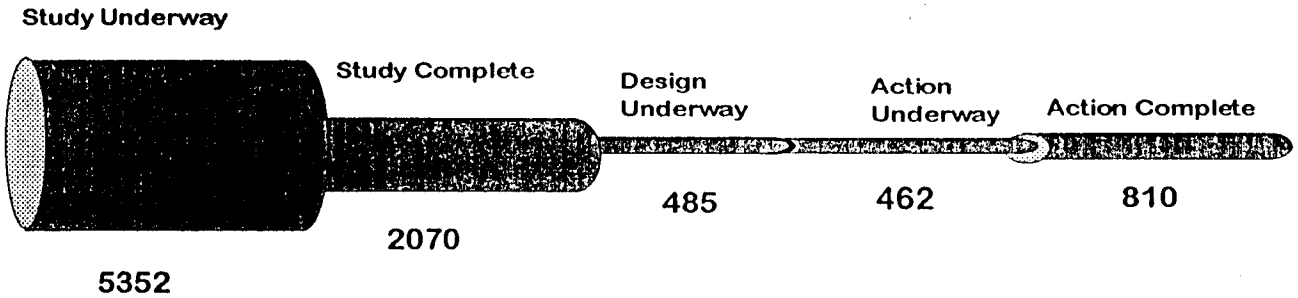
Figure 9
DoD Pipelines 1986 - 1994

Restoration Pipeline Including "No further action" Sites



Note: The "Study Underway" segment includes PA, SI, and RI/FS studies; The "Action Complete "segment includes the "no-further-action" sites.

Restoration Pipeline Excluding "No further action" Sites



Note: The "Study Underway " and "Study Complete" segments refer only to RI/FS studies.

Figure 10
1994 DoD Restoration Pipelines

sites or "flow" in each of the cleanup stages. As with the rest of the data illustrations, these pipelines (which do not include no-further-action-required sites), shown in Figure 9, depict widely-varying progress for each year and illustrate inconsistencies in the data collection and reporting process.

The number of sites in the last two segments of the pipeline falls significantly from 1988 to 1989, from 1990 to 1991, and from 1991 to 1992. In 1993, the number of sites in the last two segments of the pipeline is still lower than in any of the previous years except 1992.

Figure 10 illustrates the impact of including "no-further-action" sites in the "action complete" total. These are sites which are deemed to require no further cleanup on the basis of the site investigations and studies, or following some interim action. Including these sites makes the Department's progress appear more substantial. However, if most of these sites had little or no contamination to begin with, including them in the "action complete" totals would tend to exaggerate the amount of risk reduction that has occurred. The available data do not provide substantive information on "no-further-action" sites.

Effect of NPL Listing

Clean Sites examined the post-1992 data regarding landfills to determine whether there were significant differences between "NPL sites" (sites located on installation which EPA has included on the National Priorities List) and non-NPL. Landfills were chosen to avoid the variations inherent when including all types of sites covered by DOD's Environmental Restoration Program. Data on RI/FSs complete and underway for landfills during the 1992-1994 time frame were reviewed to determine the relevance of NPL listing to the amount of time it takes to complete an RI/FS. RI/FSs underway were selected as the milestone for evaluation because a large number of sites were in this category.

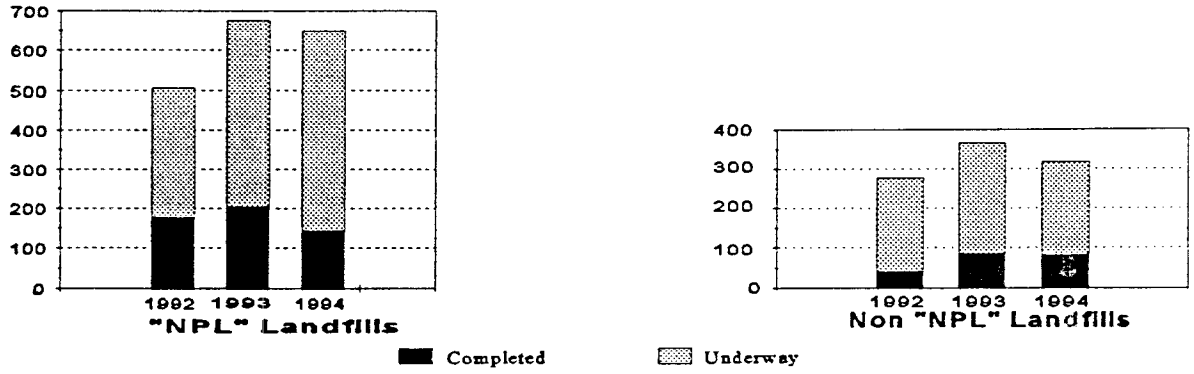


Figure 11
RI/FSs at NPL and Non-NPL Landfills

Similar trends were observed for NPL and non-NPL landfills. The number of RI/FSs complete rose between 1992 and 1993, but fell between 1993 and 1994 in both categories. Similarly, the number of landfill RI/FSs underway rose between 1992 and 1993, and between 1993 and 1994. Thus, these data demonstrate little differences between NPL and non-NPL sites. The number of RI/FSs complete and underway for landfills from 1992 to 1994 are shown in Figure 11.

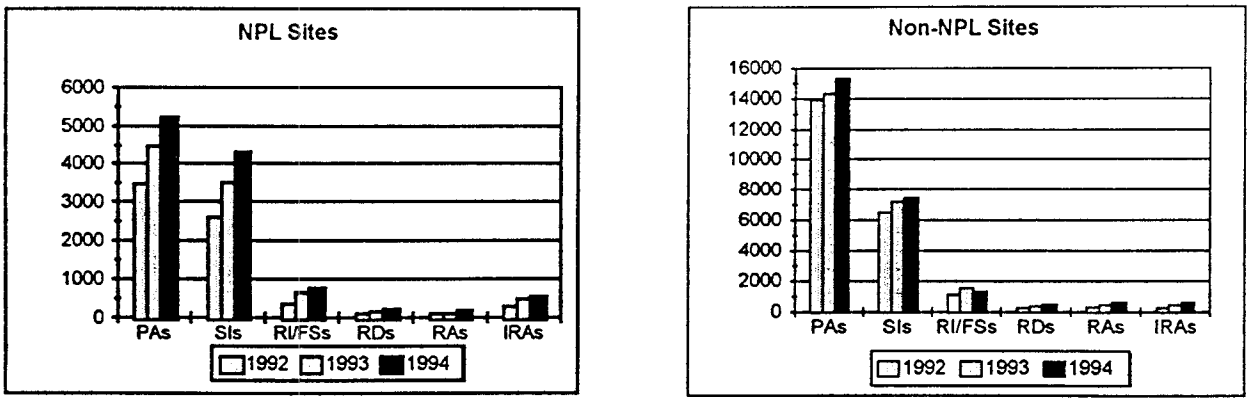


Figure 12
Progress at NPL and Non-NPL Sites: 1992 to 1994

In order to get a broader view of the effects of NPL listing on site progress, Clean Sites used data from the Department of Defense's cleanup database to evaluate the effect of NPL listing. These data show the status of all of the sites in the cleanup process from 1992 to 1994 (Figure 12).

The data suggest that DOD has shifted its emphasis from non-NPL to NPL sites in recent years. For instance, although there are almost three times as many non-NPL as NPL sites, the number of stages (i.e., the number of PAs, SIs, RI/FSs, RDs, and RAs) completed in 1993 and 1994 at NPL sites was approximately the same as at non-NPL sites.

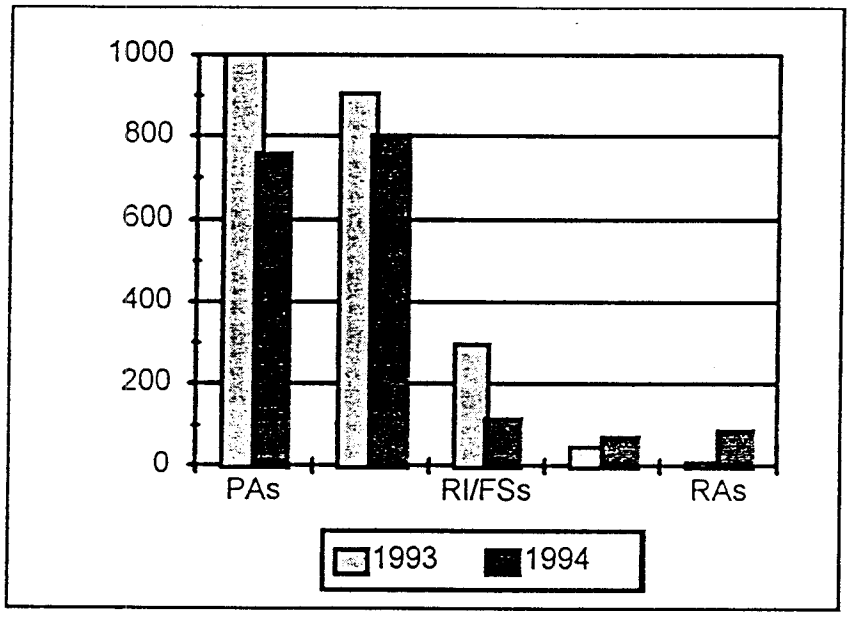


Figure 13
Completions at NPL Sites: 1993 & 1994

The data also suggest that, although a small portion of the 24,000 sites have completed the remedial action process, the pace of cleanup has apparently accelerated significantly in recent years. Figure 13 shows the number of cleanup steps completed at NPL sites in 1993 and 1994 .

Figure 14 shows the same information in terms of the percent increase in completions for each of the cleanup steps. According to these data, the number of remedial designs completed doubled between 1992 and 1994, and the number or remedial actions completed more than doubled during this period. The rate of increase for NPL sites was actually larger in 1994 than it was in 1993.

The fact that, at NPL sites, fewer PAs and SIs were completed in 1994 than in 1993, while the number of RDs and RAs completed increased, suggests that the work at these sites is moving from the identification and study phase to the design and cleanup phase. This is another indication of meaningful progress at these higher priority sites.

Clean Sites queried EPA's CERCLIS database in order to determine that agency's perspective on progress at DOD's NPL listed facilities. EPA's data confirm that DOD's NPL listed facilities have been progressing toward remedy construction at a solid pace. In 1987 DOD had approximately 165 sites with the CERCLA process initiated at 33 of them. In 1995, eight years later, the program had grown by 300% with 488 total sites. In that year activity was underway at 70% of those sites and 205 were in the Record of Decision stage or beyond. These

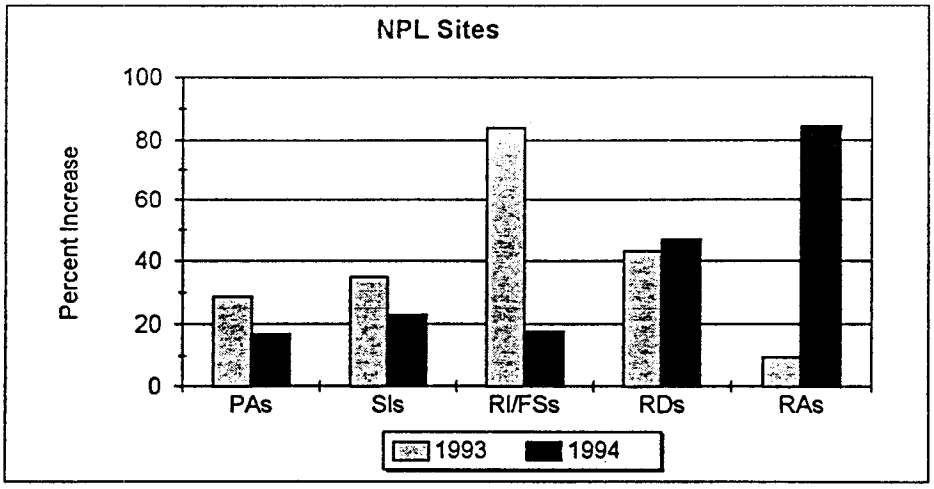


Figure 14
Percent Increase in Completions at NPL Sites: 1993 and 1994

data indicate that DERP has made significant progress on their most contaminated sites even as sites have been continually added to the NPL.

Conclusions and Recommendations

The available information from Department of Defense reports and EPA's CERCLIS information system strongly suggests that the DOD cleanup program is progressing reasonably well.

However, these data -- and particularly the data pertaining to the years preceding 1992 -- demonstrate substantial inconsistencies, making it impossible to come to robust conclusions about the program's progress. Definitions vary over time and are interpreted differently by different services, at different sites, and between different cleanup processes. Data after 1992 have been gathered in a more consistent manner but still reflect problems associated with definitional changes and interpretations by the individual components and installations.

The Department has spent the last several years attempting to improve its data gathering system to eliminate these problems. It has been developing an inventory of sites which it can track over time, and has attempted to eliminate the somewhat capricious manner in which sites appeared and disappeared in the past. Once a site enters the system it now should remain in the system. The Department has also been attempting to discourage installations from entering new sites into the system unless there is evidence that they are contaminated. These are important improvements in the system, and their benefits are already apparent.

This task of establishing and maintaining an accurate and relevant information system on DOD's cleanup program is as daunting as it is important. Data on tens of thousands of individual sites have to be collected through sometimes convoluted command structures from thousands of different sources which may use dozens of different (and sometimes incompatible) computerized

information systems. Just collecting and compiling the required data is a major task, but it alone is not sufficient. The data are of limited value unless quality assurance/quality control reviews have been conducted to ensure that they are accurate and consistent.

Indeed, the difficulty of collecting and interpreting these data at the Department level raises the question of whether it is necessary to maintain a department level information system. Since the program is being implemented by the different services and other components of the department, would it not be more efficient to allow them to maintain their own systems which could mirror their different management systems? The answer is yes, such an approach might be more efficient, but it would not suffice. The public and Congress look to the Department leadership for answers on how the billions of dollars allocated to cleanup are being spent, and to ensure that the program is proceeding effectively and efficiently. Thus, the Department must work with its various components to establish a system which is accurate, relevant, timely, useful, and not overly burdensome. Some suggested improvements for this system are:[8]

1. DOD should continue in its efforts to develop an inventory of sites and carefully and consistently track changes in this inventory over time. A year-to-year comparison should show any growth in inventory and progress at sites. Once a site has been placed in the program, it should remain in the system.

2. The Department should make a concerted effort to precisely define program reporting parameters and prepare guidance which clearly outlines program reporting definitions

[8] The improvement and upgrading of the Department's information system has been an ongoing process since at least 1992. Thus many of the suggested improvements are already being made or may have been made by the time this report is released.

3. Any sites removed from the active list because no further action is required, should be recorded as complete. Reopenings should be recorded, and reopened sites removed from the "action complete" list. The total number of sites in progress should include all sites which have not been given the response complete designation.

4. Sites which are "in progress" should be placed in one of the following categories: inactive, investigation underway, investigation complete, remedy decision pending, design underway, or cleanup underway.[9]

5. Monitoring for interim actions underway should be included.

6. For regulatory, management, or contracting purposes, groups of sites are often handled as a single unit. In such cases, the individual sites may not be reported as moving forward until all sites have completed a particular phase in the process. To be accurate, the reporting system should treat all of the individual sites separately regardless of how they are grouped together for management purposes.

7. Sites are often "reopened" when an installation is placed on the NPL, an RFA is conducted, or an environmental baseline-survey is conducted. These reopenings confuse the attempt to interpret the meaning of aggregate data regarding program progress. Some method should be developed for identifying such reopenings and the reasons why they have occurred.

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[9] For example, the State of California has instituted measures of success that include quantities of contamination removed amount of risk reduced, acres of land that have been restored to productive use, and a number of remedial and removal actions taken.

8. Until recently, no consistent process had been established to accurately account for Interim Actions and No-Further-Action designations. This has led to problems in accounting for Interim Action activities and may have resulted in DOD reporting less progress than actually exists in the cleanup program. A consistent method for defining and reporting Interim Action efforts should be included in the definitions guidance and should continue to be recorded in the Annual Reports.[10]

9. Management approaches are not entirely consistent with the manner in which data is collected and disseminated. In developing program progress definitions, DOD should ensure that the milestones adopted reflect priorities in the program and that these priorities are clearly specified in program guidance.

[10] DOD reports that this has been accomplished as a result of data collection improvements that were implemented in 1992.

Appendix

to

Section on

Program Progress

DOD Site Categories

Site Categories

Site Category	Site Description[1]	Primary Contaminants
Aboveground Storage Tanks	Aboveground storage tank sites result from release of substances to surrounding areas from above ground tanks, containers, and any associated above ground piping.	• Petroleum, oil, and lubricants (POL) (for example, heating oil, jet fuel, gasoline, and POL sludges)
Building Demolition/ Debris Removal	Building demolition/debris removal sites consist of buildings and/or debris that are unsafe or must be removed before the site can be returned to the original owner.	• Asbestos • Construction debris
Burn Area	Burn area sites consist of pits or surface areas that were used for open-air incineration of waste.	• POLs (for example, spent motor oil and jet fuel) • Solvents (for example, spent paint thinners, and degreasing agents) • Explosives • Propellants • Ordnance
Contaminated Building	Contaminated building sites result from releases within or on the outside of a structure of a substance that has been contained within the building.	• POLs • Plating waste • Metals • POL sludge • Asbestos • Polychlorinated biphenyls (PCB) • Propellants • Pesticides • Solvents • Acids
Contaminated Fill	Contaminated fill areas consist of contaminated fill resulting from excavations for construction, tanks, and other purposes.	• POLs • Metals • Ordnance compounds • Explosive chemicals • Paint waste
Contaminated Groundwater	Contaminated groundwater results from various types of releases or unknown releases, such as migration of leachate from disposal areas and migration of substances from contaminated surface and subsurface soils.	• POLs • Chlorinated solvents • Non-chlorinated solvents • Metals • Explosive chemicals
Contaminated Sediments	Contaminated sediments include sediments of bodies of water that have been contaminated by surface runoff, subsurface migration, or direct discharge of contaminants.	• POLs • PCBs • Pesticides • Metals • Solvents • Explosive chemicals
Disposal Pit/Dry Well	Disposal pit/dry well sites consist of unlined disposal pits and dry wells that were used over a period of time to dispose of small quantities of liquid wastes.	• POLs (for example, motor oil) • Acids (for example, battery acid) • Metals • Explosive chemicals • Ordnance compounds • Solvents
Explosive/Ordnance Disposal Area	Explosive ordnance disposal areas consist of open-air areas that were used to detonate, demilitarize, bury, or dispose of explosives.	• Unexploded ordnance • Ordnance compounds • Explosive chemicals • Metals
Fire/Crash Training Area	Fire and crash rescue training areas consist of trenches and/or pits where flammable materials were ignited periodically for demonstrations and training exercises.	• POLs • POL sludges • Solvents • Metals
Landfill	Landfill sites are typically areas formerly used to dispose of both domestic and industrial hazardous waste.	• POLs • Solvents • Paint • Pesticides • Metals • Ordnance compounds
Mixed Waste Area	Mixed waste areas consist of areas used to store or dispose of hazardous wastes that have been mixed with or contaminated by radioisotopes.	• Solvents • Mixed waste

1 The site descriptions provided in this table are not intended to be all-encompassing or exact regulatory definitions. They provide only general descriptions of the different categories of DoD sites.

Site Categories

Site Category	Site Description [1]	Primary Contaminants
Oil/Water Separator	Oil/water separators are typically small units that skim oil from storm water runoff. The oil/water seperator site consists of the unit, and any associated piping.	• POLs • Solvents • Industrial wastewater
Petroleum, Oil, Lubricant Distribution Line	Petroleum, oil, lubricant distribution lines are used to transport POL products from storage to dispensing facilities.	• POLs (for example, heating oil, gasoline, Jet A, diesel, and other fuels) • POL sludge
Low-level Radioactive Waste Area	Radioactive waste areas consist of areas used to store or dispose of low-level radioactive materials of various types.	• Low-level radioactive waste
Spill Area	Spill areas are small areas where spills from drums, tanks, and other waste storage units have taken place.	• POLs • Solvents • POL sludge • Solvents • Metals
Storage Area	Storage areas are areas where spills and leaks occurred from stored containers or equipment.	• POLs • Solvents • POL sludge • Solvents • Metals • Acid
Surface Disposal Area	Surface disposal area sites consist of small areas formerly used for disposal of solid wastes with little or no free liquids. Typical materials include rags, filters, paint cans, small capacitors, and batteries.	• POLs • solvents • Paint • Pesticides • Paints • Metals • Acids • PCBs
Surface Impoundment/ Lagoon	Surface impoundments and lagoons consist of unlined depressions, excavations, or diked areas which were used to accumulate liquid waste, waste containing free liquid, or industrial wastewaters.	• POLs • Solvents • Explosive chemicals • Metals • Ordnance compounds • Industrial wastewater
Underground Storage Tanks	Underground storage tank sites result from the release of substances from underground tanks and any associated underground piping.	• POLs • POL sludges • Solvents • Metals
Underground Storage Tank Farm	Underground storage tank farm sites result from the release of substances from multiple, typically large, underground tanks and associated underground piping which make-up a tank farm complex.	• POLs • POL sludges • Solvents • Metals
Unexploded Munitions/ Ordnance Area	Unexploded munitions and ordnance areas are areas that have been used for munition and ordnance training.	• UXO • Metals • Explosive chemicals • Ordnance compounds
Waste Line	Waste lines are underground piping used to carry industrial wastes to a wastewater treatment plant.	• Solvents • Platingsludges • Metals • Pesticides
Waste Treatment Plant	Wastewater treatment plant sites result from releases of substances at plants that were used to treat and dispose of domestic and industrial wastewater.	• POLs • Solvents • Plating sludges • Industrial wastewater • Explosive chemicals

1 The site descriptions provided in this table are not intended to be all-encompassing or exact regulatory definitions. They provide only general descriptions of the different categories of DoD sites.

Program Comparisons

Clean Sites attempted to compare progress in the DOD cleanup efforts with similar efforts managed by other agencies and private companies.

Such comparisons are, of course, fraught with problems. The different remediation programs are often addressing substantially different types of sites with different amounts, types, and intensity of contamination. Some are located in remote areas where human exposure and community concern are low, while others are predominately located in more densely populated areas with high levels of community concern.

The different agencies use different management approaches and definitions, and collect, report, and analyze their data differently. Data for the DOD program are compiled by installations and sites. Neither is consistent with EPA's definition of "operable units." EPA may divide a single significant DOD site into several operable units, and the definition of these operable units often changes over time as the remediation process proceeds or the responsible EPA official changes.[11] Private companies are usually very reluctant to provide any public information about their sites beyond what is required by law or regulations. The Department of Energy's method for identifying, defining, and reporting on cleanup problems is not clear.

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[11] The appendix to this chapter contains a listing of operable units at DOD sites from EPA's CERCLIS data system as of December 1995.

Unfortunately, there are some common characteristics. This review has frequently pointed out the inconsistencies, gaps, and other problems with DOD's historical data. This is a problem in all of the agencies. Indeed, particularly considering the number and diversity of sites that DOD is responsible for, its data system is more comprehensive and may well be more accurate than systems maintained by other agencies. However, one disadvantage of the DOD system is that, however thorough and detailed its annual reports to Congress, the data themselves are not available for analysis by the public. EPA has made substantial efforts to make its information publicly available through computerized bulletin boards and via the Internet.

In spite of these problems, Clean Sites has attempted to make some comparisons between the different programs. The available data allowed only a very few such comparisons, and even these must be interpreted with great caution and many caveats. Nevertheless, they may illustrate some general program trends.

Pipeline Comparisons

The first comparisons are pipeline illustrations based on data from EPA's CERCLIS database and DOD's RMIS database, as well as current and historical progress reports supplied by EPA's Office of Emergency and Remedial Response and DOD's Office of Environmental Security.

A striking comparison between the DOD and EPA programs is the growth in the number of sites in each program. This comparison, of course, presents problems because sites are defined differently by each program. Nevertheless, the comparison is striking. From 1986 through 1994, EPA's Superfund program grew approximately 65%. During the same period the number of sites included in DERP grew 600%.

The difference in growth, of course, is partly the result of variations in scope among the two programs, and the fact that the types of sites included in the DERP has expanded over the

years. For example, when a DOD installation is listed on the NPL, all of the sites on that installation are considered as part of the DOD cleanup program. In the private sector or for EPA fund-lead sites, there is actually only one specific site listed on the NPL (e.g., a landfill). Much of DOD's effort has been spent completing Preliminary Assessments and Site Investigations at sites added to the program. In contrast, EPA has been able to focus its effort on moving existing sites through the pipeline.

Pipelines displaying the number of sites at each of the stages in 1986 and 1994 for the two programs are presented in Figures 15 and 16 respectively. EPA's pipeline displays a fairly consistent progression of sites through the process between 1986 and 1994. According to the agency's reports, more than half of the NPL sites have progressed from the investigation stages to the design and action stages.

Both DOD pipelines, which depict only those sites that are in the RI/FS stage or beyond, show most of the sites as being in the study phases, although over 3,800 were beyond this stage by September of 1994. These pipelines do not include the sites that require "no further action" based on either no evidence of significant contamination or sufficient risk or as a result of interim remedial actions which have sufficiently addressed site risk. There were over 9,000 such no-further-action sites in 1994.

This highlights another significant difference between EPA and DOD's programs. EPA begins monitoring its program progress after the site has been listed on the NPL which means that significant contamination is known to exist. DOD begins accounting for sites at earlier stages, often before any significant contamination has been confirmed. Although DOD uses the same terminology of PA and SI phases, the extent and types of investigations may differ substantially from site to site, and in many cases are much less than required by EPA for a site listed on the

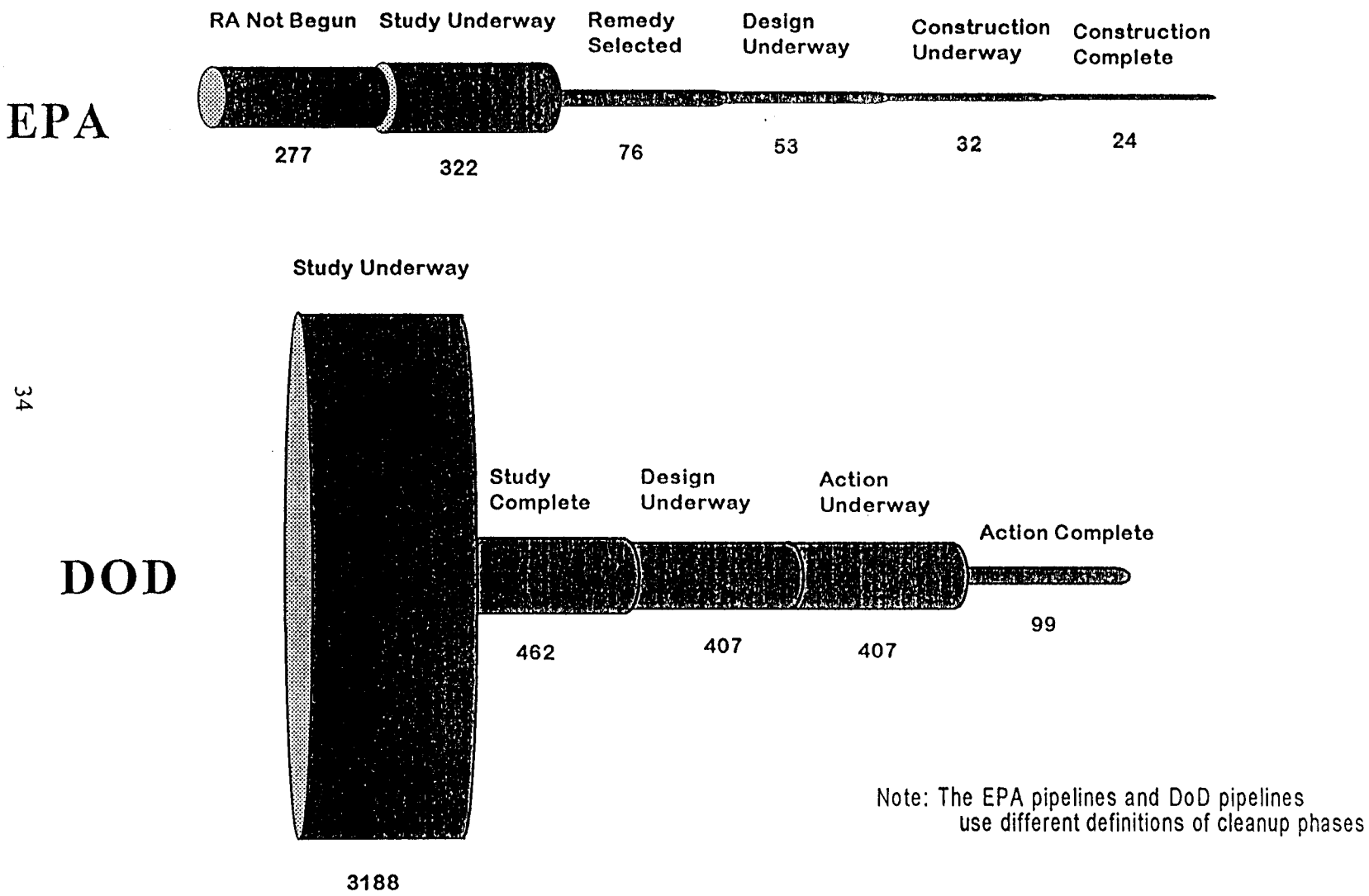
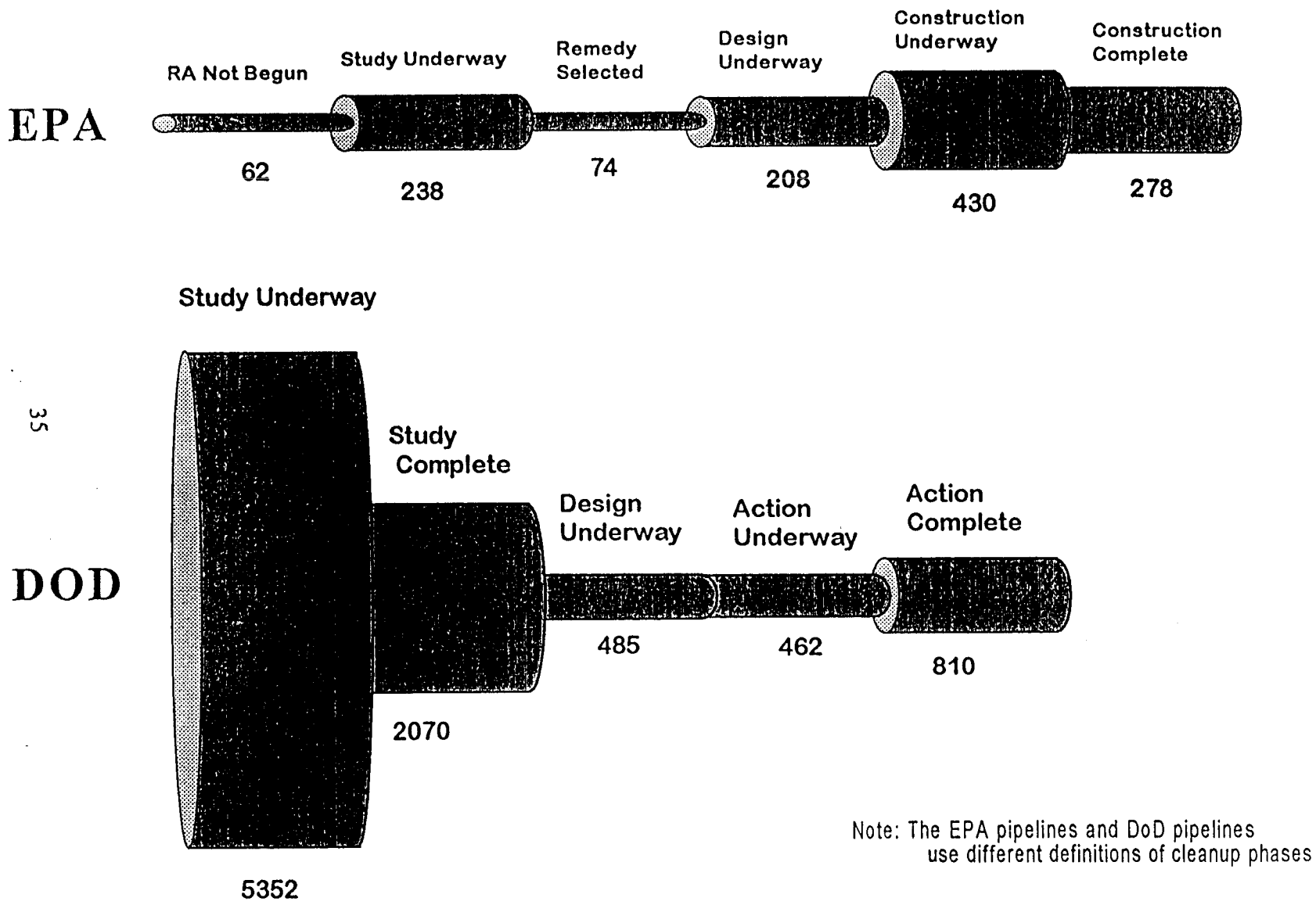


Figure 15
1986 EPA and DoD Restoration Pipelines



Note: The EPA pipelines and DoD pipelines use different definitions of cleanup phases

Figure 16
1994 EPA and DoD Restoration Pipelines

NPL. In many cases, the DOD studies find that no significant contamination exists, and these sites too are added to the no-further-action list.

Speed of Cleanup

Clean Sites used information gathered from EPA's CERCLIS database, which includes some information from all Federal cleanup programs, to make another comparison between the various programs. Again, data quality problems prohibit drawing specific numerical conclusions, but the data may indicate general trends.

Cleanup programs from several Federal agencies were compared using aggregate data from EPA's database to analyze average durations of various events within the remedial process. The results of these analyses are shown in Figures 17 through 19. Figure 17 shows the duration from NPL listing to RI/FS completion; Figure 18 shows the average duration of the Remedial Design, and Figure 19 shows the average length of Remedial Action. These data indicate that DOD sites appear to progress as rapidly as other types of sites, and, indeed, significantly more rapidly in completing remedial designs. These differences are statistically significant.

Nevertheless, they must be interpreted with great caution. The statistics only include operable units which have completed the phases indicated. At many sites, regardless of who is managing them, the activities are not yet completed and may have already dragged on significantly beyond the mean times indicated in these figures. Thus, an agency that had completed only a few of the relatively easy remediation tasks could look very good in such a comparison even though it was demonstrating very little progress on the majority of its sites that created the most significant risk.[13]

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[13] There were insufficient resources available for this review to undertake the analyses required to determine the extent to which such problems existed. Nevertheless, even a casual observation would question whether the relatively short time shown for DOE to complete

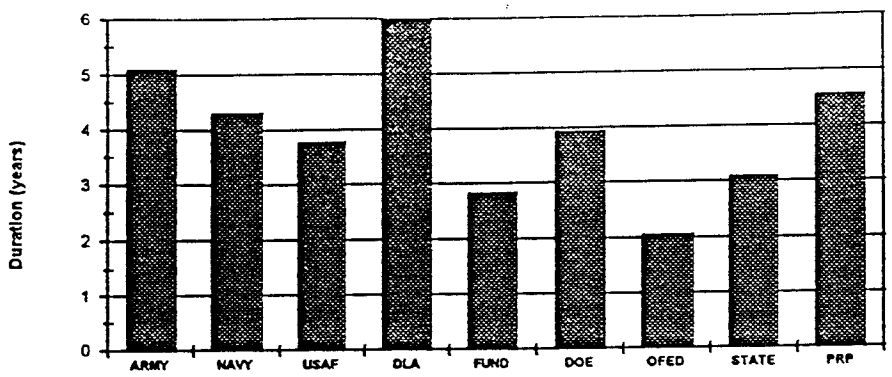

Figure 17
Duration from NPL Listing to RI/FS Complete

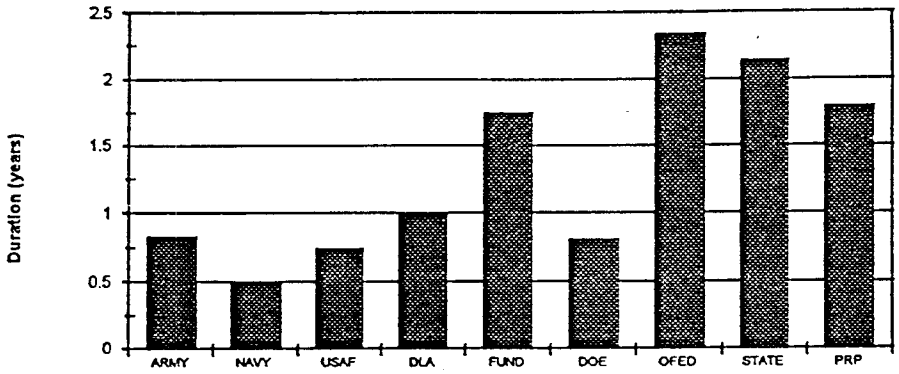

Figure 18
Duration from RD Start to RD Complete

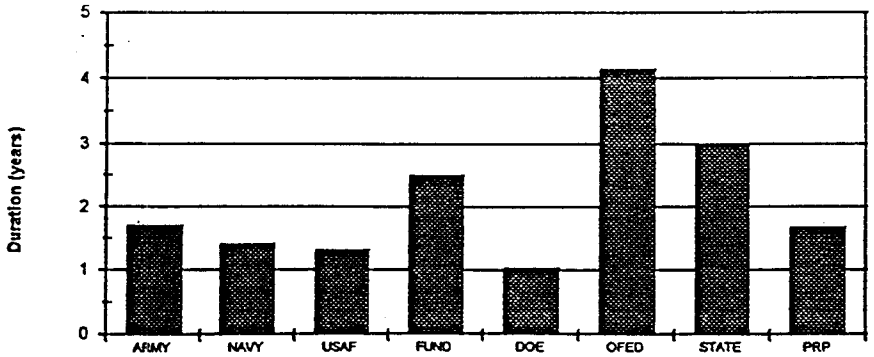

Figure 19
Duration from RA Start to RA Complete

remedial actions is an accurate representation of that agency's progress given the magnitude and complexity of its cleanup problem.

Conclusions

It is impossible to make strong comparisons between the cleanup programs managed by different agencies. Nevertheless, there is no evidence that the DOD program is less efficient than programs managed by other agencies, and some evidence that it may be more efficient.

Some of the problems in making such comparisons are:

1. ***Differing definitions***: The different agencies have different measures and definitions of progress. Even within the Department of Defense, the different components report to the Deputy Under Secretary's Office using different definitions to report progress and track milestones. These differences result in inconsistencies and make it difficult to draw accurate conclusions with respect to actual progress in any given year. Similarly, definitions of milestones have changed dramatically from year to year within the individual components and program-wide. Again, this fact makes analysis of program progress difficult to assess.

2. ***Differing Scope:*** The different scopes of the cleanup programs make it difficult to draw meaningful comparisons. EPA's program includes approximately 1,300 NPL sites, while DOD's program encompasses roughly 24,000 sites of varying sizes and levels of contamination. In addition, DOD's program includes several sub-programs which address differing priorities including: the Base Realignment and Closure Program and the Formerly Used Defense Sites Program.

3. ***Different Types of Sites:*** In addition to the NPL sites, DOD's program addresses numerous types of sites including UST's, Fire Training Areas and Fuel Spills. This

inhibits the ability to draw meaningful comparisons because of the obvious differences in the scope and complexity of these sites.

Priorities set by Congress also skew the data on the progress of cleanup programs. In the past two years, Congress has artificially affected the programs by forcing DOD managers to push sites into the design and construction phases. Anecdotally, many of these sites have since been reopened after determinations that data were not complete enough to support remedial decisions. This type of artificial, policy-based prioritization does not allow DOD to manage its program in the most efficient manner.