CHAPTER 6
DEMAND FOR REMEDIATION OF DEPARTMENT OF DEFENSE SITES

The Department of Defense (DOD) has undertaken the task of cleaning up wastes that have resulted from numerous industrial, commercial, training, and weapons testing activities, as well as cleaning up closing military bases so that the properties can be transferred to local communities for economic revitalization. This task is formidable, especially in view of the overall limitation of DOD resources and proposals to reduce the defense budget. DOD has estimated that of the sites it has begun investigating, over 8,300 sites on over 1,500 installations or formerly used defense sites (FUDS) that will ultimately require remediation have not begun remedial design or remedial action. These facilities contain hazardous waste contamination involving soil, groundwater, and other media. Typical contaminants include petroleum products, solvents, heavy metals, explosives, polychlorinated biphenyls (PCBs), pesticides, and munitions residues from weapons testing.

Much of DOD's past efforts in environmental restoration were devoted to investigating the problem. In fiscal year (FY) 1995, DOD reported that for the first time it was devoting more resources to actual cleanup of contaminated sites than to site investigations and analyses. This trend has continued through 1996 and DOD anticipates that it will continue into the future. DOD has been incorporating a prioritization scheme for sequencing work based on the relative risk of individual sites. Under DOD's relative risk management approach, decisions regarding such issues as cleanup standards, remedy selection, and no further action determinations are made site-by-site rather than for an entire installation. Decisions on these issues are based on the relative threat to human health and the environment, reasonable anticipated land use, cost-effectiveness, and speed of cleanup, and depend on early and meaningful public participation. DOD works with the regulatory agencies and other interested parties to streamline and find economies in the restoration process.

To accomplish the cleanups, DOD will need the services of firms that can clean up wastes similar to those found at private sector industrial facilities as well as firms that can remediate wastes that are unique to DOD, such as unexploded ordnance. These environmental service firms will have to understand DOD operating procedures and keep abreast of the overall direction of its environmental programs.

6.1 Program Description

The Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), and the Resources Conservation and Recovery Act (RCRA) are the primary federal laws governing the investigations and cleanup of DOD contaminated sites. DOD installations typically have multiple contaminated sites regulated by either CERCLA, RCRA corrective action provisions, RCRA underground storage tank (UST) provisions or all three. Through Executive Order 12580, signed in January 1987, the President directs the Secretary of Defense to implement investigation and cleanup measures, in consultation with EPA, for releases of hazardous substances from facilities under the jurisdiction of the Secretary. The interface between CERCLA and RCRA authorities is determined by the circumstances at specific sites, including factors such as: the source and cause of the contamination, the status of the installation as either a National Priorities List (NPL) or non-NPL site, and whether the installation has or is seeking a RCRA permit to manage hazardous wastes. DOD cleanups also must consider the requirements of state laws and the Base Closure and Realignment Acts of 1988 and 1990 (BRAC).[1] Partnering efforts allow DOD, EPA, and the states to work through overlaps and inconsistencies in regulatory requirements to ensure the most effective and timely cleanup of DOD sites. A detailed description of their remediation programs is included in the *Defense Environmental Restoration Program Annual Report to Congress*.[2]

The implementation process for the DOD regulatory program generally follows those of the environmental statutes. Although the regulatory frameworks of CERCLA and RCRA differ in many ways, their implementation processes generally parallel one another. Each requires assessments and investigations to determine the need for cleanup, and to select and design appropriate remedies to ensure protection of human health and the environment. However, each program has its own nomenclature for the various phases of study, design, and cleanup.

6.1.1 Installation Restoration Program

The task of promoting and coordinating the evaluation and cleanup of contamination at DOD sites has been assigned to the Defense Environmental Restoration Program (DERP). The Superfund Amendments and Reauthorization Act of 1986 (SARA) authorizes DOD to carry out this program in consultation with EPA. Executive Order 12580 assigned the Secretary of Defense responsibility for establishing and managing DERP within the overall framework of SARA and CERCLA. The Defense Appropriations Act provides the funding for DERP. Restoration activities, including work conducted under the BRAC program, are under the authority of the Assistant Deputy Under Secretary of Defense (Environmental Cleanup).

DOD refers to the program for meeting its responsibilities under CERCLA as the Installation Restoration Program (IRP). Under IRP, DOD cleans up all contaminated sites for which cleanup is required by environmental statutes, whether or not the sites are on the NPL. Although policy direction and oversight of IRP are the responsibility of the Assistant Deputy Under Secretary of Defense (Environmental Cleanup), each individual DOD Component (Army, Navy, Air Force, and Defense Logistics Agency) is responsible for program implementation. The Army Corps of Engineers (Corps) is the execution agent for all FUDS as well as for the Defense and State Memorandum of Agreement (DSMOA) program which funds states and territories for technical services they provide to support the cleanup of DOD facilities.

DERP has specified procedures for evaluating sites and procuring cleanup services under IRP that conform to the requirements of the National Oil and Hazardous Substances Contingency Plan (NCP), and follow EPA guidelines for site investigations and remediation. These procedures cover all phases of site operations, including preliminary assessment (PA), site inspection (SI), remedial investigation/feasibility study (RI/FS), remedial design (RD), and remedial action (RA). In most cases, activities related to preliminary assessment through remedial design are conducted by different contractors than are those related to remedial action. Activities conducted under IRP are classified as follows:

- Investigation: Analysis to characterize the nature, extent, and risk of releases of hazardous substances to the environment and to develop and select a cleanup remedy.
- Interim Action: Early measure to reduce the risk of releases of hazardous substances before the initiation of more complicated, comprehensive, and long-term cleanup remedies. For example, placing fences around contaminated areas or removing and treating or disposing of contaminated soil.
- Design: Performance specifications or detailed engineering plans and specifications to construct and implement a final cleanup remedy.
- Cleanup: Action to construct and implement a final cleanup remedy.

In selecting and designing remedies, DOD officials coordinate with EPA Regional officials to ensure that cleanup goals meet regulatory requirements. Most contracting is done by installations, either through centralized contracting service centers or directly with the installation. Although the DOD Components follow the general procedures specified by DERP, each DOD Component procures its own cleanup services. Section 6.5 describes typical procurement practices.

6.1.2 Base Realignment and Closure (BRAC)

Additional procedures have been established for the cleanup at bases being closed or realigned. Known as DOD's Fast Track Cleanup Program, these procedures have influenced the sequence of work to be conducted. This program has been designed to ensure that environmental policies take into account the relative risks of individual

sites on an installation and the potential and need for reuse of the property. In the past, most restoration projects included the same overall cleanup timeline for an entire installation, regardless of the relative threat to human health and the environment that individual sites caused. In implementing the new relative risk approach, DOD is working with EPA, the states, and the public to review the prioritization process.[3]

A major influence on the selection of projects for remediation is DOD's effort to speed the economic recovery of communities where installations are scheduled to close. In prioritizing sites and developing cleanup plans DOD considers the following: the potential for local job creation and economic development; the use of transition coordinators at bases slated for closure; larger economic development planning grants to communities affected by base closures; and accelerated pace of site investigation, evaluation, and cleanup efforts. The key features of the program are:

- A BRAC Cleanup Team (BCT) is established at each installation slated for closure, to enhance environmental decision-making at the installation. Each BCT includes representatives from the installation, state environmental regulatory agency, and EPA Regional Office. These teams have the authority, responsibility, and accountability for environmental restoration programs at those installations.

- A BRAC Cleanup Plan (BCP) is prepared for each installation slated for closure and updated annually to reflect new information and changing conditions. The BCP serves as a comprehensive and consolidated statement of the status of the installation and strategy to expedite its cleanup. The BCT is responsible for the preparation of this plan.

- A Restoration Advisory Board (RAB) is established in communities where interest is sufficient to warrant it. RABs are intended to bring together people who reflect diverse interests within the community, in order to foster the early and continual flow of information between the affected community, the installation, and the state and federal regulatory agencies.[4]

- An Environmental Baseline Survey (EBS) is conducted for each closing installation, as mandated by the Community Environmental Response Facilitation Act (CERFA), which is an amendment to CERCLA signed on October 19, 1992. The CERFA requires DOD to identify and document all uncontaminated parcels of land at installations undergoing closure. These properties quickly can be turned over to communities for economic reuse.

The BRAC environmental program encompasses more than environmental restoration efforts. BRAC environmental funding also addresses closure-related environmental compliance, which includes such actions as the removal of USTs, closure of hazardous waste treatment, storage, and disposal facilities (TSDFs), radon surveys, and asbestos abatement. In addition, DOD is committed to accelerating the preparation of final Environmental Impact Statements (EIS), environmental planning, or other analyses required under the National Environmental Policy Act (NEPA). To undertake this effort, DOD may need to evaluate all reasonable reuse scenarios or alternatives based on its experience and judgment and on consultations with community planning entities.

After completing these efforts at a site, DOD will be in a position to determine, in coordination with EPA and the state, whether a parcel of land is suitable for lease or transfer to the community for reuse.

6.2 Factors Affecting Demand for Cleanup

The following factors could alter the scope of the cleanup needed as well as the technologies used:

- The pace of remediating sites is subject to change in response to general budgetary and political developments. The entire DOD budget for restoration, including the Defense Environmental Restoration Account (DERA) and BRAC funds, decreased from $2.5 billion in FY 1994 to $2.1 billion in FY 1995 and FY 1996, and is expected to remain at that level for FY 1997. Of these amounts, BRAC accounts for $523 million in FY 1994, $624 million in FY 1995, $717 million in FY 1996, and $777 million in FY 1997. Thus, BRAC

projects account for 37 percent of all DOD restoration funds budgeted for 1997. In addition, the DOD Components may add funds for base realignments and closure by transferring funds from other accounts.[1]

- DOD anticipates that the proportion of the IRP budget allocated to remedial design and remedial action will continue to increase while a smaller portion of the budget will be allocated to site investigation and evaluation activities. In FY 1994, 48 percent of the Defense Environmental Restoration Account (DERA) funds were spent for remedial design and remedial action. DOD reports that this percentage grew to 61 percent in FY 1995 and 64 percent in FY 1996, and is expected to grow to 74 percent in FY 1997.[2]

- Although DOD believes that most sites have been located, new sites continue to be identified. DOD's list of identified sites has increased about six percent annually for the last four years. Most of these sites are on installations already identified as containing hazardous waste sites.[2]

- In determining the priorities for funding, DOD gives top priority to cleanup activities necessary to: prevent near-term adverse impacts to workers, the public, or the environment; accelerate the conversion of military properties to economic reuse; and satisfy agreements with local, state, or other federal agencies. In implementing its priorities, DOD may assign varying levels of priority to different sites on a given installation. This policy may lead to the acceleration of some projects at a given installation while causing other projects at the same installation to be postponed.

- DOD is in the process of classifying more than half its sites where response action is not complete on a relative risk basis as high, medium, or low relative risk. The classification is based upon three key factors: the amount and extent of contamination, migration pathways, and human and ecological receptors. The resulting relative risk evaluation is not an estimate of absolute risk or a substitute for a baseline risk or health assessment. It serves as a basis for discussing the relative risk of sites with involved stakeholders.[5]

- The rate of closures and realignments of bases and installations will affect the scheduling of site cleanup. Prior to closing or realigning a base, DOD may be required to clean up the site, although cleanup activity may continue after closure. Pursuant to the Base Realignment and Closure Acts of 1988 and 1990, DOD designates military installations for closure or realignment. Of the BRAC installations designated in the first four rounds (BRAC 1988, 1990, 1993, and 1995), 206 have or are suspected to have contamination and 108 have been designated "fast-track" cleanup sites.[6]

- DOD policy calls for extensive coordination with EPA, state environmental authorities, local communities, local planning authorities, and other interested parties in planning and implementing its cleanup programs. These requirements may influence the sequence of work and types of technologies selected for a site.

- Changes in regulatory requirements also may affect cleanup goals, technologies used, and cost. For example, some categories of DOD sites are likely to be affected when the recently proposed regulations for munitions cleanup at training ranges becomes final. In February 1997, EPA promulgated new rules for remediation of munitions at training ranges which could significantly reduce the cost of cleaning up DOD munitions sites. However, because more bases and ranges are expected to close, DOD may incur significant costs for these closure-related cleanups. DOD now will be required to treat or dispose of wastes that, heretofore, were being contained.

- Cleanup requirements are uncertain because the nature and magnitude of the contamination at many identified sites are still only partially known. As DOD continues to characterize its contamination problem and accumulate data from site investigations and cleanups, its cleanup needs will become more clearly defined.

6.3 Number and Characteristics of Sites

Data on site characteristics presented in this chapter are based on an analysis of DOD's Restoration Management Information System (RMIS), which is an important tool used throughout DOD for program management and oversight. RMIS contains data provided by the Components on the status of the DOD sites for which they are responsible.[7]

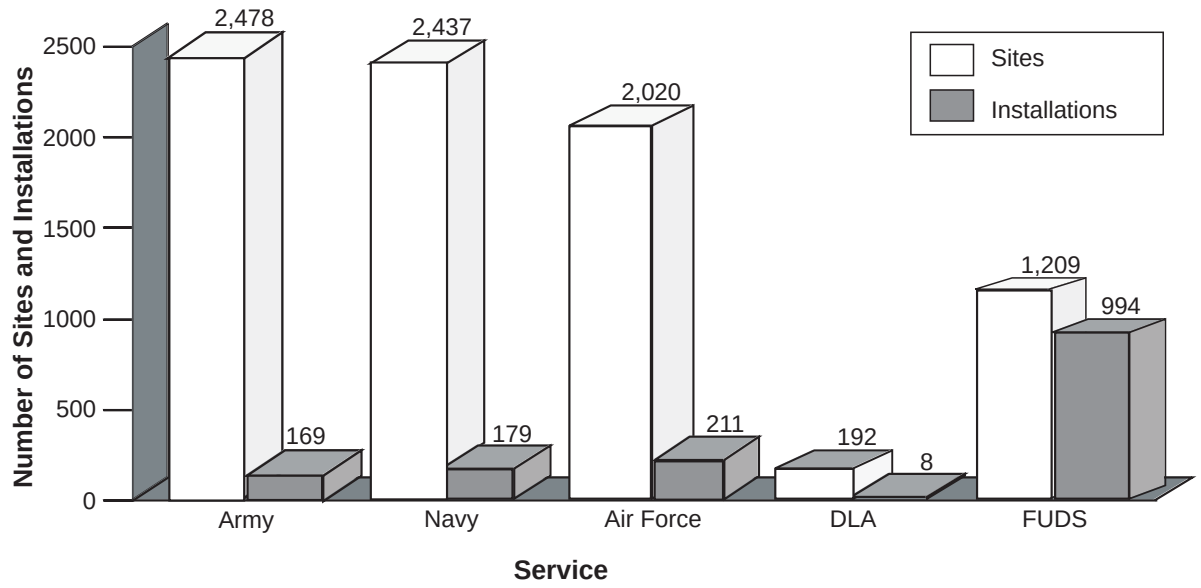
6.3.1 Number and Types of Sites

As of September 30 1995, DOD had identified 22,089 sites located on 1,705 installations, and 8,830 FUDS properties with potential hazardous waste contamination involving soil, groundwater, or other media.[2] Of these, response actions were completed at 10,372 sites on DOD installations and facilities. In addition, 5,141 FUDS properties were determined to require no further action or be ineligible for DERA funding, and the eligibility of 1,048 FUDS properties had not yet been determined. Thus, 15,406 (11,717 DOD sites and 3,689 FUDS sites) were in various stages of site investigation or cleanup. The number of identified sites has grown about 26 percent from FY 1991 to FY 1995. Most of the newly identified sites are on installations that have other contaminated areas. A site is a distinct area of contamination and there may be more than one site on an installation or facility.

Of the 15,406 sites, DOD estimated that 8,336 eventually will require remediation of contaminated materials and, for most of these sites, DOD had not selected RA contractors. The remaining sites either were being cleaned up, have been completely remediated, or were found to require no further work. A breakdown of the 8,336 sites by DOD component is shown in Exhibit 6-1. More than 85 percent of the sites are almost evenly distributed among the Air Force, Army, and Navy, and most of the remainder are FUDS. Although FUDS are managed by the Army, they are the result of activities from all the services.

DOD derived these estimates from a combination of data in RMIS, and information provided by the DOD Components as of September 30, 1995. However, because the SIs and RI/FSs have not been completed at a number of these sites, these estimates, as well as program cost estimates, may be revised somewhat over the next several years. Exhibit 6-2 shows the geographic distribution of these sites, and Appendix Exhibit C-1 shows the

Exhibit 6-1: Number of DOD Sites and Installations Needing Cleanup



Note: Totals equal 8,336 sites and 1,561 installations to be remediated as of September 30, 1995.

Source: DOD, Office of the Deputy Under Secretary of Defense (Environmental Security), Restoration Management Information System, November 1996.

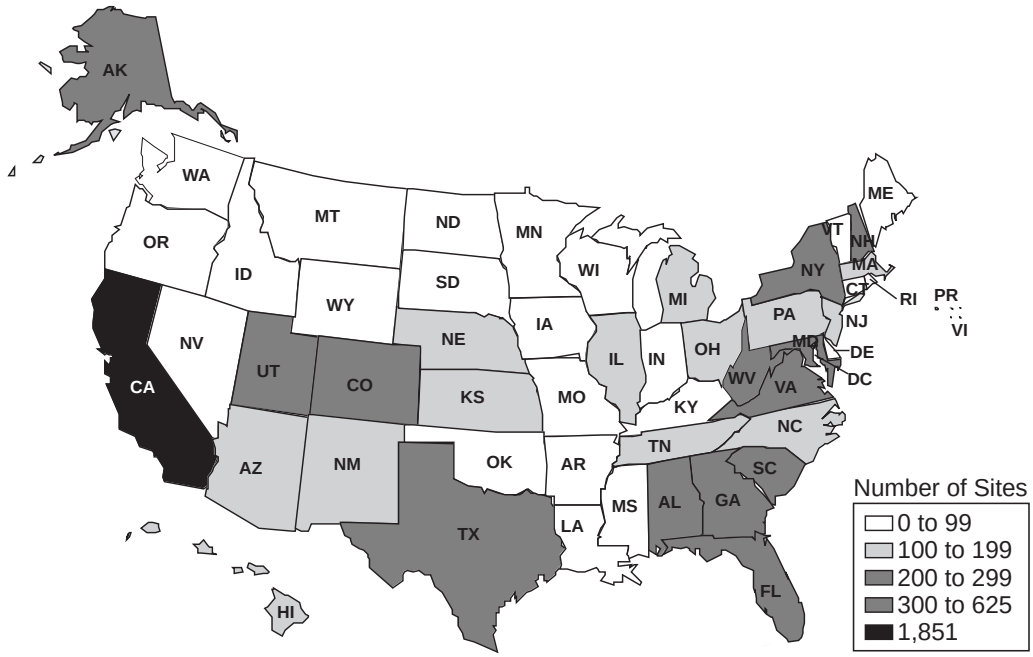
breakdown by DOD Component and state. The states with the most DOD sites needing cleanup are California with 1,851 sites, Maryland with 434 sites, Alaska with 416 sites, Florida with 390 sites, Texas with 344 sites, and Virginia with 306 sites. DOD categorizes its sites into 45 types, which are different than the site types used to categorize the NPL sites in Chapter 3 of this report. The DOD system of site nomenclature uses categories that include both activities and physical descriptions. Exhibit 6-3 shows the number of sites for each of these 10 site types that need cleanup. These 10 site types account for 75 percent of all DOD sites needing remediation. Although some sites may have resulted from more than one type of activity, each site is placed in only one category. The definitions of all the site types are provided in Appendix Exhibit C-2. Appendix Exhibit C-3 details, by DOD Component, the number of each site type needing remediation.

6.3.2 Contaminated Matrices

The data on matrices and contaminants used for this chapter are from RMIS as of September 30, 1994. Of the 9,331 sites then needing cleanup, data that identified the type of matrix (contaminated soil, groundwater, surface water, and sediment) were available for 3,212 sites (over 34 percent). The analysis of site characteristics in the remainder of this report is based on this 1994 data set. Exhibit 6-4 shows, by DOD Component, the number of sites that contain each type of matrix. Seventy-one percent of the sites have contaminated groundwater and 67 percent have contaminated soil, which indicates that many sites have both. Contaminated surface water and sediment are associated with only 19 percent and six percent of the sites, respectively. The totals add to more than the number of sites, since a site may contain more than one type of contaminated media.

The relevant media vary from one site type to another (Exhibit 6-5). For example, contaminated groundwater was found at 83 percent of disposal pit/dry well sites, but only 51 percent of the storage area sites. Likewise, 58 percent of underground storage tank sites had soil contamination, compared to 100 percent of the building demolition sites and 84 percent of storage area sites. However, the amount of

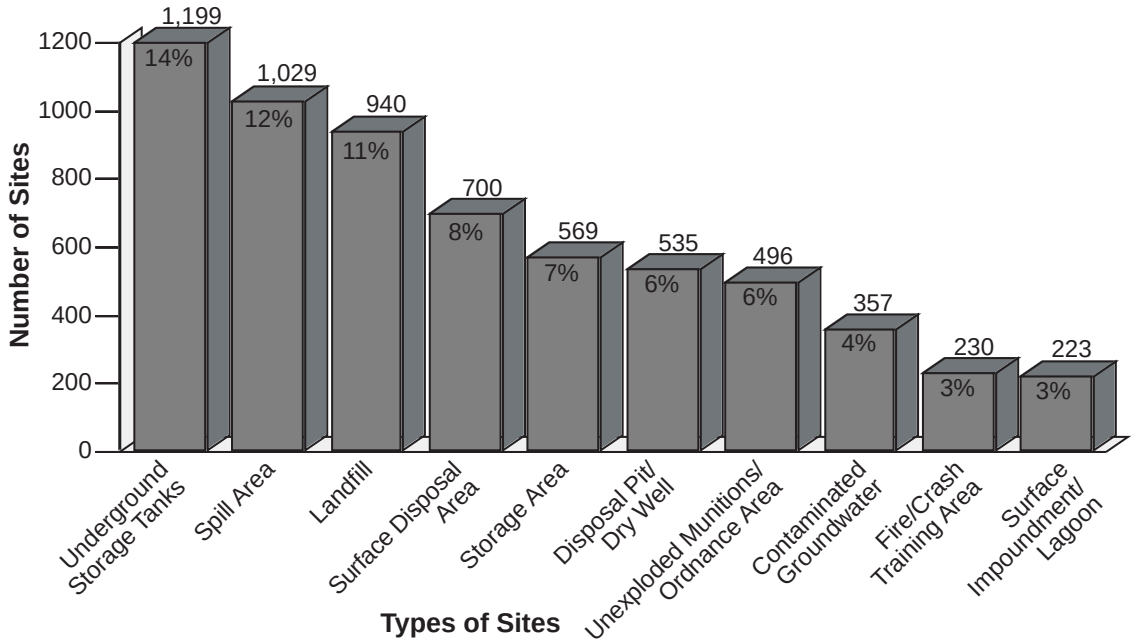
Exhibit 6-2: Location of DOD Sites Needing Cleanup



Note: Total equals 8,336 sites to be remediated as of September 30, 1995. Appendix Exhibit C-1 provides the data by state and DOD component.

Source: DOD, Office of the Deputy Under Secretary of Defense (Environmental Security), Restoration Management Information System, November 1996.

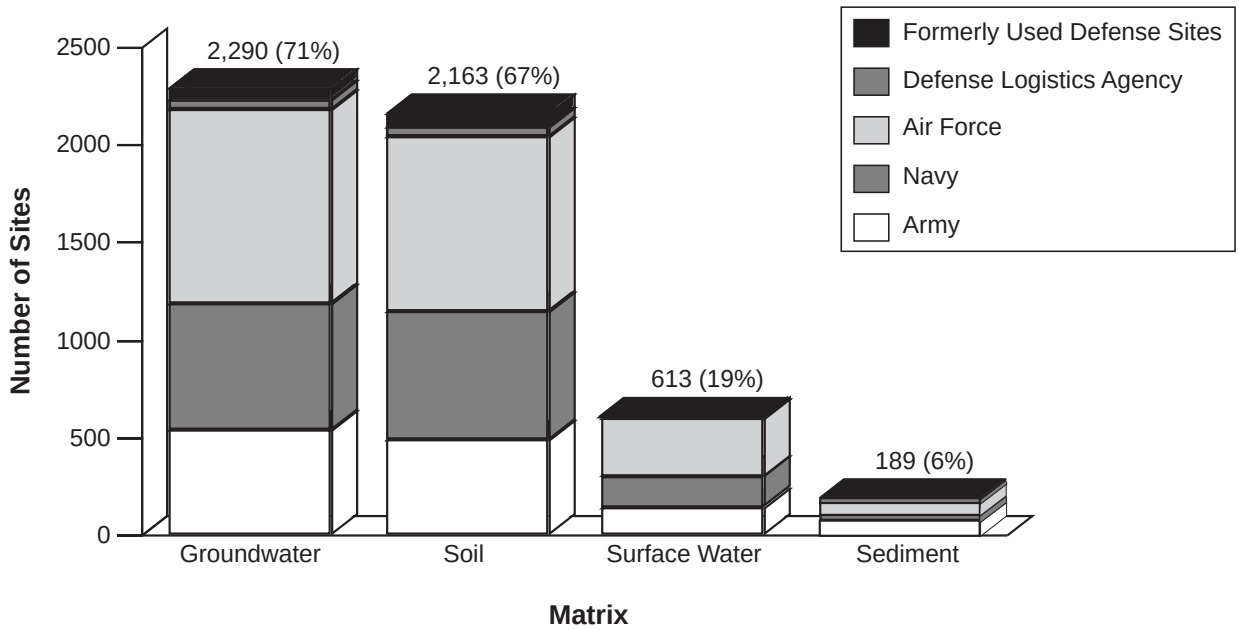
Exhibit 6-3: Most Common Types of DOD Sites Needing Cleanup



Notes: These 10 site types account for 6,278 (75%) of the 8,336 DOD sites to be remediated as of September 30, 1995. Appendix Exhibit C-2 gives definitions of the 45 site types. Appendix Exhibit C-3 lists the frequencies of all 45 site types.

Source: DOD, Office of the Deputy Under Secretary of Defense (Environmental Security), Restoration Management Information System, November 1996.

Exhibit 6-4: Frequency of Contaminated Matrices at DOD Sites Needing Cleanup



Notes: Based on 3,212 sites on 480 installations for which data were available as of September 30 ,1994. Appendix Exhibit C-4 shows the breakdown of these data by site type. Appendix Exhibit C-5 shows the breakdown by DOD component.

Source: DOD, Office of the Deputy Under Secretary of Defense (Environmental Security), Restoration Management Information System, November 1995.

Exhibit 6-5: Frequency of Contaminated Matrices by Site Type at DOD Sites Needing Cleanup

Site Types	No. of Sites	No. of Sites W/Data	Ground-water Contami-nation	Soil Contami-nation	Surface Water Contami-nation	Sediment Contami-nation
Underground Storage Tanks	1,361	444 (33%)	75%	58%	4%	1%
Spill Area	1,234	539 (44%)	71%	66%	66%	19%
Landfill	914	491 (54%)	79%	62%	35%	8%
Unexploded Ordnance	784	14 (2%)	43%	79%	29%	7%
Surface Disposal Area	748	347 (46%)	66%	72%	25%	5%
Disposal Pit/ Dry Well	612	334 (55%)	83%	76%	19%	8%
Storage Area	608	181 (30%)	51%	84%	69%	6%
Contaminated Groundwater	357	86 (24%)	97%	33%	13%	7%
Fire/Crash Training Area	271	157 (58%)	80%	77%	17%	5%
Building Demolition/ Debris Removal	225	6 (3%)	0	100%	0	0

Notes: The 10 most common site types account for 7,114, or 76% of the 9,331 DOD sites to be remediated as of September 30, 1994. Appendix Exhibit C-4 lists the frequency of contaminated matrices for all 45 site types to be remediated as of September 30, 1995.

Source: DOD, Office of the Deputy Under Secretary of Defense (Environmental Security), Restoration Management Information System, November 1995.

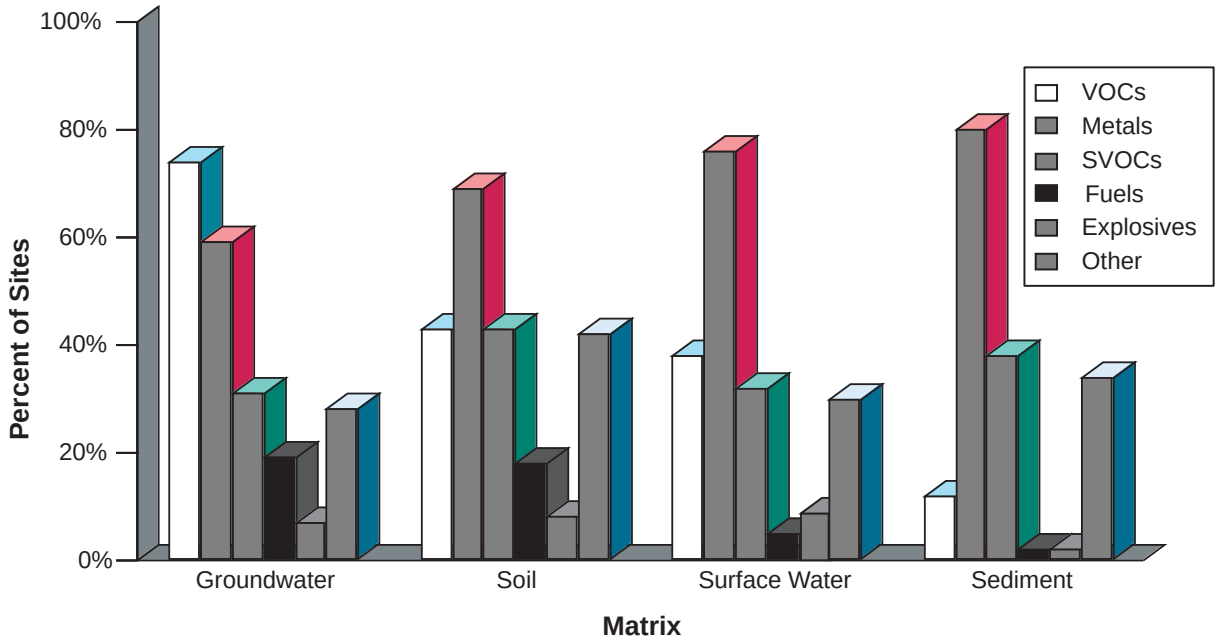
available data varies from one site type to another. Of the top 10 site types, data were available for a low of two percent of the unexploded ordnance sites to a high of 58 percent of the fire/crash training areas. Appendix Exhibit C-4 provides the matrices associated with all 45 site types.

6.3.3 Types of Contaminants

As is the case for the analysis of matrices above, contaminant data are available for 3,212 (over 34 percent) of the 9,331 sites that needed cleanup as of September 30, 1994. For this study, the contaminants were grouped into six categories: volatile organic compounds, (VOCs), semivolatile organic compounds, (SVOCs), metals, fuels, explosives, and "other." "Other" primarily includes inorganic elements and compounds such as asbestos, arsenic, inorganic cyanides, corrosives, pesticides, and herbicides. Exhibits 6-6 and 6-7 show the major contaminant groups by matrix and DOD component. The data used to create these exhibits are in Appendix Exhibit C-5.

The most prevalent contaminant groups in groundwater are VOCs and metals, which appear in 74 percent and 59 percent of DOD groundwater sites, respectively (Appendix Exhibit C-9). However, while metals appear in the majority of sites in all matrices, VOCs are present in only 43 percent and 38 percent of the soil and surface water sites, respectively. SVOCs and metals were more consistent across different media than VOCs. SVOCs were found at between 31 and 43 percent of the sites, and metals were found at between 59 and 80 percent of the sites. Fuels were found at fewer than 22 percent of all sites

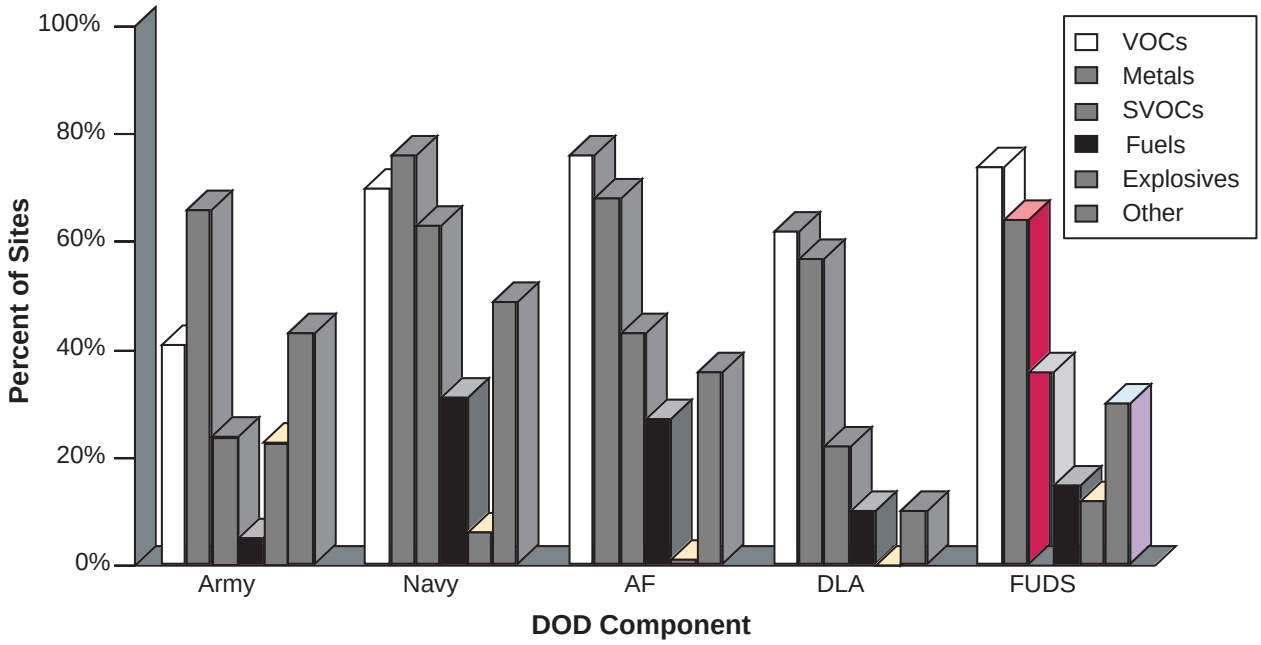
Exhibit 6-6: Major Contaminant Groups by Matrix at DOD Sites Needing Cleanup



Notes: Based on 3,212 sites needing cleanup at 480 installations for which data were available as of September 30, 1994. A contaminant group may appear in more than one matrix at a site. Appendix Exhibit C-5 provides the supporting data.

Source: DOD, Office of the Deputy Under Secretary of Defense (Environmental Security), Restoration Management Information System, November 1995.

Exhibit 6-7: Frequency of Major Contaminant Groups by Component at DOD Sites Needing Cleanup



Notes: Based on 3,212 sites needing cleanup at 480 installations for which data were available as of September 30, 1994. More than one contaminant group can appear at a site. Appendix Exhibit C-5 shows the supporting data.

Source: DOD, Office of the Deputy Under Secretary of Defense (Environmental Security), Restoration Management Information System, November 1995.

(Appendix Exhibit C-5), which is surprisingly low, given DOD's substantial use of fuels at many facilities. However, it may be due to the reporting of the benzene, toluene, ethylbenzene, and xylene (BTEX) constituents of fuels and petroleum products under VOCs.

Exhibit 6-7 and Appendix Exhibit C-5 show the major contaminant groups by DOD Component. The most frequently occurring group—metals—is found at 69 percent of all sites with data, followed by VOCs at 65 percent, and SVOCs at 43 percent. VOCs and metals are found at most sites in all the services, except at Army sites, where VOCs account for only 41 percent of the sites. SVOCs and fuels show more variations (24-63 percent and 5-31 percent, respectively) (Appendix Exhibit C-5). These waste groups also are frequently found at sites related to non-defense industrial facilities. In addition, some sites contain contaminants that are found less frequently in industry and that present unique problems for selecting remediation approaches. For example, over eight percent of the DOD sites contain explosives, and an unspecified number contain low-level radiation. Explosives are found at 23 percent of Army sites, 6 percent of Navy sites, and only 1 percent of Air Force sites. Appendix Exhibit C-5 shows a breakdown of these data into the frequencies of the most common contaminant groups for each medium and DOD Component.

The frequency of occurrence of contaminants also varies by site type. Exhibit 6-8 shows the relative frequency of occurrence of the major contaminant groups for five of the six most common site types. The contaminant data for the fourth most common site type, unexploded munitions/ordnance areas, are not shown in this exhibit because the available contaminant data for these sites were sparse. Metals and organics occur frequently in all five site types, although the frequencies vary. For example the occurrence of metals ranges from 50 percent of underground storage tank sites to 84 percent of landfills. Appendix Exhibit C-6 shows contaminant group occurrences for all 45 site types.

To describe the details of the contaminants present at DOD sites, the data are further broken out into 19 subgroups, such as halogenated VOCs, nonhalogenated VOCs, and BTEX. Exhibit 6-9 shows the frequency of occurrence of these subgroups. Heavy metals is the most prevalent subgroup, in part because, for this analysis, it is a major contaminant group and is not divided into narrower categories as are the organics.

Most of these subgroups also are found at non-defense industrial facilities. In addition, about eight percent of the sites contain explosive and propellant materials and about one percent of the sites contain radioactive metals. The contaminant subgroups of importance to each medium are shown in Appendix Exhibit C-7 and by site type in Appendix Exhibit C-8.

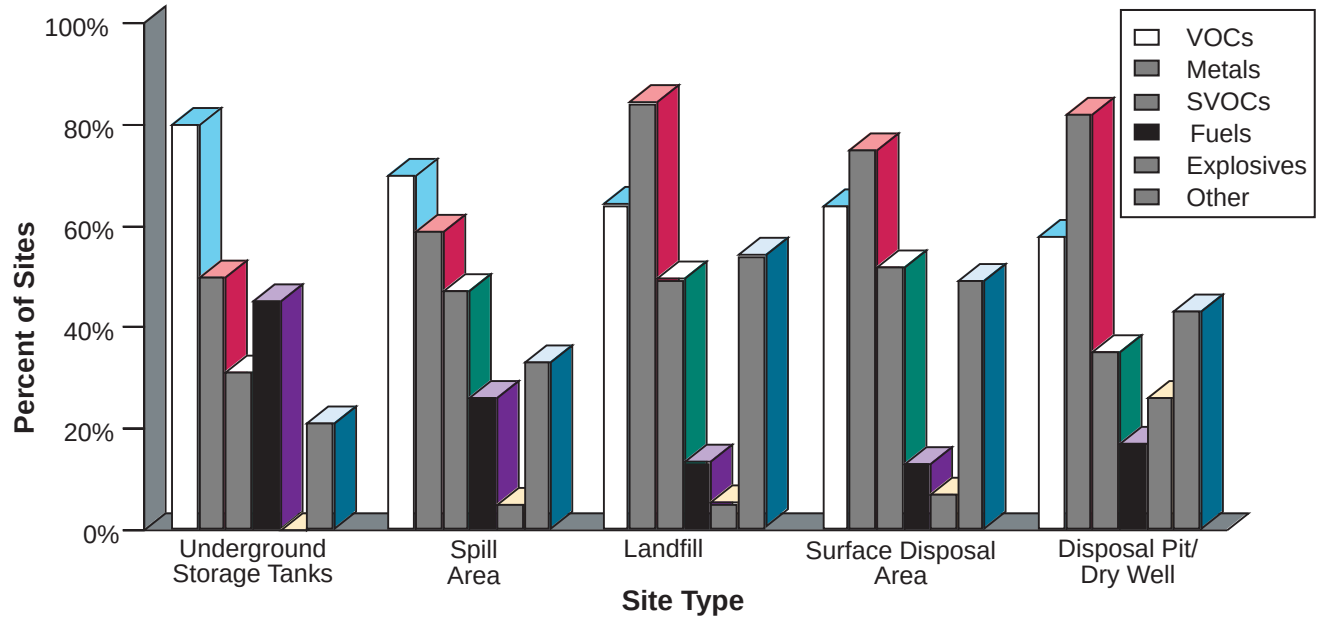
RMIS also contains data on specific contaminants present at each of the 3,212 sites for which information is available. The eight most frequently found contaminants in each matrix are shown in Exhibit 6-10. The most frequently found specific contaminants in all media are the metals lead, zinc, barium, nickel, cadmium, and copper. The most common organic chemicals are trichloroethylene and benzene.

6.4 Estimated Cleanup Costs

DOD annual funding for DERP and BRAC grew from $150 million in FY 1984 to $2.5 billion in FY 1994 and declined to $2.1 billion in FY 1995. It has remained at this level for FYs 1996 and 1997. These figures include funding for BRAC which began in FY 1991. However, as explained below, not all of the BRAC funds are used for site restoration. This point is especially important, since BRAC funds have been accounting for an increasing share of the DOD restoration budget. DOD expects that BRAC funding, which accounted for 25 percent of total DOD restoration funding over the 1991 through 1995 period, has grown to 37 percent of all DOD restoration funds budgeted for FY 1997.

BRAC environmental funding also may be used for other closure-related environmental expenses and environmental compliance. Compliance efforts may include actions such as the removal of underground storage tanks, closure of hazardous waste TSDFs, radon surveys, and asbestos abatement. Planning may involve environmental analyses required under NEPA, and to aid decisions related to property reuse and redevelopment. On the other hand, BRAC

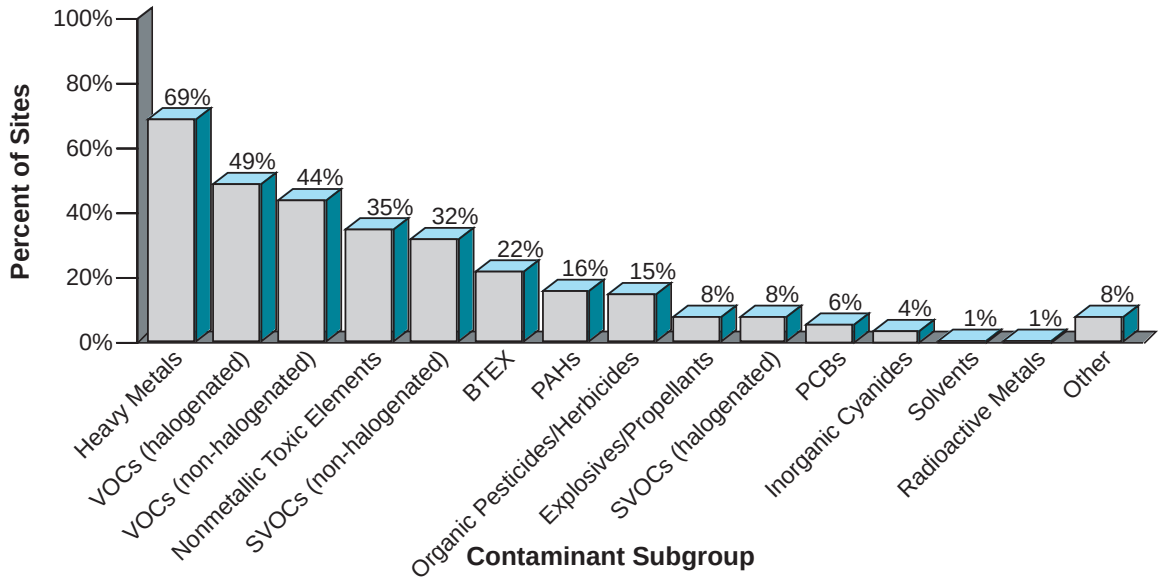
Exhibit 6-8: Frequency of Major Contaminant Groups for the Most Common DOD Site Types Needing Cleanup



Notes: Based on 3,212 sites needing cleanup at 480 installations for which data were available as of September 30, 1994. More than one contaminant group can appear at a site. Appendix Exhibit C-6 shows the breakdown of the data for all site types.

Source: DOD, Office of the Deputy Under Secretary of Defense (Environmental Security), Restoration Management Information System, November 1995.

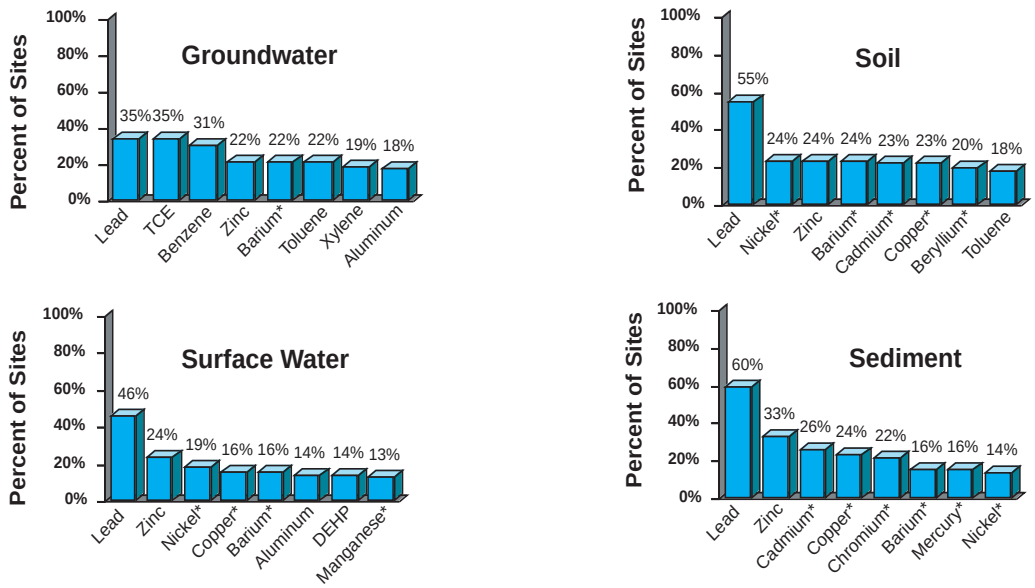
Exhibit 6-9: Frequency of Contaminant Subgroups at DOD Sites Needing Cleanup



Notes: Based on 3,212 sites needing cleanup at 480 installations for which data were available as of September 30, 1994. Subgroups found at fewer than one percent of the sites include: dioxins/furans, organic corrosives, inorganic corrosives, and organic cyanides. "Other" primarily includes inorganic elements and compounds such as asbestos, arsenic, inorganic cyanides, pesticides, and herbicides. Totals may exceed 100% because more than one contaminant may occur at a site.

Source: DOD, Office of the Deputy Under Secretary of Defense (Environmental Security), Restoration Management Information System, November 1995.

Exhibit 6-10: Frequency of the Most Common Contaminants by Matrix at DOD Sites Needing Cleanup



Notes: TCE = Trichloroethylene; DEHP = Bis (2-ethylhexyl) phthalate
* Also includes compounds.
Percent of 3,212 sites with data. 2,290 had contaminated groundwater; 2,452 had contaminated soil; 613 had contaminated surface water; and 189 had contaminated sediment.

Source: DOD, Office of the Deputy Under Secretary of Defense (Environmental Security), Restoration Management Information System, November 1995.

environmental funding is not limited to the aforementioned amounts. These amounts are considered minimum amounts, and DOD Components may allocate additional funds from other accounts.

DOD estimates that the cost of completing the remaining remediation work at all DOD sites from FY 1997 until all sites are cleaned up will be over $28.6 billion, distributed as follows: Army $10.6 billion; Air Force $7.4 billion; Navy $5.6 billion; Defense Logistics Agency (DLA) $0.4 billion; Defense Nuclear Agency $0.1 billion; and FUDS $4.5 billion. Most of the past DOD expenditures for restoration have gone for site investigation and analysis. Since 1984, DOD has identified over 29,000 sites with a reported potential for significant contamination. These sites had to be investigated and evaluated to determine the extent of the problems and potential remedies. Beginning in FY 1995, more than half the restoration budget was spent on actual cleanup as compared to investigations. DOD estimates that by FY 1997, 74 percent of its restoration funds will go to cleanups. DOD estimates that it will take until 2015 before all of its sites are cleaned up.

6.5 Market Entry Considerations

Although policy is determined centrally by the Deputy Under Secretary of Defense (Environmental Security), each service is responsible for investigating and restoring its own sites and uses its own approach to this work. Almost all DOD site assessments and remedial actions are done by contractors. Generally, there are two groups of contractors: those that work on site investigations and assessments and those that do remedial actions. Contractors in the first group seldom do the construction work. Vendors interested in innovative technologies should take action to ensure that their technologies are considered at the earlier stages of site investigation and assessment. For example, even if a vendor is precluded from working on the RI/FS of a particular site, he or she may provide information on their technology to the DOD officials and

contractors working on the RI/FS. Appendix E lists the contract management or program offices. The following is a summary of the practices of each DOD Component.

Army

The management of the *Army* IRP is the responsibility of the U.S. Army Environmental Center (USAEC), which sets overall policy and determines the sequence of work to be done. The Corps of Engineers implements the program, including developing schedules for all activities and studies for PAs, SIs, and RI/FSs, through more than two dozen contractors. RD/RA is done by the Corps under the direction of USAEC. The Corps also implements the remediation programs for DLA and FUDS and conducts more than half of the site investigation and remediation work for the Air Force. The Corps also supports EPA, other federal agencies and states in environmental restoration activities. For EPA, the Corps provides design, construction, and technical assistance in support of the Superfund program. In FY 1994, the Corps conducted $264 million of work for the Superfund program, of which 80 percent was for remedial action. The Corps also does restoration work for the Economic Development Agency, Farmers Home Administration, Federal Aviation Administration, Commodity Credit Corporation, Federal Emergency Management Agency, and the Department of Energy. These efforts amounted to over $100 million in FY 1994.[8]

In the past, most of the design work was done by the Corps' Missouri River Division (MRD) in Omaha, Nebraska, although some work is also done by other Corps divisions and districts. The MRD contains the Hazardous, Toxic, and Radioactive Waste (HTRW) Mandatory Center of Expertise whose 76-person staff serves as a technical resource for environmental restoration. The center is responsible for maintaining state-of-the-art technical expertise for all aspects of restoration activities and providing technical assistance to designated Corps design districts. The Corps uses four basic types of contracts:

- Total Environmental Response Contracts (TERC). These contracts are designed to enable DOD to use a single contractor for all work at a site, from initial studies through construction and to perform multiple tasks at multiple sites on an installation. The Army anticipates that when all these contracts are in place, each of the 12 Corps divisions will have at least one TERC contract, and the work under these contracts primarily will be for construction and for sites for which the remediation approach is relatively well defined. As of November 1995 there were 10 TERC contracts and three in the process of evaluation and selection.

- Pre-placed Remedial Action Contracts. These contracts are exclusively for construction work managed by the Corps divisions. Each division has at least one contract and remedial action contractors are prohibited from working on site investigation and related work that contribute to the preparation of Records of Decision (RODs) and remedial designs.

- Rapid Response Contracts. The Corps's MRD manages two rapid response contracts that provide a nationwide capability to respond to requests for action within 45 days. The work under this contract may include administrative, engineering, and construction work.

- Architectural and Engineering Contracts. These contracts cover a wide variety of activities, such as new construction, renovation, maintenance, and planning. Although they generally are not specifically for remediation work, remediation or related investigations and studies may be conducted under some of these contracts, depending on their specific statements of work.

Navy

The management of the *Navy* IRP is the responsibility of the Navy Facilities Engineering Command (NAVFAC), which reports to the Assistant Secretary of the Navy for Installations and Environment. The day-to-day work of the IRP is run by ten field divisions that operate within distinct geographical boundaries. Each division has at least one contract for its region, known as the Comprehensive Long-Term

Environmental Action Navy (CLEAN) contract. These contracts, which are issued through NAVFAC, are primarily for work relating to PA through RD. As of November 1995, the Navy had 13 active CLEAN contracts and two additional potential contracts were undergoing evaluation and selection. Remedial action work is conducted through large pre-placed remedial action contracts (RACs) and, generally, the contractors that do the construction work are prohibited from working on site investigations and assessments. As of November 1995, there were 10 RAC contracts. The CLEAN and RAC contracts are multi-year, task-order type contracts ranging from $75 million to $300 million in potential work.

Air Force

The *Air Force* IRP is decentralized, and executed by the 11 Air Force Major Commands. Each may use specialized technical support from environmental contractors. Contractors are accessed either through pre-established task-order contracts administered through five contract service centers, individual contracts let by the commands themselves, or by individual installations. For example, environmental officials at McClellan Air Force Base have procured multi-million dollar contracts for environmental remediation work. A majority of the Air Force's site investigation and restoration work has been conducted by the Corps.

The Air Force base conversion program is separately managed by the Air Force Base Conversion Agency (AFBCA). The overall policy for this agency is determined by the Deputy Assistant Secretary of the Air Force for Environment, Safety and Occupational Health. About 15 percent of the work is done by the Corps, and the remainder through direct contracts, usually the same contractors used for the IRP program. The minimum budget for the Air Force BRAC was $147 million in FY 1994 and $107 million in FY 1995. As previously stated, the BRAC funds may be used for more than environmental restoration.

The Defense Logistics Agency's sites are managed by the Huntsville, Alabama, District of the Corps.

6.6 Technologies Used and Research, Development and Demonstrations

A partial list of DOD and other federal sites using innovative technologies appears in the EPA report *Innovative Treatment Technologies: Annual Status Report*.[9] The following are examples of innovative technology applications at DOD sites known to EPA: bioremediation has been selected to treat for VOCs and PAHs; soil vapor extraction has been selected for VOCs, polynuclear aromatic hydrocarbons (PAHs), and gasoline; and soil washing has been selected for PCBs and metals.

DOD actively participates in technology innovation to meet its environmental restoration needs more efficiently and effectively. The Department's efforts predominately focus on three major areas:

- Technology transfer,
- Demonstration and certification of emerging technologies, and
- Development of new technologies.

Technology Transfer

DOD has been active in facilitating technology transfer among development and demonstration programs and technology users. For example, DOD is working with the Federal Remediation Technologies Roundtable, an interagency organization created to facilitate collaboration among federal agencies, such as the Department of Energy (DOE) and EPA, which also have a stake in technology development. The Federal Remediation Technologies Roundtable is described in Chapter 3.

DOD has been especially active in Roundtable initiatives to develop the *Remediation Technologies Screening Matrix and Reference Guide, Second Edition (Screening Matrix)*, an easy-to-use compendium of current information on available remediation technologies.[10]

DOD is using the latest communications technologies to disseminate technology information, including the World Wide Web. DOD has provided many Technology Application Reports

on the Web and plans to add the Screening Matrix and additional Technology Application Reports as they become available (http://www.frtr.gov). Installations across the country also are using the Web to share information on technology application with local communities and the environmental technology industry.

The BRAC Public Affairs Office at the Presidio of San Francisco provides information regarding restoration activities, including cleanup technology information on the Web. The home page is intended for use by the public as well as other environmental technology users in the field (http://www.envcleanup.gov).

Demonstrations and Certification of Emerging Technologies

DOD's demonstration programs provide project managers with a set of previously tested and certified technologies, which they can then apply with greater assurance of acceptable cost and performance. DOD's flagship demonstration program is the Environmental Security Technology Certification Program (ESTCP), which DOD established to demonstrate and certify emerging technologies. Through this program, DOD ensures that technologies that appear promising based on laboratory work are demonstrated at military installations, where their cost, performance, and market potential are documented. In FY 1995, the ESTCP initiated 27 demonstration projects, 15 of which were related to environmental cleanup. For example, the Army Environmental Center jointly with EPA is currently evaluating a more cost-effective advanced oxidation technology at Cornhusker Army Ammunition Plant in Nebraska. DOD shares these technologies with other federal agencies and brings them to the commercial market. Under ESTCP, EPA has initiated joint projects with DOE, where technologies developed by DOE will be demonstrated and validated at DOD sites.

The Defense National Environmental Technology Test Site Program (NETTSP) established national test centers to compare demonstrations and evaluate cost-effective innovative technologies, thereby enabling the technologies to be transferred from research to full-scale use. Under this program, DOD Components and EPA select sites with appropriate contaminants to serve as test locations; develop common quality assurance/quality control procedures; and develop coordinated dissemination mechanisms for reporting results of technology demonstrations and evaluations. The DOD Components and EPA are establishing partnerships with government and private interests to carry out the technology demonstrations at the selected installations and provide researchers and developers with technical and field support. DOD plans technology demonstrations at the following installations:

- Port Hueneme Naval Construction Battalion Center sites for technologies to remediate fuel hydrocarbons;
- Volunteer Army Ammunition Plant sites for demonstrations involving technologies for the remediation of energetics and heavy metals contamination;
- Wurtsmith Air Force Base for development and testing of integrated biological/physiochemical processes and evaluation of innovative monitoring and measurement technologies;
- McClellan Air Force Base sites for demonstrating technologies for solvent remediation; and
- Dover Air Force base to house the Groundwater Remediation Field Laboratory.

Each of the individual services also maintains technology development and demonstration programs. The Air Force Center for Environmental Excellence, Army Environmental Center, and Naval Facilities Engineering Service Center are leaders in cleanup technology demonstration.

For example, the Navy has had success in demonstrating the TerraKleen™ soil washing technology at North Island Naval Air Station, California in FY 1994, in cooperation with the EPA Superfund Innovative Technology Evaluation (SITE) Program. The technology was placed into full-scale operation to remediate soil contaminated with polychlorinated biphenyls at several sites on the installation. This action may lead to closing the three sites with no further action required. Technology demonstration and full-scale performance data were distributed Navy-wide to facilitate the use of the technology at other Navy installations.

DOD also participates in another demonstration program, the Clean Sites Public-Private Initiative, described in Section 2.5.

Development of New Technology

DOD also supports basic and applied research and development on environmental technologies based on user-generated requirements. To coordinate and focus these activities, the services work together to define technology needs and DOD then prioritizes and communicates service-validated requirements to the technology development community.

DOD coordinates new technology development through the Tri-Service Environmental Quality Laboratory Plan (sometimes called the Green Book), which allows program funding to be matched to identified needs. To coordinate and leverage resources, DOD has implemented a plan in which services are designated as leads for various cleanup technology focus areas. For example, researchers at the Air Force's Armstrong Laboratory are developing a bioslurping system that improves the effectiveness of bioventing by removing free product before treatment.

DOD also participates in the Strategic Environmental Research and Development Program (SERDP). SERDP was established by Congress in 1990 to address environmental technology needs of the Departments of Defense and Energy. It is managed by DOD, DOE, and EPA and is supported by DOD funds. The program funds government laboratory, academic, and private industry research and the development of technologies needed by DOD, DOE, and EPA. Most of the funding is used to support technology development in the areas of cleanup, compliance, conservation, and pollution prevention. The cleanup area accounts for the largest percentage of program funds and includes 34 cleanup-related technology projects. For example, through the Mobile Underwater Debris Survey System (MUDSS) project, SERDP hopes to provide the DOD services with an effective technology for detecting unexploded ordnance at underwater ranges.

Examples of technologies being developed or demonstrated in DOD programs include: *in situ* vapor extraction for petroleum, oil and lubricants (POLs), VOCs, and solvents in soil, *in situ* vapor extraction for VOCs in groundwater, *ex situ* vapor extraction, *in situ* soil venting of POLs and solvents, *in situ* bioventing of POLs in soil and groundwater, *in situ* bioremediation of POLs and solvents in soil and groundwater, *ex situ* bioremediation of POLs in soil and groundwater, *ex situ* bioremediation of explosives and propellants in soil, chemical detoxification of chlorinated aromatic compounds in soil, *in situ* carbon regeneration, incineration of explosives-contaminated soil, infrared thermal destruction, low temperature thermal stripping of VOCs in soil, mobile rotary kiln incineration of soils, thermal destruction, radio frequency thermal soil decontamination for POLs and solvents, xanthate treatment for heavy metals in groundwater or wastewater, stabilization/solidification, and compacting of explosives contaminated soils.

DOD work on these and other technologies are summarized in several EPA and DOD documents.[11] [12] [13] [14] [15]. In addition to a brief summary of each project, these documents provide a contact for further technical information. A list of relevant DOD program offices appears in Appendix E.

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