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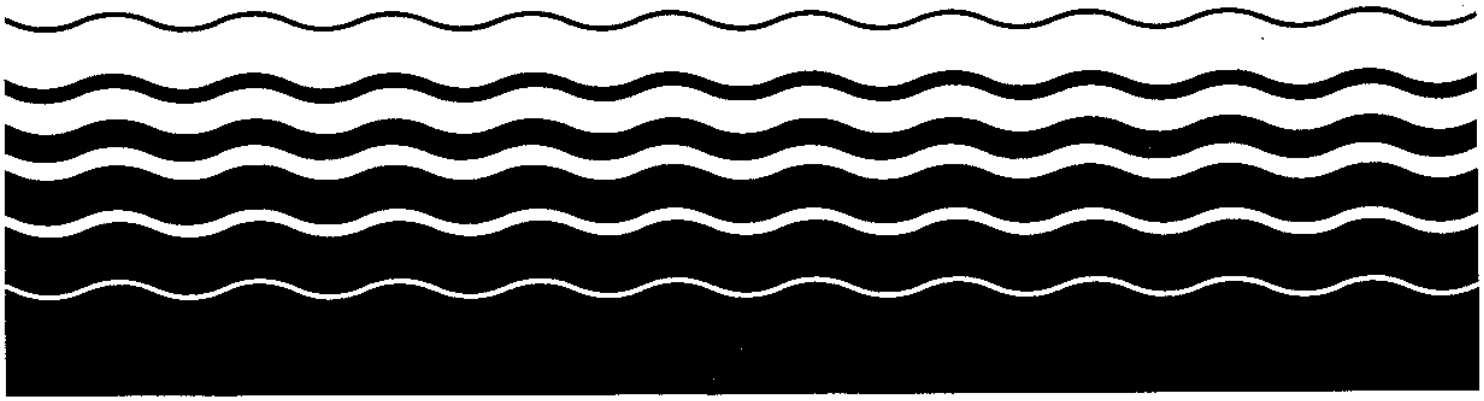
Remedy Selection and Land Use at Federal Facilities



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EXECUTIVE SUMMARY

BACKGROUND

This report presents the results of an examination of remedy selection at Federal Facility Superfund sites on the National Priorities List (NPL). Because a great deal of debate in the Superfund reauthorization process has centered around the role of land use in remedy selection and assertions that future residential land use is too frequently chosen as the basis for a protective remedy, particular emphasis was placed on the relationship between potential future land use at the sites and the role that it plays in determining the nature of the remedy. Other factors affecting remedy selection and the types of remedies and their costs were also examined. Information to support the analysis was collected from Federal Facility Remedial Project Managers (RPMS) in all 10 U.S. Environmental Protection Agency (EPA) Regions. The data collection covered approximately 98 percent of the interim and final source control Records of Decision (RODS) that had been signed at Federal Facilities on the NPL from the beginning of the Superfund program through August 1995.

The primary tool for the study was a survey questionnaire that was mailed to all EPA Regions to collect information on the cleanup remedies selected at Federal Facilities and the factors that influenced the selection of these remedies.[1]

The survey was supplemented by follow-up telephone interviews at 27 percent of those sites that selected a potential future land use of residential. In all, 297 surveys were received from 85 Federal Facilities representing 245 operable units. The data discussed in this report relate to the individual sites or multiple sites for which a single survey provided information. For convenience sake, however, the term site is used to refer to the number of surveys.

Of 297 surveys for which a response was received, 6 referred to petroleum sites, 65 involved only no action sites, and 226 selected remedial action. Of the 226 sites which involved some sort of remedial action, 61 involved only ground-water cleanup (e.g., ground-water 'pump and treat' with no source control); 3 did not provide enough data; 120 had an action that included ground-water remediation and source control, while 45 had an action that only involved source control, with no ground-water remedy.

FINDINGS

Remedy Selection and Cost:

The results of the analysis of cleanup remedies at Federal Facilities revealed that:

- Twenty-nine percent of the remedies and over half (57 percent) of the remedies that do not involve ground-water treatment involve on-site management (i.e., treatment, disposal, or containment).

- Thirty-three percent of the sites show a ground-water remedy. Of these, almost two-thirds employ an active

[1]Many RODs contain multiple, discrete areas of concerns (sites) in one operable unit (OU). Respondents to the Federal Facility Superfund Survey (FFSS) were instructed to complete a separate survey for all sites within an OU that were "geographically distinct areas and with different land uses and remedies." Therefore, each individual survey may refer to an individual site or multiple sites with the same remedy selection and related factors. For convenience sake, the work "site" in this report is used to refer to an individual completed survey and may encompass more than one site.

ground-water treatment remedy.

- Over two-thirds of the sites selected remedies costing less than $5 million, with 24 percent costing less than $500,000. Twenty-two percent were over $10 million.[2]

- The results suggest that remedies involving active ground-water treatment are typically more expensive than remedies involving passive ground-water management or nonground-water remedies. No conclusions can be drawn that this is due to the costs of the ground-water remedy. In fact, for the most costly remedies (i.e., more than $50 million), the cost of ground-water remediation is minimal when compared to other cost drivers such as volume of waste material. The need for a ground-water remedy may be reflective of the complexity of the site, which may also drive the cost.

- Examination of residential land use shows no discernible pattern of relationships to the overall cost of the remedy for the universe as a whole. Residential land use is likely to have an impact at individual sites. However, because no unit cost data or data comparing costs for a residential versus nonresidential scenario at the same site are available, that impact is not documented in this study.

Future Land Use

The results of this study show that a variety of future land use designations are operative at Federal Facilities. The following results are for surface/source control remedies that are not ground-water only remedies. A total of 165 sites fell into this category. The most frequently chosen future land uses are residential (45 percent (i.e., 75 sites)), landfills (15 percent (i.e., 25 sites)), and industrial/military (about 20 percent (i.e., 34 sites)). However, a telephone survey provided a closer examination of the sites that chose a residential future land use and revealed that a significant percentage (15 percent of the total (about 26 sites)) are considered suitable for a future land use of residential, but the remedial action (and cleanup to levels suitable for residential use) was chosen to be protective of ground water. In other words, addressing the source of ground-water contamination was the driver of the remedy, not future land use. The residential future land use designation was a result of the cleanup, not a cause. In addition, 7 percent (i.e., 11 sites) are landfills which had a future land use designated as residential. Presumably, however, these landfill sites will not be cleaned to unrestricted use. Consequently, an extrapolation based on the telephone survey suggest that the percentage of sites for which the remedy is based on a truly residential future use scenario is only about 24 percent (about 40 sites).

Examination of FFSS statistics and follow-up telephone interviews suggest that there is a great deal of confusion about what is being asked when the question is posed--"What is the future land use of the site on which the remedy is based?' This confusion appears to have a number of sources, one of which is the apparent lack of a clear, written definition of residential land use. Therefore, study results described above are based on an integration of survey and telephone interview data, particularly with regard to the designation of residential future land use. For the purposes of this study, the authors used a definition that reflects the national policy debate on this issue, and that is commonly accepted. Namely, that protectiveness to residential land use is defined as protection to human health levels that allow unrestricted use of the site. This definition is consistent with residential exposure assumptions, and with requirements to review sites every 5 years if waste above unrestricted use levels has been left onsite. In addition, the survey clearly asked that the future land use that is identified be the one on which the remedy selected is based. Yet, regional responses to the survey showed substantial inconsistency over the definition of residential land use and interpretation of what it

[2]The survey asked respondents to identify the "estimated cost of the selected remedy." As a result, depending on the interpretation of the responder, the cost data may only include capital cost, it may or may not be present value costs, it may or may not include operation and maintenance (O&M) cost, etc. Cost data presented in this report, therefore, should be evaluated somewhat cautiously.

means to base the protectiveness of the remedy on a particular land use. This confusion was reflected in the survey results with identification of future land use as residential at sites where the basis of the remedy was cleanup of the site to be protective of ground water, where landfill surfaces were made safe for nearby residents to walk upon or otherwise recreate, and, in some cases, where the ground-water remedy was designed to clean up the ground water to d@g water levels (and the remedy had nothing do so with the surface use of the land). This confusion regarding the definition of residential land use does not mean that poor decisions are being made. In fact, the evidence suggests that the assertion that Federal Facilities are too frequently asked to clean up to residential land use is based partly on this confusion rather than fact.

Raw data responses indicate that 45 percent of the remedies selected were based on a residential future use scenario. Most of these remedies were at Department of Defense (DOD) installations. Further analysis suggests that this percentage is overstated (perhaps by as much as 50 percent) for several reasons, including:

- **Surface cleanup to protect ground water resulting in residential land use designations.**

- **Designation of large landfills as residential land use.**

Reasons why cleanup is based on residential future land use **at** Federal Facilities include:

- **Uncertainty over the future use of military bases in the face of the Base Realignment and Closure (BRAC)** process over the past several years. This uncertainty may have a substantial influence on the two other factors listed below, as well.

- **Proximity of military Base personnel or off-site residences** to the site (i.e., residential use nearby) may have led to a 'residential' cleanup designation although the remedial site is currently intended for recreational or other use.

- **Site-specific decisions that the cost of cleanup to residential levels may have a low incremental cost over a cleanup to industrial or commercial levels and should, therefore, proceed.** Cleanup to reduce future liabilities (e.g., operation and maintenance costs) and 5-year reviews, and to ensure the property could be transferred in the face of a future property transfer also plays a role. Federal Facilities may contain a number of smaller, less complex sites that lend themselves to a simple remedial action which are, in turn, designated as residential.

- **Anticipation by the Federal Facility of a residential cleanup scenario such that other options may not have been fully explored.**

- **State preferences for residential land use in selected States.** There is evidence from EPA Regional RPM interviews that State regulators play a significant role in determining cleanup levels at NPL sites. Survey data supports this anecdotal data.

ORGANIZATION OF THE REPORT

The report that follows is organized into three chapters and a series of appendices. Chapter I presents an introduction to the report, and summarizes the data sources and analytical methodology. Chapter 2 discusses remedy selection and remedy cost at Federal Facilities. Chapter 3 presents the results of the study regarding land use selection at Federal Facilities. The document also contains the following appendices:

- Appendix A - Contains a blank copy of the survey form and instructions;

- Appendix B - Lists the RODs for surveys that were received;

- Appendix C - Presents the follow-up telephone survey questionnaire as well as the detailed results of the interviews;
- Appendix D - Outlines the FFSS analytical methodology; and
- Appendix E - Presents an analysis of the effects of land use assumptions on remedy cost. [Note: This analysis was previously prepared under EPA Contract No. 68-D3-0013, Work Assignment 10.]

CHAPTER 1. INTRODUCTION

1.0 INTRODUCTION AND PURPOSE

Ms report presents the results of an analysis of the National Priorities List (NPL) Federal Facility Superfund Survey (FFSS) questionnaire data on remedy selection. The purpose of the survey was to develop a broad understanding of the kinds of remedies selected as cleanup options at Federal Facilities on the NPL, and the factors that influenced the selection of these remedies including future land use. A great deal of debate in the Superfund reauthorization process has focused on the role of land use in remedy selection and assertions that residential land use is extensively chosen, resulting in expensive cleanups. Therefore, particular emphasis was placed on gathering data on the role that land use plays in determining the nature of the remedy. Other factors affecting remedy selection and the types of remedies and their costs were also examined. Information to support the analysis was collected from Federal Facility Remedial Project Managers (RPMS) in all 10 U.S. Environmental Protection Agency (EPA) Regions. The data collected covered approximately 98 percent of the interim and final source control Records of Decision (RODS) that had been signed at Federal Facilities on the NPL from the beginning of the Superfund program through August 1995. In all, 297 surveys were received representing 85 Federal Facilities.[3]

1.1 Data Sources

Two main sources of data were used to prepare this report. The first is a data base created from the results of the FFSS. The second is a series of follow-up telephone interviews directed at over 25 percent of the sites where residential future land use was identified. The survey was modeled, in part, on the RPM Site Evaluation Survey conducted of all Superfund sites in August 1993, which was used in a similar study of land use at private party sites.[4] To create the FFSS, however, additional questions were added to the RPM survey regarding issues that appeared to require further clarification. The FFSS was distributed by EPA Headquarters to Federal Facility managers in each EPA Region. The manager then provided the questionnaires to the EPA site managers. Appendix A contains a copy of the FFSS form and the instructions for completing the survey form.

RPMs were requested to complete a survey for all operable units (OUs) for which an interim or final ROD had been signed. Using EPA's Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) data base, a preliminary listing of RODs was developed and sent to each Region. Information was requested on 251 RODS. RPMs were asked to complete **a** separate survey whenever the information in the survey was different for different sites within the OU. Survey forms were returned for 98 percent of the RODS. Two-hundred ninety-seven responses were received for 245 OUs on 85 Federal Facilities. Approximately 70 percent of these surveys were from Department of Defense (DOD) facilities, 23 percent were Department of Energy (DOE) facilities, and 7 percent were "other" Federal agency facilities. Six responses could not be used because they were incomplete or petroleum only sites. Appendix B contains **a** listing of the RODs for which information was requested, and indicates those for which a completed survey was received.

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[3]Many RODs contain multiple, discrete areas of concerns (sites) in one operable unit (OU). The 297 surveys represent many more sites than the number of surveys received. However, for convenience sake, the term “site” is used in this report to refer to the number of completed surveys.

[4]*Land Use Decisions in the Remedial Process*, U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. OSWER 9355.0-55. EPA/540/R-95/037. PB95-963230. March 1995.

The term site in this report is used to refer to the number of surveys, not the actual number of sites. Some of the surveys represent more than one site; therefore, the results based on the actual number of sites may be different than those presented in this report. However, a limited analysis of future land use selection based on the number of sites at source control surveys was very similar to the same analysis based on number of surveys.

In addition, a telephone follow-up survey of 20 sites (each reflecting one or more sites) with a future land use of residential was conducted. The 20 sites were selected from those source control sites identified in the FFSS with a future land use of residential. They were selected randomly, but roughly proportionate to two factors that appeared to have a strong influence on the selection of projected future land use -- involvement of ground-water protection in cleanup and regional location. (Regional location was used as a surrogate for State location because a focus on States in the selection of sites for follow-up would have had too small a number of sites in most States.) Information collected during the telephone interviews was not entered into the data base, but was used to enlighten and clarify the findings and conclusions contained in this report. In addition, telephone interview data were extrapolated to all sites for which potential future residential land use was identified. Appendix C contains a copy of the telephone interview questionnaire and the detailed results of the telephone interviews, including the *type* of questions asked of respondents. (The follow-up interviews were interactive, and as a result, the exact questions varied from interview to interview.)

1.2 Methodology

This section presents a brief description of the key elements of the study methodology. A detailed description of the study methodology is contained in Appendix D.

Of 297 sites, 6 sites were removed from the data base. These six sites dealt strictly with petroleum sites, which are not managed under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), or did not have a signed ROD. Of the remaining 291 sites, 65 were "no action" RODs; these were removed from the study universe, resulting in a total of 226 sites.

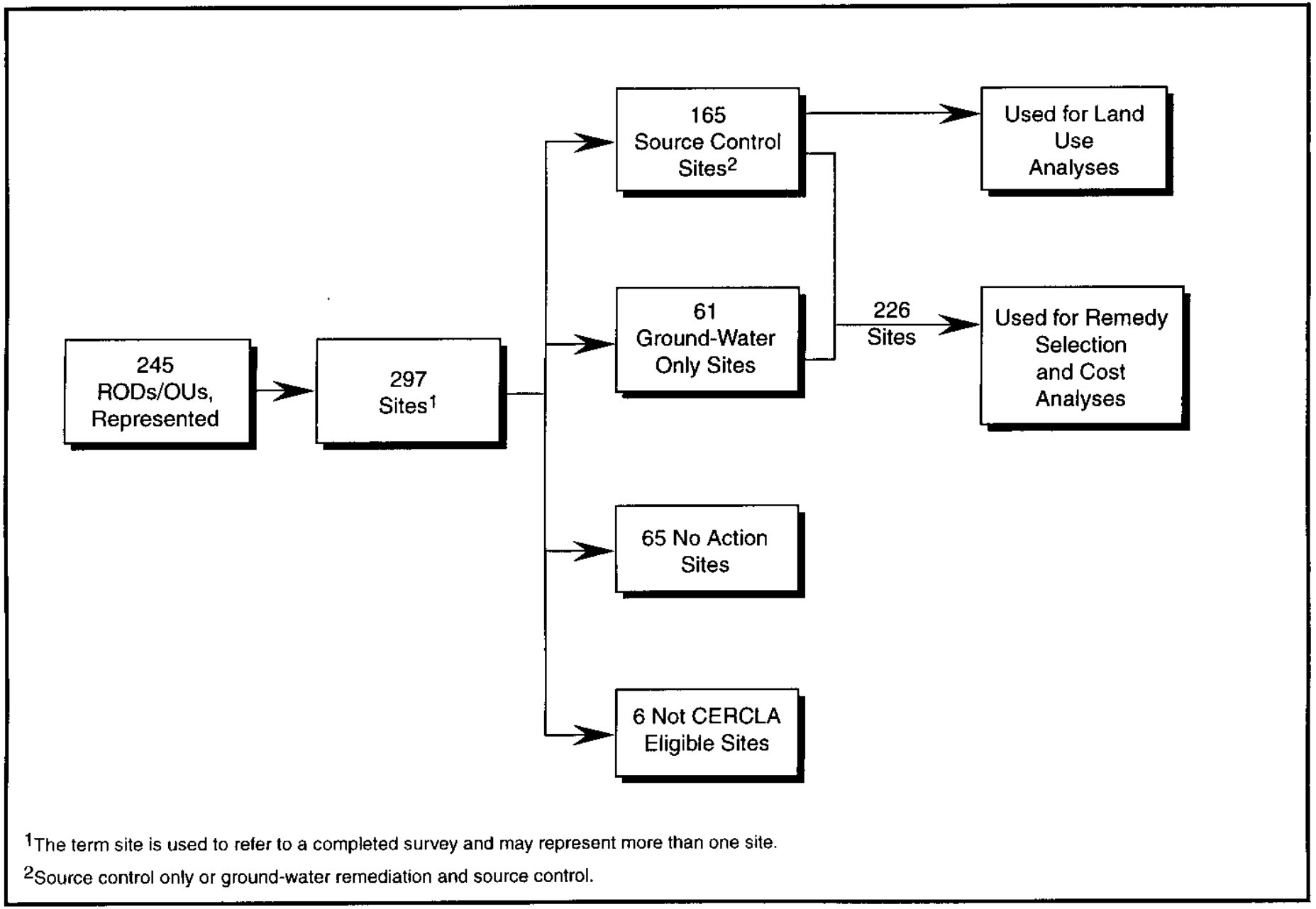
Remedy Selection and Cost Analyses. For the remedy selection and remedy cost analyses, data from all OUs/sites covered by an action ROD were included (i.e., 226 sites).

Land Use Analyses. This analysis assumed that the surface land use will generally have no bearing on the remedy selection process at a site that only involves ground water (i.e., no surface source control), 61 such "ground-water only" sites were removed from most of the analyses involving land use (e.g., current land use, surrounding land use, future land use). The remaining 165 sites are referred to as "source control" sites. Only sites that involved source control were included in the land use analyses.

Highlight 1 provides key definitions of the various site types. Figure 1 summarizes the data sets used for the various analyses.

Highlight 1: Key Definitions to Remember

- Source control sites - Sites where some surface remediation is involved; may or may not also involve ground-water treatment.
- Ground-water only sites - Sites that involve ground-water treatment only (i.e., no surface remediation).
- All sites or all "action" sites - All sites received, except for sites with all no action sites (i.e., all source control and ground-water only sites).



[1]The term site is used to refer to a completed survey and may represent more than one site.

[2]Source control only or ground-water remediation and source control.

Figure 1. Summary of Data Set

Hierarchy of Identified Land Uses. Because respondents to the FFSS were given the opportunity to identify all applicable land uses, most responses to the land use questions contain multiple identified land uses (e.g., sites with identified future land uses of residential, recreational, and commercial). Because of the endless possible combinations of land uses, analysis of land use, and its impact, using multiple responses would be difficult, if not impossible. In order to alleviate this problem, a two-step process was employed. First, all landfills were placed into a separate grouping. Landfills were considered unique because they are typically 'managed' differently than non-landfill sites in that, at virtually all landfills waste is contained (e.g., covered with a protective cap to reduce infiltration to ground water) and left in place. For non-landfill sites, a hierarchical scheme was created to place sites with multiple identified land uses into a single category. Basically, the hierarchical scheme, detailed in Appendix D, evaluates all the identified land uses and assigns the site to the land use category that would typically result in the most restrictive exposure assumptions. Based on this, the hierarchy assumed the following order from most conservative to least conservative: residential, industrial/commercial,[5] military, recreational, agricultural, and other. For example, if the future land uses were identified as residential, industrial, and recreational, the site would be assigned a future land use of residential for the purpose of analysis because residential exposure scenarios are typically more restrictive (i.e., result in a higher calculated risk) than either industrial or recreational scenarios.

[5]For the purpose of this study, industrial and commercial land uses were assumed to lead to the same or very similar exposure assumptions and, therefore, were combined into a single “industrial” group.

CHAPTER 2. REMEDY SELECTION AND REMEDY COST AT FEDERAL FACILITIES

2.0 REMEDY SELECTION AND COST

This chapter presents the detailed results of the analysis of remedy selection at Federal Facility sites in the survey. The relationship between remedy and cost will also be discussed in the following sections.

2.1 Overview of Remedy Selection Data from the FFSS

An overview analysis of remedy selection reveals that landfills are more likely to chose on-site management with institutional controls. Landfill sites are less likely to select off-site management than non-landfills. Specifically, Figure 2 presents the FFSS results on remedy selection at all non-landfill "action' sites (i.e., excluding landfills and no action sites) based on the percentage of sites that chose each remedy type, and Figure 3 shows the remedies selected at landfills in the FFSS survey based on the percentage of landfill sites that chose each remedy type.

A closer look at remedy selection at source control sites shows that for landfills the remedy is significantly more likely to be on-site management as compared to non-landfill sites. For example, Figure 4 shows that at 45 percent of the non-landfill source control remedies (i.e., do not include ground-water pump and treat only sites)[6] wastes are managed onsite, and that wastes are managed either offsite only or both onsite and offsite at 32 percent of the sites. On the other hand, Figure 4 suggests that none of the landfill source control remedies involve off-site waste management exclusively, and only 3 percent involve any off-site management.

It is important to remember that the FFSS remedy selection question allowed respondents to check all applicable answers; therefore, specific sites are often represented in more than one category. For example, if an RPM checked ground-water pump and treat and on-site treatment, the site would be represented in **both** categories.

Figure 5 presents the results of the analysis of ground-water treatment remedy selection at non-landfill and landfill sites. Figure 5 shows that when a ground-water remedy is selected at non-landfills, the remedy is an active ground-water remedy[7] 56 percent of the time, a passive remedy 23 percent of the time, and a combination of an active and passive remedy 21 percent of the time. At landfills, however, the numbers are substantially different (Figure S). Ground-water remedies at landfills are passive 47 percent of the time and active only 29 percent of the time. There are several potential explanations for this. One possibility is that because the source at landfills is capped rather than removed, active pump and treat to cleanup ground water is often not practical, whereas containment of the ground water or natural attenuation may be.

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[6]The percents shown on these figures only include nonground-water remedies; however, due to the structure of the remedy selection questions in the FFSS, if respondents indicated a ground-water remedy and also indicated a source remedy (e.g., on-site treatment) for the ground-water portion of the remedy, these have been inadvertently included.

[7]The designation of “active” and “passive” ground-water treatment/management was based on FFSS responses. Active treatment included: ground-water pump and treat; ground-water pump and discharge; ground-water biological treatment; and ground-water chemical/physical treatment. Passive management included: ground-water natural attenuation; ground-water containment; and ground-water engineering controls.

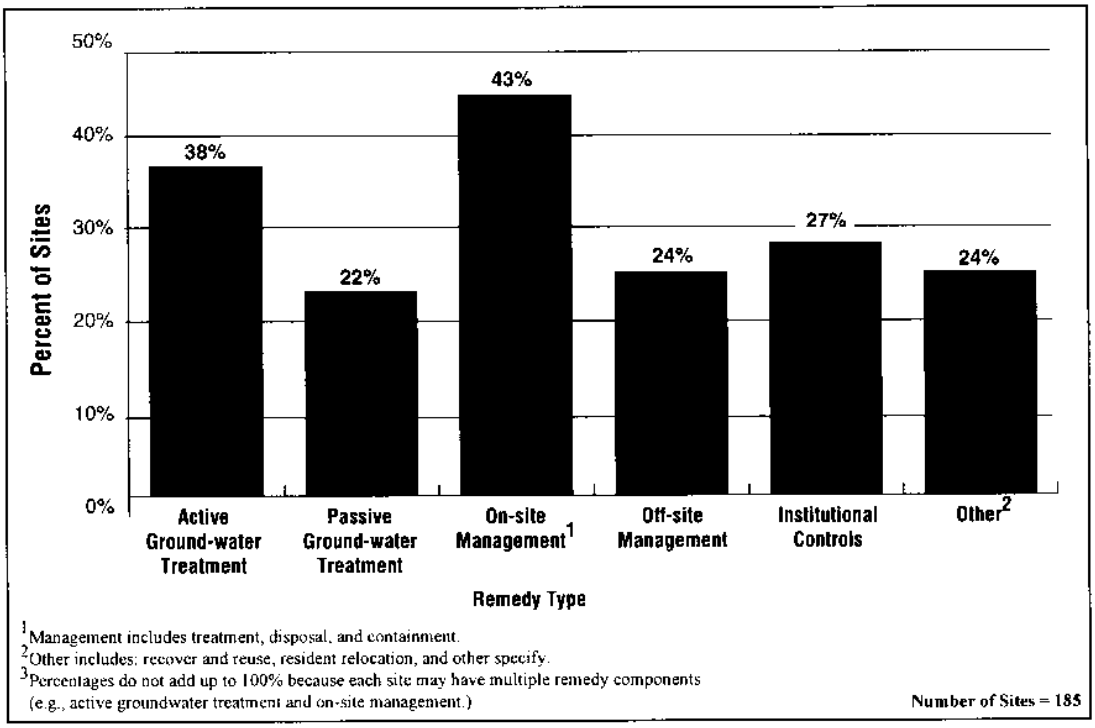


Figure 2. Percent of Sites for Which Specific Remedies are Identified: Non-Landfill Sites[3]

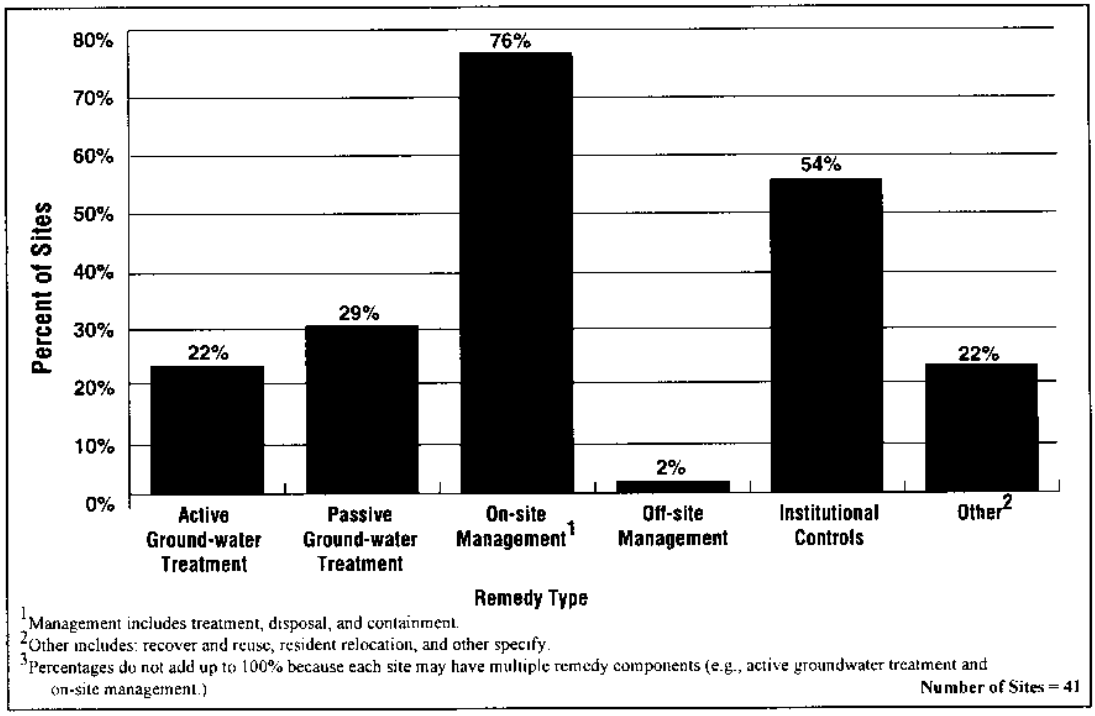
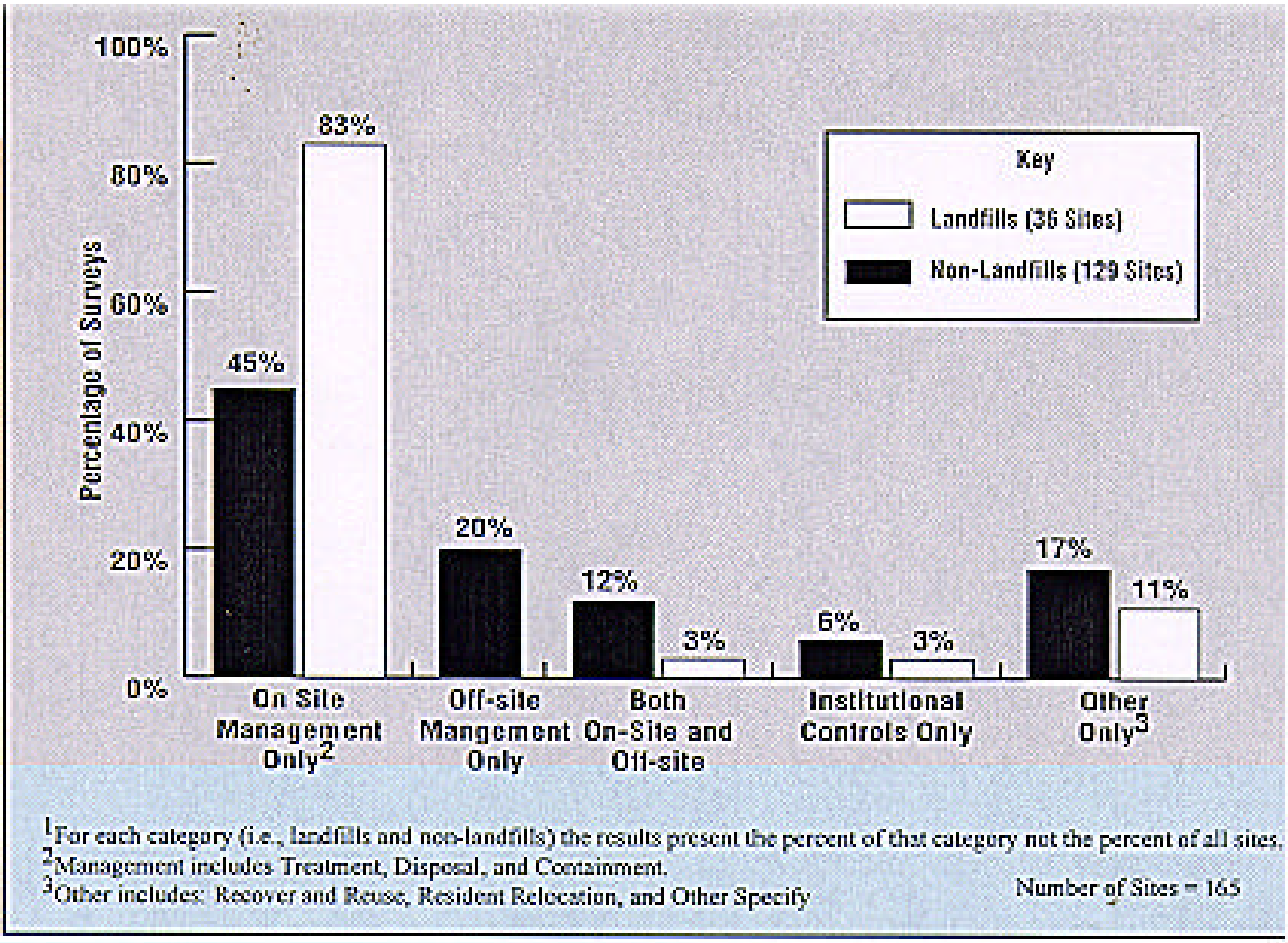


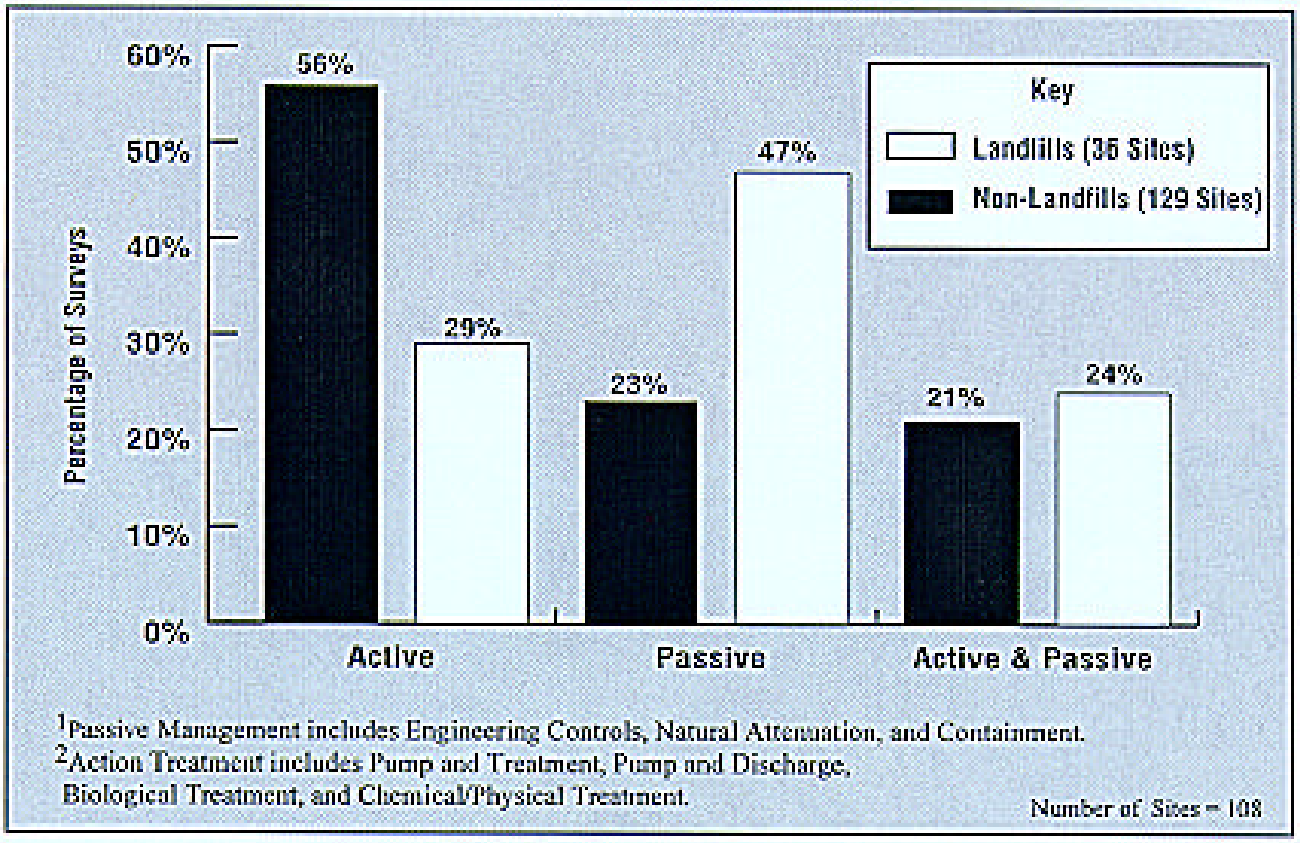
Figure 3. Percent of Sites for Which Specific Remedies are Identified: Landfill Action Sites[3]



[1]For each category (i.e., landfills and non-landfills) the results present the percent of that category not the percent of all sites.
[2]Management includes Treatment, Disposal, and Containment.
[3]Other includes: Recover and Reuse, Resident Relocation, and Other Specify

Number of Sites = 165

Figure 4. Source Control Remedy Selection at Landfills and Non-Landfill Sites



[1]Passive Management includes Engineering Controls, Natural Attenuation, and Containment.
[2]Action Treatment includes Pump and Treatment, Pump and Discharge, Biological Treatment, and Chemical/Physical Treatment.

Number of Sites = 108

Figure 5. Ground-water Treatment Remedy Selection at Landfill and Non-landfill Sites Involving Ground-water Management

2.2 Remedial Cost Analysis

As shown in Figure 6, 69 percent of the remedies are estimated to cost less than $5 million, and less than 7 percent of the remedies are estimated to cost more than $50 million. During the follow-up telephone survey, more than half of the RPMs contacted indicated that cost, whether remedial cost or operation and maintenance (O&M) costs, played a role in remedy selection. Presented below are the results of some detailed analyses of remedy cost.

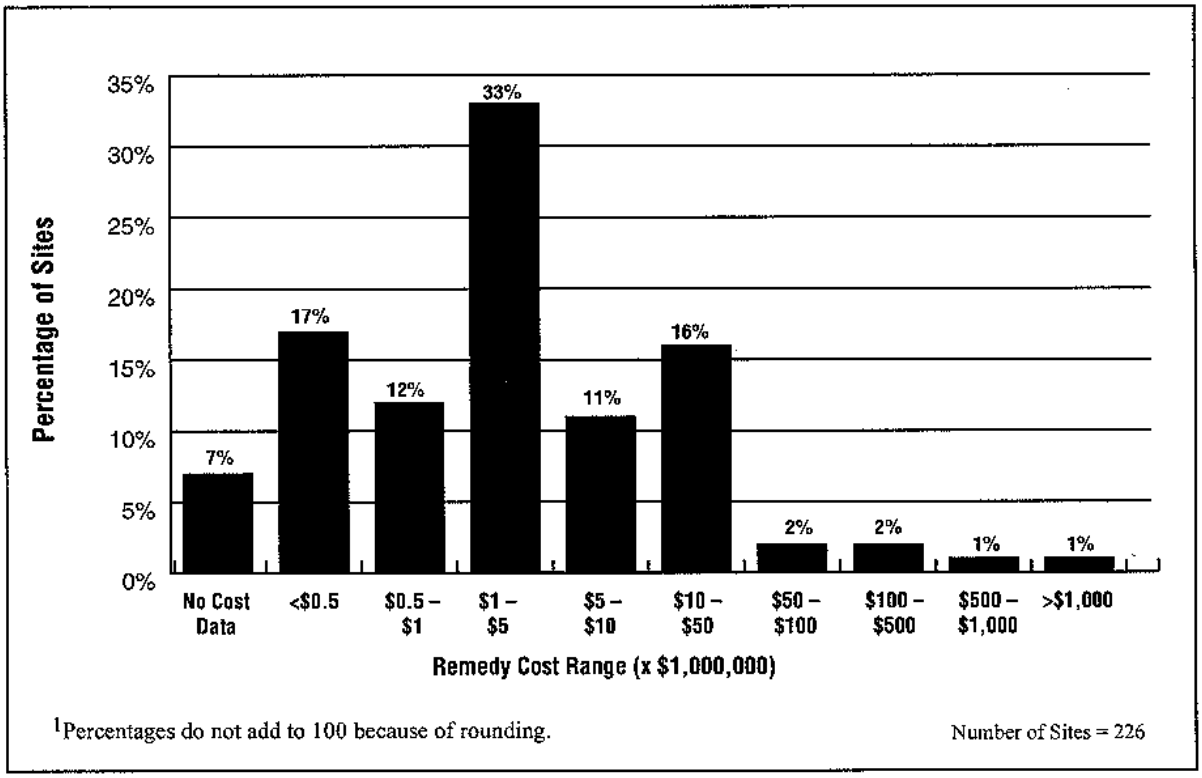
Based on Survey Results, There Is No Major Difference in Remedy Cost Between Sites with a Designated Future Land Use of Residential vs. Nonresidential. One might expect that future land use would have a major impact on the cost of the remedy for a site. As shown in Figure 7, however, the FFSS results indicate that there is no identifiable difference in the cost of the remedies at future land use residential and nonresidential sites. At any individual site, the choice of future land use may play a role in the cost of a remedy, but there was no nationally discernible pattern in this regard. In addition, many other site-specific factors affect the cost of the remedy (e.g., volume of waste, actual cleanup levels, need to protect ground water, specific type of remedy chosen), and in some cases, the residual risk level on which the cleanup level is based may play a larger role in the final remedy cost than the future land use. For example, the cleanup levels from an industrial 10^{-6} risk scenario may, in fact, be lower (i.e., more stringent), and therefore, result in a higher cost than the cleanup levels from a residential 10^{-4} risk scenarios[8] (See Appendix E.)

Selection of an Active Ground-water Treatment May Play a Role in Overall Remedy Cost. As shown in Figure 8, analysis of the impact of ground-water treatment with respect to remedy cost suggests that remedies involving active ground-water treatment typically cost more compared to remedies involving either passive ground-water treatment only or remedies not involving any ground-water treatment. For example, although 52 percent of the sites representing active ground-water remedies had remedial costs of less than $5 million, fully 94 percent of the sites with passive ground-water remedies and 76 percent of the sites with nonground-water remedies had remedial costs of less than $5 million. In addition, 56 percent of the passive ground-water sites and 48 percent of the nonground-water sites cost less than $1 million, but only 14 percent of the active ground-water sites cost less than $1 million.

It is difficult to draw clear conclusions from the survey on the impact of ground water on the cost of remedies. Total remedy costs are summarized on each site and may reflect the combined costs of several types of remedies. The higher cost of remedies from sites with active ground-water remediation may, in part, reflect the complexity of a site cleanup that has affected ground water. It may also reflect the costs associated with long-term operation and maintenance of ground-water pump and treat systems. At the highest end of the cost range, ground water is often not involved, and costs probably reflect high volumes of waste material or soil.

DOE Has More "High End" Remedies Than DOD. Additional cost analysis was conducted comparing DOD to DOE. As shown in Figure 9, DOE had a much higher percentage of higher cost remedies. In fact, 45 percent of DOE responses had remedial costs exceeding $10 million, compared to only 16 percent of DOD responses. Because DOD sites are more likely to involve a residential future land use, this disparity further amplifies the lack of a pattern regarding costs associated with residential land use. It should be emphasized that the ratio of

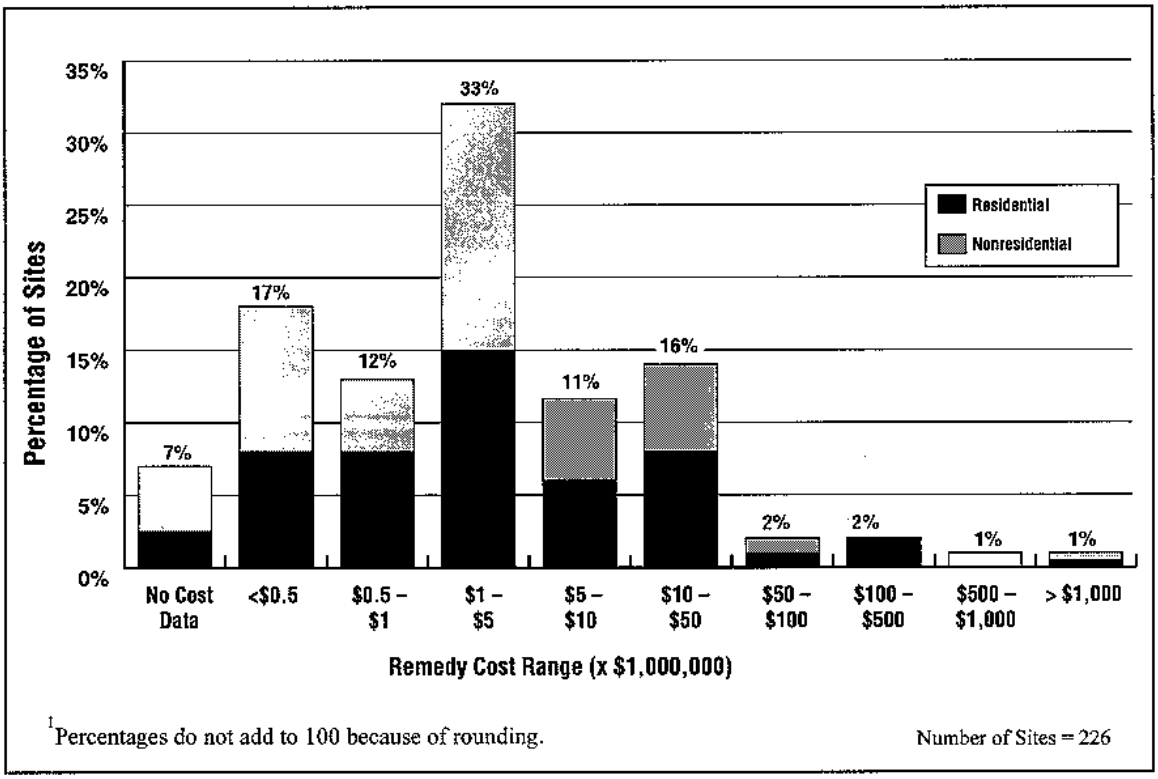
[8]Terms such as 10^{-6} and 10^{-4} are common terms used to express the results of a human health risk assessment. A 10^{-6} scenario represents a 1 in 1 million excess cancer risk, and a 10^{-4} scenario represents a 1 in 10,000 excess cancer risk. The range from 10^{-6} to 10^{-4} is typically considered to be the "acceptable" risk range.



[1]Percentages do not add to 100 because of rounding.

Number of Sites = 226

Figure 6. Overall Remedy Cost Distribution for All Action Sites[1]



[1]Percentages do not add to 100 because of rounding.

Number of Sites = 226

Figure 7. Remedy Cost Distribution for All Action Sites by Landuse[1]

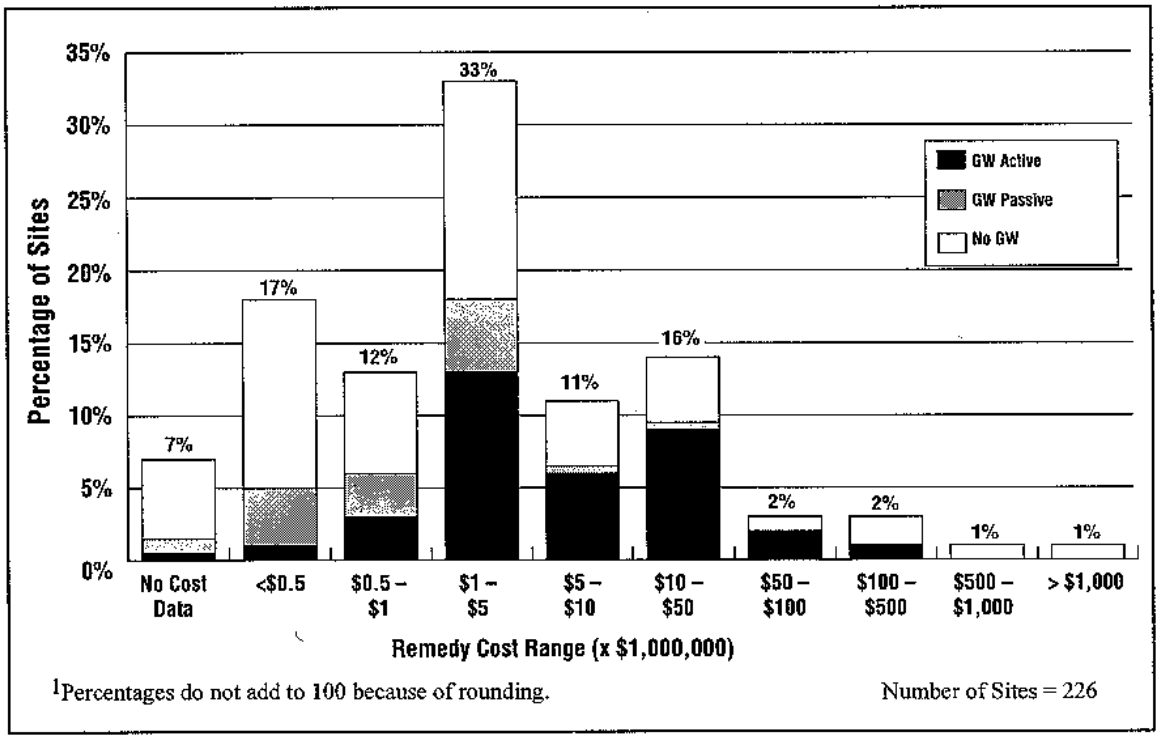


Figure 8. Remedy Cost Distribution for All Action Sites by Ground-water Category[1]

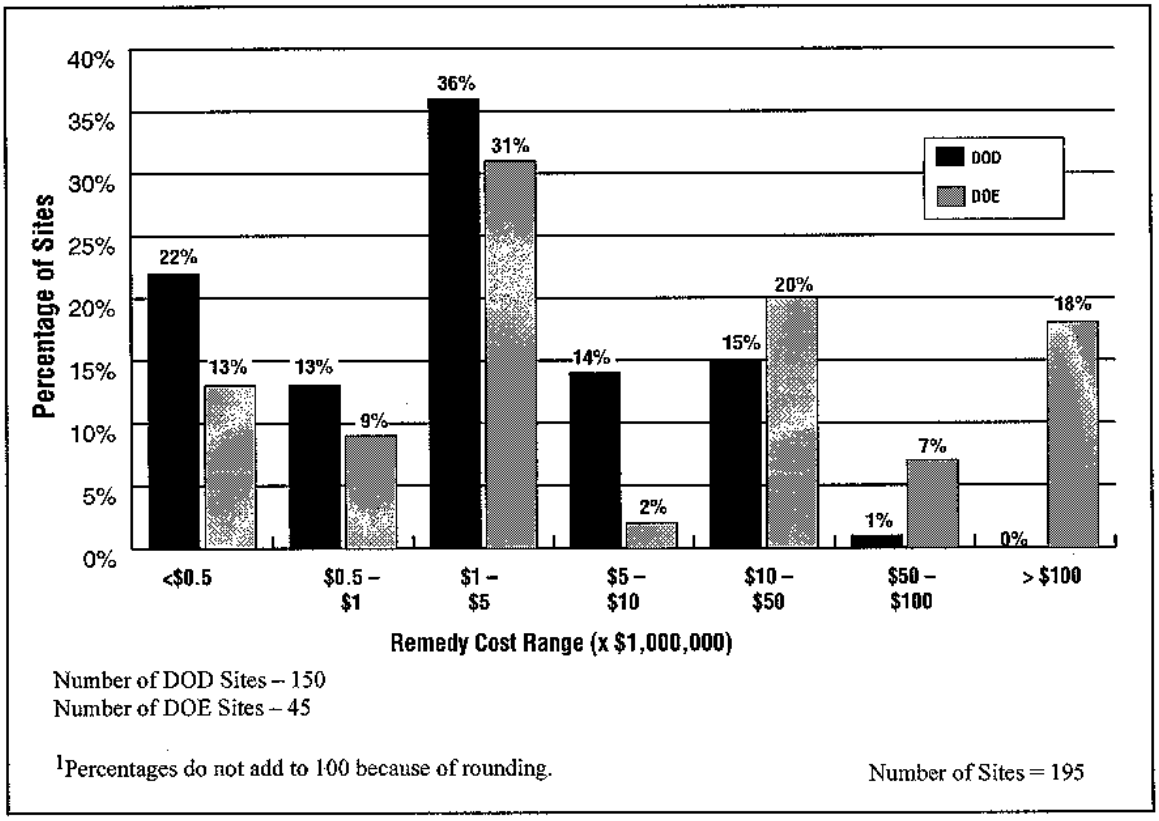


Figure 9. Percentage of DOD and DOE Sites in Each Remedy Cost Range

DOD to DOE sites is over 2.5 to 1; as a result, DOE results are much more sensitive to the influence of outliers.[9] High cleanup costs at DOE sites might be attributable to relatively more complex (e.g., radioactive or mixed) wastes that are not as frequently found on DOD sites as well as to high volumes of waste material to be managed.

2.2.1 O&M Cost Analysis. Part of the FFSS asked respondents about operation and maintenance cost for remedies. Of the 226 action sites, 46 percent had O&M costs greater than $60,000 per year. Figure 10 shows the breakdown of the O&M costs by "type" (i.e., source control for soils, source control for ground water, source control for soils and ground water, and ground-water pump and treat sites). The figure suggests that ground-water treatment plays a significant role in O&M cost. In fact, of the 103 sites that have O&M costs greater than $60,000 per year, 88 percent involve ground water.

2.2.2 Cost Drivers. Another FFSS question asked respondents to identify the 'principal cost driver of the cleanup.' The breakdown of the principal cost drivers for all action sites is depicted in Figure II. It is important to note that because the RPMs were allowed to select multiple responses for this question, the percentages reflect the number of responses, not sites. The cost to treat large volumes of waste was selected the most frequently (40 percent of the responses); unique waste/complex site characteristics were selected 28 percent of the time; and treatment/disposal cost and other at 19 percent and 13 percent, respectively.

As shown in Figure 12, the cost drivers for all residential future land use sites and nonresidential future land use sites are quite similar. However, residential future land use sites are slightly more likely than nonresidential uses (that are not landfills) to identify large waste volumes as a cost driver, and nonresidential future land use sites are slightly more likely to identify treatment/disposal costs as a cost driver. On the other hand, large waste volumes and treatment/disposal costs (presumably of large waste volumes) are the major cost drivers at landfills.

2.3 Influence of DNAPLs

Dense Nonaqueous Phase Liquids (DNAPL) issues did not appear to play **a** significant role in remedy selection at the sites in this survey. Of the 108 sites that involved a ground-water remedy, only 17 indicated that DNAPLs were involved at the site. None of these 17 DNAPL sites signed **a** contingent ROD or implemented a technical impractibility (TI) applicable or relevant and appropriate requirements (ARARS) waiver. In addition, 12 of these RODs involved active ground-water remedies, and S (29 percent) involved only passive ground-water remedies.

2.4 Innovative Technologies

Data from the FFSS indicate that 114 (50 percent) of the 226 action sites considered innovative alternative technologies in the development of alternatives. However, only 87 (38 percent) of the 226 action sites formally considered innovative alternative technologies in the detailed analysis of alternatives. The FFSS does not contain data on the number of times an innovative technology was chosen.

Consideration of Innovative Technologies at DOD Versus DOE Sites. The innovative alternative treatment technologies analysis was broken down one step further, comparing the DOD sites to DOE

[9]Of the 226 action sites, 159 (70 percent) are at DOD facilities, 51 (23 percent) are at DOE facilities, and 16 (7 percent) are at other Federal agency facilities. The analysis discussed in this subsection and presented in Figure 9 does not include the 16 other agency sites. In addition, the analysis only includes sites for which cost data were available. As a result, 150 DOD sites and 45 DOE sites were evaluated in this portion of the study.

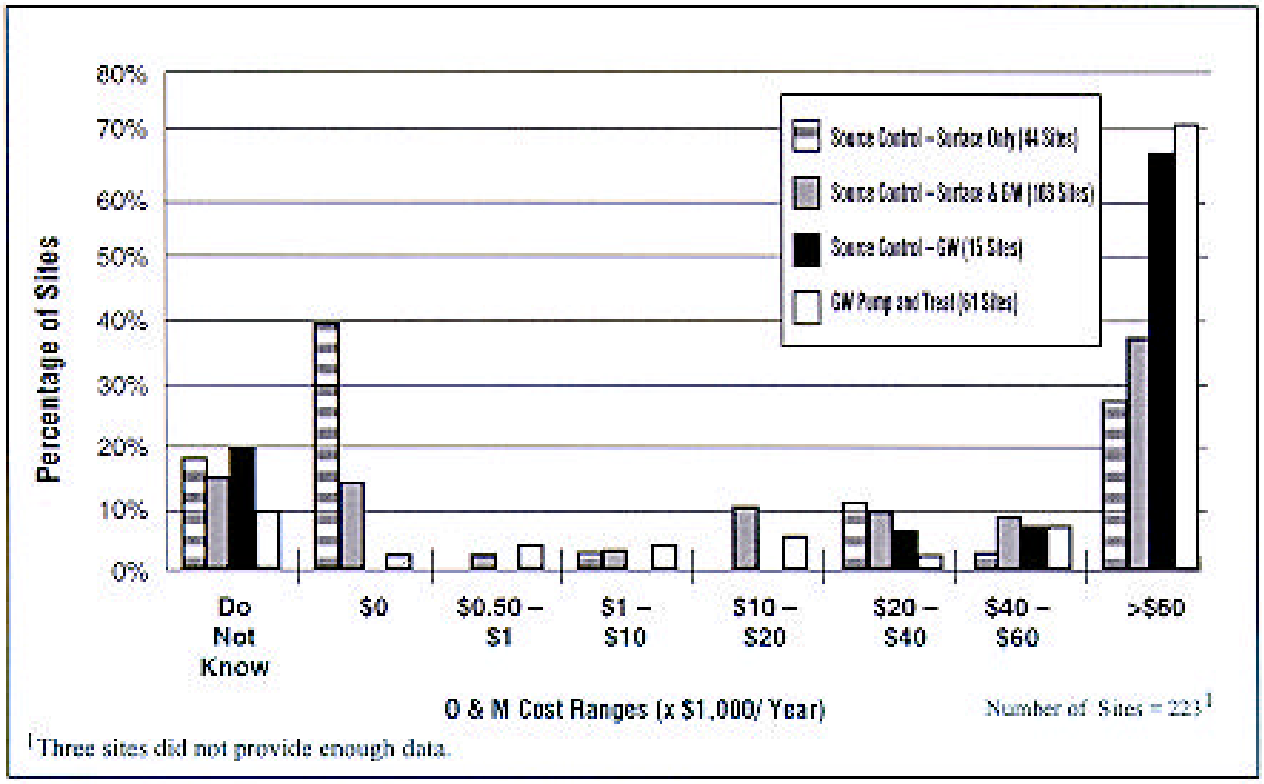


Figure 10. Operation & Management Cost by Site Type

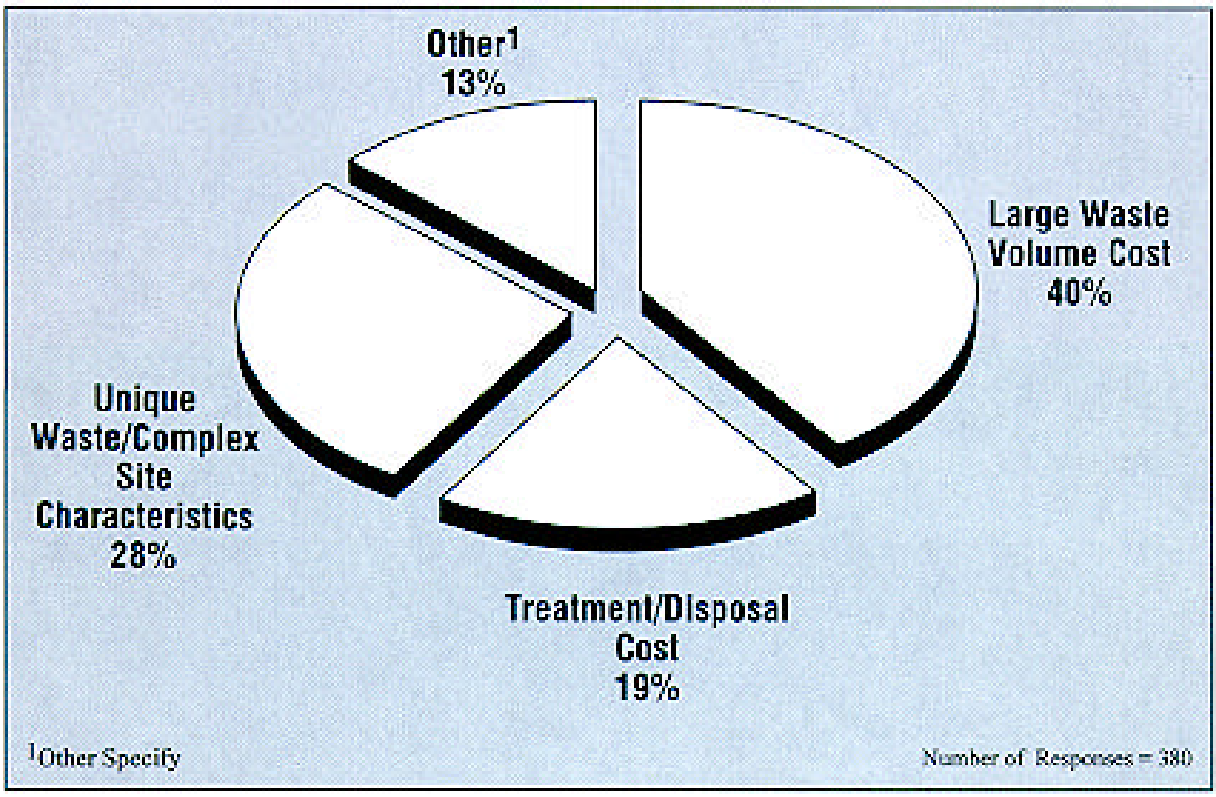


Figure 11. Principal Cost Drivers

sites. As shown in Figure 13, both DOD and DOE sites considered innovative alternative technologies roughly 50 percent of the time in the development of treatment alternatives; however, there is a much larger disparity between the two agencies in the formal consideration of innovative alternative technologies in the detailed analysis of alternatives (42 percent for DOD versus 27 percent for DOE).

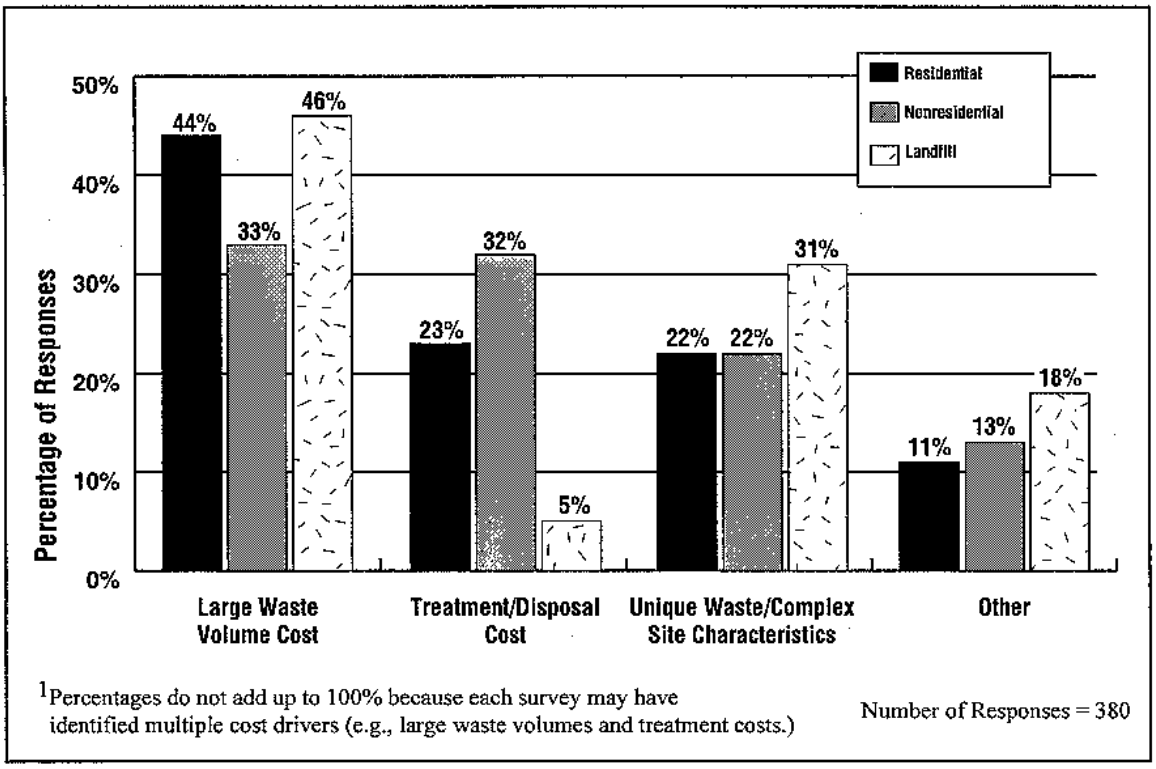


Figure 12. Comparison of Principal Cost Drivers by Future Land Use[1]

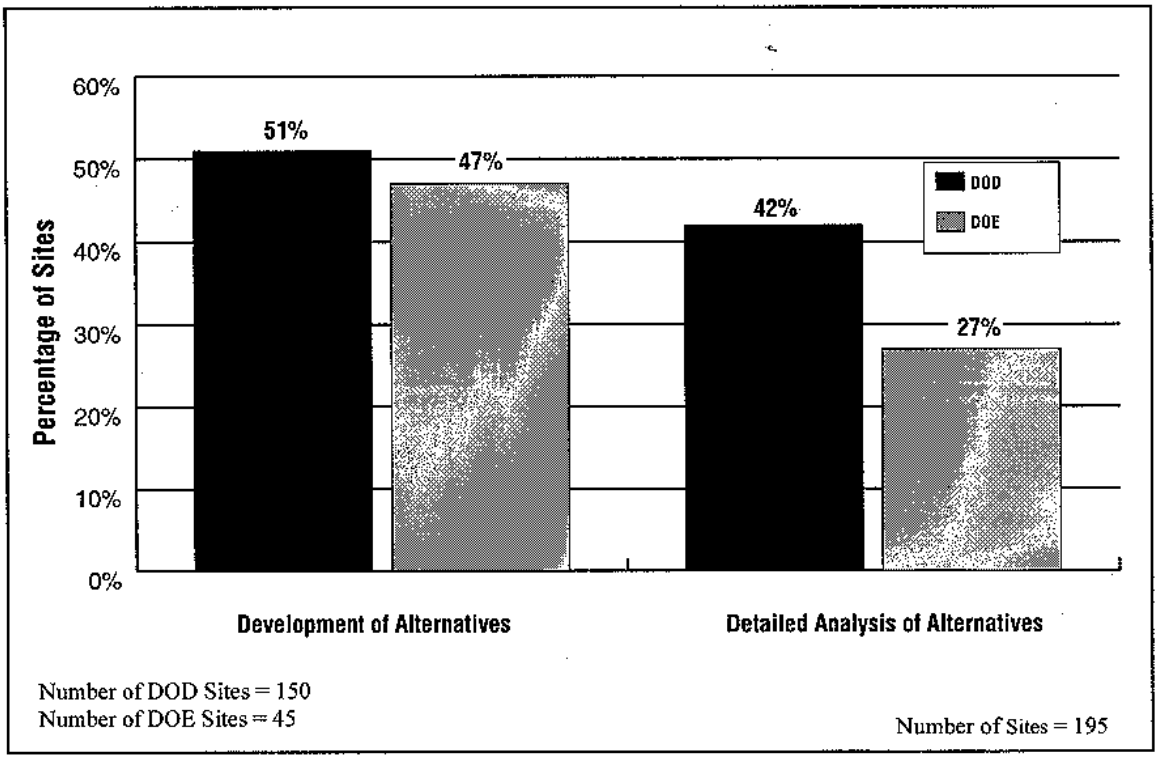


Figure 13. Consideration of Innovative Treatment Technologies at DOD and DOE Sites

CHAPTER 3. IDENTIFICATION OF POTENTIAL FUTURE LAND USE AND ITS RELATIONSHIP TO REMEDY SELECTION

3.0 IDENTIFICATION OF POTENTIAL FUTURE LAND USE

The identification of a projected future land use at a Superfund site plays **a** potentially important role at two key points of the process. First, current and future land uses are evaluated to determine the need for cleanup action. The National Contingency Plan (NCP) asks that assessment of the current and future risks associated with a site be based upon current and potential exposures under "reasonable maximum exposure scenarios." This baseline risk assessment is used to determine if action is necessary to protect current and future users against exposure to site contaminants. Second, risk management decisions made in the remedy selection process are designed to protect current and future users from exposure. Identification of future land use is used to determine the exposure calculations to set cleanup levels. Residential land use is considered the most restrictive land use. Exposure assumptions that go into calculation of cleanup levels to support residential land use generally assume unrestricted access to surface and near surface waste. Therefore, residential cleanup levels assume that no waste is left on the site that could result in exposure during intrusive activities such as housing construction or to children who may play in exposed areas.

For the purposes of this report, Residential Future Land Use is defined as a surface use of the land that supports unrestricted use of the land such that a residence can be safely built on the land with no institutional controls (e.g., deed restrictions) and no waste left onsite to be managed above levels that are protective of human health and the environment. **In this definition, Residential Land Use has nothing to do with the use of ground water beneath the site.** What became clear in the course of the investigation into the role of future land use on remedy selection is that **there is no single accepted definition of residential land use,** and that regional responses to questions concerning "what is the potential future land use of the site" may have different interpretations than the definition given above.

The sections that follow present the detailed results of the analysis of potential future land uses selected at Federal Facility sites as of August 1995.

3.1 Overview of Future Land Use

As shown in Figure 14, a residential future land use was chosen 45 percent of the time, 16 percent selected other (e.g., recreational or open space), 15 percent were nonresidential landfills (i.e., landfills with a future land use other than residential), industrial was chosen 13 percent of the time, and military use 7 percent of the time. However, as also shown in Figure 14, the telephone survey analyzing the nature of future land use choices at Federal Facilities suggests that 15 percent of the sites indicated that the site may be suitable for future residential land use, but the cleanup levels selected were not a result of a projected future residential land use. In these cases, removal of sources of contamination to levels required to protect and/or remediate ground water to achieve drinking water standards (i.e., maximum contaminant levels (MCLs)) is typically below levels required to be protective for residential land use on the surface of the land. In these instances, RPMs filling out the survey questionnaire identified the potential future land use as residential. Interviews with RPMs and a closer understanding of the role of groundwater in driving remedy selections lead to a conclusion that, in these cases, the identification of residential

future land use is a result of the level of cleanup achieved, not a cause.[10] These sites are shown on Figure 14 as "Ground-water/Source Control (Residential)" sites. In addition, 7 percent of the sites are landfills with a future land use of residential, which, in most cases, one would assume would not be cleaned up to unrestricted use (i.e., waste left on site). Consequently, it is estimated that only about 24 percent of the sites will involve a future residential land use that drove the remedy.[11]

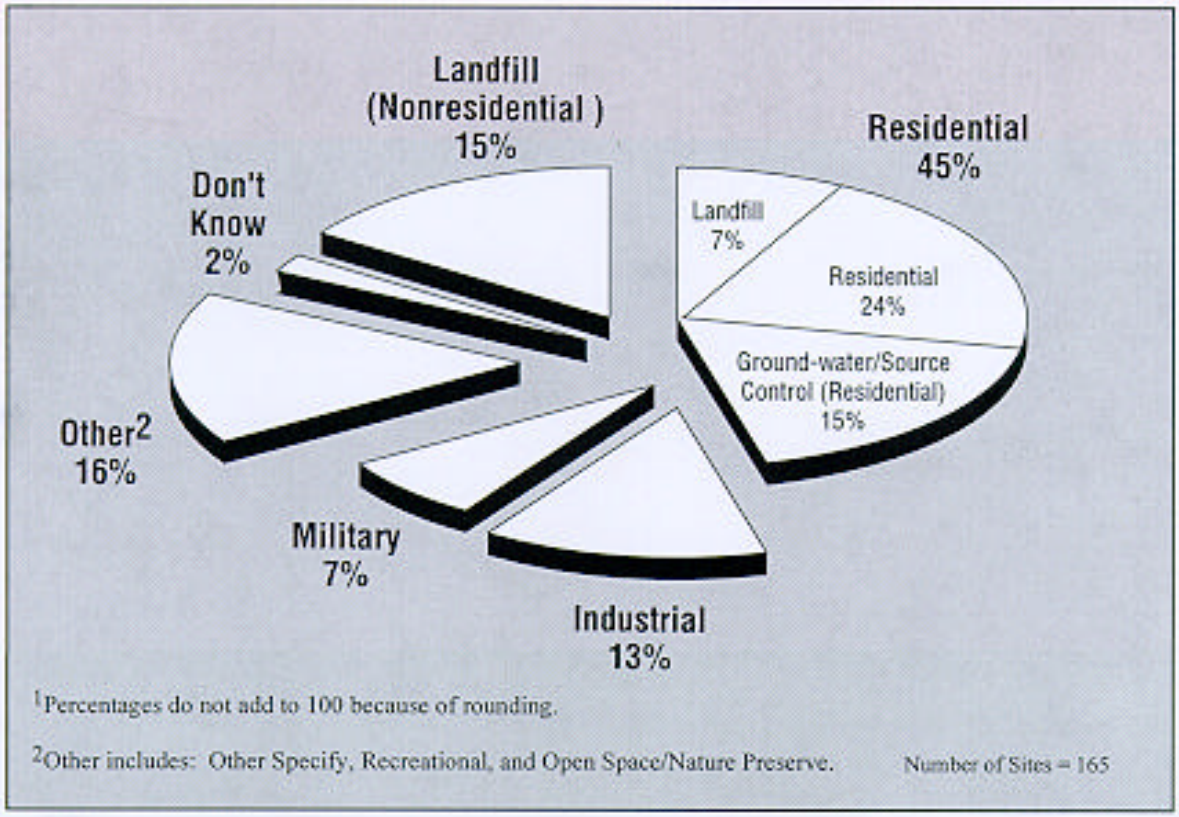


Figure 14. Future Land Use Selection at Federal Facilities[1]

[10]The data in this section are based upon the results of the FFSS as modified by the results of the telephone interview data described in Section 3.2. The modification was completed with a simple extrapolation of the telephone data to the numbers in the survey. Therefore, percentages of land use identified in the residential, ground-water, and "other" categories may not be tracked back to individual surveys.

[11]The definition of residential land use used in making this statement is the one offered in Section 3.0.

3.2 Understanding the Data

For the purposes of this report, cleanups that are protective of a residential future land use are assumed to clean up the site to an unrestricted use. This means that the surface media (i.e., soil) on the site will remain protective no matter what the future use of the site is, and will not require institutional controls to maintain this protectiveness. This definition is consistent with the national level policy debate on the role of land use in remedy selection. It also mirrors the circumstances for sites to be identified as requiring a 5-year review.

A particularly striking outcome of this analysis is the apparent lack of national consensus on the definition of residential land use. This does not mean that poor decisions are being made. In fact, the evidence suggests that the assertion that Federal Facilities are too frequently asked to clean up to residential land use is based, partly on confusion rather than fact.

Residential land use is clearly identified in the NCP as the most conservative reasonable maximum exposure scenario. Conservative residential exposure assumptions for contaminated soil found in risk assessment guidance are based on the ingestion of soil by children for a duration that generally reflects the assumption that children are living onsite. This duration assumption may be varied according to the climate (e.g., the amount of expected time over the course of a year that children will be expected to be exposed to soil -- due to snow cover or other climatological conditions). Anecdotally, it appears that regional risk assessors differ in the depth of contaminated soil to which they apply these assumptions. These differences may depend upon the nature of the housing stock, existence of basements, etc.

From a national policy perspective, the term residential land use usually refers to a use of the land that is unrestricted in nature (i.e., no waste is left onsite to be managed into the future). However, this definition doe-, not appear to be written anywhere -- or at least it is not written in a widely accessible location.

The lack of common understanding as to the nature of the debate on land use becomes evident when the EPA regional RPMs' responses to the question concerning the future land use on which the protectiveness of the remedy is based are analyzed in detail. Regional responses included:

- Assignment of residential land use status to municipal landfill sites. In most cases, it appeared as though this assignment had nothing to do with the remedy, or with the actual potential use of the land. Residences were nearby, and residential users may recreate or trespass on the land.

- Assignment of residential land use status when ground water is cleaned up to drinking water levels (i.e., MCLS). In some cases, this cleanup involves source removal that may result in land being considered protective for residential use. In these cases, cleanup to be protective for residential use is a result, not a cause, of the remedy. In other cases, the assignment of the residential land use category refers to the residential use of ground water (i.e., as drinking water).

In the survey, regional RPMs were asked to identify the “future land use decision on which the protectiveness of the remedy is based." Residential land use was identified at 45 percent of the action sites for which data were received. A follow-up telephone survey was conducted of 27 percent (20 sites) of the sites-selected at random[12]--that fell into the category of residential future land use. Of these 20 sites, 2 were landfills. The first survey consists of two landfills that have been remediated so that nearby residences can use the site for recreational use and, therefore, should have been coded as recreational. At the other landfill site, a residential land use was chosen because of fears that the site would be used residentially by the Native Americans to whom it was being turned over. The surface of the land was safe for

[12]For a further discussion of the methodology for selection of the sites for the telephone interviews, see Appendix D.

residences for which there was no intrusive activity. Of the 18 non-landfills contacted, 39 percent (7 sites) stated that the source control actions were designed to achieve MCLs in ground water. One site was miscoded by the RPM. It was a ground-water cleanup site involving no source control. At another site, the cleanup was driven by the need to meet surface water National Pollutant Discharge Elimination System (NPDES) discharge levels. Therefore, at 55 percent of the sites in the telephone follow-up survey, the selection of residential land use was either a result of the cleanup determination needed to protect water or a mistake.

Table 1 summarizes the interview results, and Appendix C contains a detailed summary of each interview.

3.2.1 Role of Ground-water Protection in Remedy Selection and Identification of Potential Future Land Use.

At 39 percent of the non-landfill sites contacted during the telephone interviews, ground-water protection and the need to meet MCLs were the major factors in remedy selection and formed the bases of cleanup. This is supported by a closer look at the survey data, which show that, when source control involves ground-water protection, residential land use is more likely to be identified as the potential future land use.

During the telephone interviews, some RPMs stated that in order to achieve MCLs in the ground water, the surface soils must be cleaned beyond residential protection levels. In other words, protection or cleanup of ground water drives the selection of residential cleanup levels, not the actual or projected surface use of the site (i.e., the residential cleanup levels are the result - not the cause). Others said that MCLs are based on being able to drink the water, and that drinking water equates to a residential land use. In those cases, the categorization of a site as a residential land use site refers to the use of water beneath the ground, not unrestricted use of land above the ground.[13]

In addition, the FFSS results show that 33 percent of the future land use **residential** source control sites identified MCLs as a basis for cleanup, but only 21 percent of the **nonresidential** future land use source control sites identified MCLs as a basis for cleanup.

3.2.2 Restricted Use and Residential Future Land Use.

As discussed above, residential land use is considered to be **a** designation that supports unrestricted use of the land surface. Exposure assumptions that establish cleanup levels are designed to ensure that if housing is built, children and adults living on the property will not be exposed to contaminated soil. Yet, in the FFSS, 31 percent of the landfill source control sites (7 percent of the total number of source control sites), for which the remedy is containment of waste onsite, identified a future land use of residential. These clearly are not being remediated to unrestricted residential use.

3.2.3 Relationship of Human Health Risk Assessment to Residential Future Land Use.

One question in the survey asked respondents to identify the basis of the cleanup decision. Specifically, the instructions told respondents to identify the factors on which a decision to remediate the site was made. Categories included: human health risk assessment (quantitative or qualitative); Federal or State applicable or relevant and appropriate requirements (ARARS) and to be considered requirements (TBCs); citizen and State concerns; and MCLs or maximum contaminant level goals (MCLGs). Because human health risk assessments are based on future use scenarios (a "reasonable" maximum exposure to receptors under the use scenario chosen), the future surface land use scenario will play a major role in the derivation of cleanup levels and in the risk management decisions that emerge from the Human Health Risk Assessment when the cleanup is designed to be protective of a surface land

[13]Given that only 20 sites were included in the follow-up telephone survey, a decision was made not to change responses in the FFSS data base as a result of information obtained during the telephone interviews.

Table 1. Results of Follow-up Telephone Calls to Selected Residential Future Land Use Sites

Region	EPA ID	OU	Facility	Reason for Residential FLU Selection	Driving Force in Cleanup	Did Cost Impact Remedy Selection?	Comments
1	ME9570024522	2	Loring AFB	Current and surrounding land use; and uncertainty of FLU	Air Force	No; however, the remedy selected involved consolidation of wastes from other sites on the base, thereby saving money for the cleanup of the base as a whole.	The site is two old landfills; "restricted" residential use was based on surrounding area and BRAC status; RPM probably should have identified a recreational FLU.
1	NH7570024847	8	Pease AFB	Source control to protect GW will achieve residential levels	MCLs	O&M cost did; remedial costs did not.	Basis of cleanup is MCLs, not surface use.
3	WVD980713036	2	West Virginia Ordnance Works	Uncertainty of FLU (probably)	Unknown	Yes	Residential FLU used in risk assessment as worst case scenario; FLU decisions made before RPM became involved at the site.
4	GA7170023694	5	USMC Logistics Base	Uncertainty of FLU	State	Unknown	State policy to consider residential at all times; incremental cost to clean up to residential levels relatively small as compared to industrial levels.
4	KY8890008982	8	Paducah Gaseous Diffusion Plant	Source control to protect GW will achieve residential levels	MCLs	Unknown	Basis of cleanup is MCLs, not surface use.
4	TN3890090003	2	Oak Ridge Reservation	Source control driven by need to achieve SW discharge levels	State NPDES discharge levels	Unknown	Need to achieve NPDES surface water discharge levels required removal of all wastes, and NPDES discharge levels are "drinking water" levels; RPM, therefore, selected residential FLU (unrestricted use). The site is, and will remain, industrial.

Table 1 (continued)

Region	EPA ID	OU	Facility	Reason for Residential FLU Selection	Driving Force in Cleanup	Did Cost Impact Remedy Selection?	Comments
5	IL3210020803	1	Savannah Army Depot	Uncertainty of FLU; remedy achieved residential levels anyway	Army, State	No	Regional policy at the time of the ROD was to consider residential at all sites; in addition, residential FLU was chosen due to BRAC concerns at this facility, site location (prime residential sites if not owned by military), and incremental costs to clean up to residential levels were minimal.
5	MN7213820908	8	New Brighton/Arden Hills	Uncertainty of FLU; remedy achieved residential levels anyway	Army, Region	Yes	Since the issue of the ROD, FLU policy for this facility has changed, land use will now be industrial; however, incremental cost to clean up to residential levels is minimal.
6	OK1573724391	2	Tinker AFB	Current and surrounding land use; uncertainty of FLU	Air Force	No	
7	MO3210090004	1	Weldon Springs	Uncertainty of FLU	State, Army, Region	Yes	Remediation goal in ROD is to achieve residential levels, if possible; actual land use is recreational.
8	SD2571924644	1	Ellsworth AFB	Uncertainty of FLU; source control to protect GW will achieve residential levels	Air Force, State, MCLs	O&M costs did, remedial costs did not	Basis of cleanup is MCLs, not surface use.
8	UT9210020922	1	Ogden Defense Depot	Uncertainty of FLU	Region	Yes	Residential FLU across base.
9	AZ7570028582	1	Williams AFB	Uncertainty of FLU; source control to protect GW will achieve residential levels	State for GW, Region for Soil	Yes	Potential for residential use by nearby Native American Tribe. Basis of cleanup is MCLs, not surface use.
9	CA8210020832	1	Sharpe Army Depot	GW pump and treat	MCLs		Survey was incorrectly filled out; no source control; only GW pump and treat.

Table 1 (continued)

Region	EPA ID	OU	Facility	Reason for Residential FLU Selection	Driving Force in Cleanup	Did Cost Impact Remedy Selection?	Comments
9	CA0210020780	3	Sacramento Army Depot	Remedy will achieve residential levels anyway	Technology	No	Best technology was selected; minimal incremental cost to achieve residential levels.
10	AK8570028649	4	Elmendorf AFB	Uncertainty of FLU; source control to protect GW will achieve residential levels	Region, State, MCLs	Yes	Residential FLU across base; residential FLU used in risk assessment as worst case scenario, if GW had not been issue, residential land use would still be chosen.
10	ID4890008952	18	INEL	Uncertainty of FLU	State, Site Advisory Board	No	Considered potential residential 100+ years in the future.
10	WA1170023419	2	Naval Undersea Warfare Center	Uncertainty of FLU; source control to protect GW will achieve residential levels	State, MCLs	Yes	Basis of cleanup is MCLs, not surface use.
10	WA7210090067	2	Fort Lewis Logistics Center	Source control to protect GW will achieve residential levels	Army, MCLs	Unknown	MCLs for landfill portion of OU; base wanted unrestricted use for non-landfill portion of OU.
10	WA9571924647	1	Fairchild AFB	Source control to protect GW will achieve residential levels	MCLs	Yes	Basis of cleanup is MCLs, not surface use.

Key:

FLU = Future Land Use
GW = Ground Water
OU = Operable Unit
SW = Surface Water
MCLs = Maximum Contamination Levels
NPDES = National Pollutant Discharge Elimination System
BRAC = Base Realignment and Closure
RPM = Remedial Project Manager
ROD = Record of Decision

use. Although 83 percent of the sites that identified residential future land use in the FFSS identified the Human Health Risk Assessment as a primary factor for the cleanup decision, analysis of the relationship of ground water to residential land use suggests that **the real influence may be overstated.** Normally, when a source is remediated to protect or to achieve drinking water levels in ground water, the degree of source control required will be based on modeling of the source to establish the transport of contaminants and their fate in ground water in relation standards (i.e., MCLS) rather than a baseline risk assessment.

3.3 Factors Affecting Selection of Future Land Use

The selection of future land use is driven by a variety of factors. The significance of these factors will often be different when residential land use is selected, than when another land use is selected (e.g., industrial, military, recreational, or other). The results of the telephone interviews and the survey suggest that major considerations are:

- Current land use;
- Minor incremental costs of residential future land use over industrial/commercial;
- Role of States; and
- Uncertainty regarding the future operational status of the facilities.

3.3.1 Current Land Use. Current land use is clearly more significant at nonresidential land use sites than at residential land use sites. The current and future land use are the same at almost half (49 percent) of the source control sites with a nonresidential future land use. In contrast, only 11 percent of the future land use residential source control sites also have a current land use of residential.[14] As shown in Figure 15, for most of the future land use residential source control sites, the current land use identified is military (47 percent), industrial (15 percent), and landfills (15 percent).

Major factors influencing the switch from a nonresidential current land use to a future land use of residential are described below.

3.3.2 Minor Incremental Cost. The telephone survey data suggest that residential land use is frequently chosen when the incremental cost of achieving residential land use is minimal in comparison to achieving industrial land use. In fact, minimal incremental cost between cleaning up to a residential versus a industrial future land use scenario was cited as a factor in the selection of a residential future land use by 20 percent of the RPMs contacted (four sites) in the telephone survey. In these cases, decisions were made to reduce future liabilities by cleaning up to unrestricted uses.

3.3.3 Role of States. The results of the survey and the follow-up telephone interviews also indicate that, in selected States, the influence of the State in future land use selection can be significant. The FFSS shows that State concerns were identified as a primary factor influencing future land use selection at 22 percent of the future land use residential source control sites, but at only 13 percent of the future land use nonresidential source control sites. A closer analysis of survey data, in conjunction with telephone interview information, suggests that the FFSS information may understate the influence of the States.

[14]When residential land use is the current land use, the future land use chosen is almost always residential; however, relatively few of the sites have a current residential land use.

Of the 31 States represented in the FFSS, 5 States (California, Idaho, Maine, Utah, and Washington) account for 61 percent of the future land use residential source control sites, but only 41 percent of all source control sites. Furthermore, Utah and Washington alone account for 36 percent of the source control future land use residential sites, but only 22 percent of all source control sites.

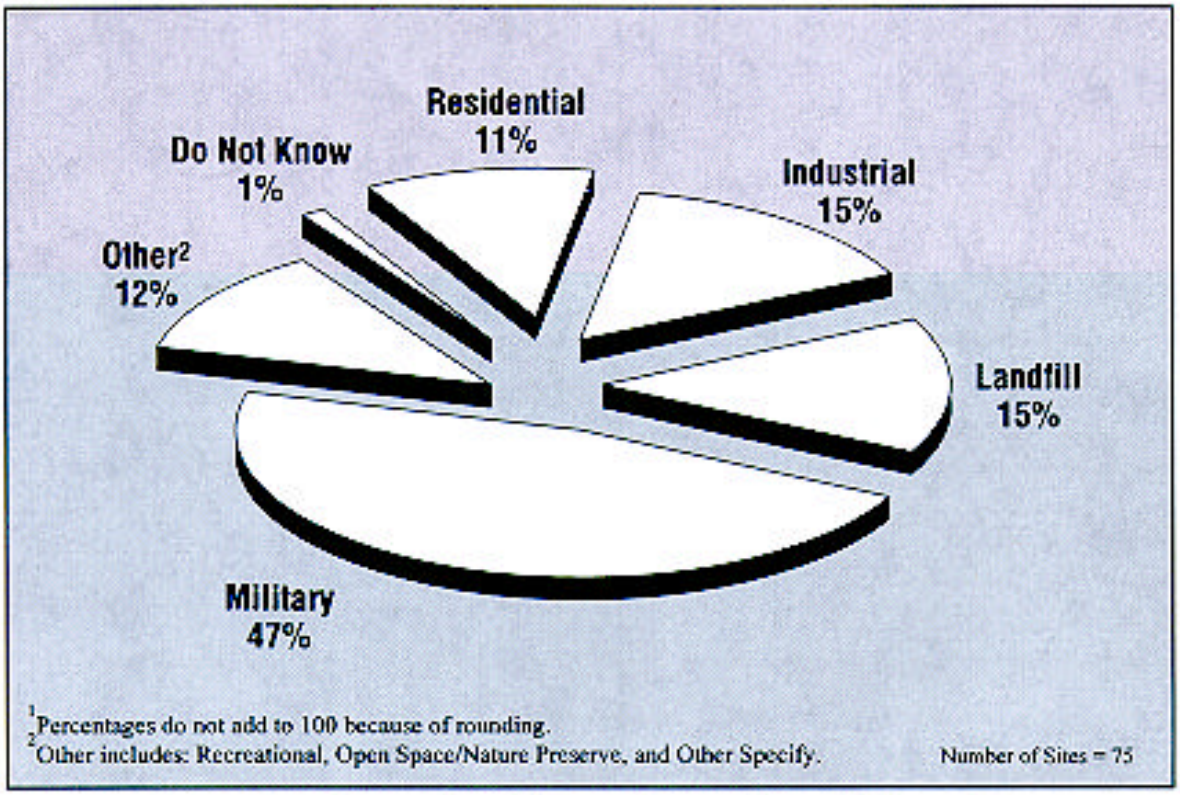


Figure 15. Current Land Use at Source Control Sites with a Future Land Use of Residential[1]

In addition, in follow-up telephone interviews, RPMs said that when residential land use was selected, the State played a major role in the selection of the future land use more than 35 percent of the time. As shown in Table 1, the State was identified as a driving force in the cleanup at 8 of the 20 sites.

3.3.4 Uncertainty Regarding Future Operational Status. Although analysis of survey data does not depict a significant difference between Base Realignment and Closure Act (BRAC) and non-BRAC sites, several pieces of information work together to suggest that concerns over the future BRAC status of facilities may play a role in future land use selection.

In 1990, Congress passed the Base Realignment and Closure Act (BRAC), which authorized DOD to conduct a series of base closure and realignments. The purpose of the closures and realignments was not only to permanently close all or part of a base, but to transfer the land from DOD control to another Federal agency, State or local government, or to the general public for nonmilitary uses. According to several RPMs contacted, BRAC has dramatically undermined the future land use argument "once a military base, always a military base." Although not subject to BRAC, it is also possible that DOE sites could be closed as a result of Federal Government downsizing. One could postulate, however, that, given the types and complexities of the waste problems at DOE facilities, they may be less likely to be "turned over" to non-DOE control in the near future.

During an initial examination of residential land use data, an attempt was made to use survey statistics to analyze the role of uncertainty and, in particular, the BRAC process, on the identification of projected future land use. In this analysis, uncertainty was cited as a primary factor in future land use selection at 33 percent of the future land use residential source control sites, but at only 17 percent of future land use nonresidential source control sites.

Of the source control sites in the FFSS, 32 percent are at BRAC facilities, and the remaining 68 percent are at non-BRAC facilities. BRAC source control sites are slightly more likely than non-BRAC sites to select a residential future land use (51 percent at BRAC source control sites versus only 43 percent at non-BRAC source control sites). In addition, DOD sites showed a significant preference for residential future land use over DOE sites. This is interesting because DOD sites are potential closure candidates under BRAC. Uncertainty regarding the future BRAC status of the DOD facilities may play a much larger role at DOD facilities than at DOE facilities.

During the telephone interviews conducted to follow-up FFSS information at residential future land use sites, RPMs indicated that the potential of BRAC may exert as strong an influence over the selection of a potential residential future land use as the actual identification of a facility as BRAC. Over 50 percent of the RPMs (12 of 20) cited the need to be protective in the face of uncertainty as a reason for selecting a residential future land use. Many RPMs felt that, given the recent base realignments and closures, bases may not always be under Federal Government control. Others noted that Federal agencies are often not able to enforce use restriction on lands cleaned up to less than residential (unrestricted) use. Still others noted that uncertainties regarding future use may encourage the military to clean up sites to unrestricted (i.e., residential) use to facilitate potential transfers to nonmilitary uses. In some cases, the cost of cleanup to residential may not be significantly greater than the cost to cleanup to a different land use. In these cases, the base operators opt for cleaning up the site to residential levels in hopes of ridding themselves and the military of future liabilities.

3.3.5 Other Factors Examined as Potential Influence on Future Land Use

Surrounding Land Use Appears To Play a Minor Role in Future Land Use Selection. Analysis of the FFSS data on surrounding land use reveals that 56 percent of the source control sites with a residential future land use have a surrounding land use of residential. However, although surrounding land use was identified as a primary factor in future land use selection at 52 percent of the future land use residential source control sites, it was mentioned as a factor for future land use selection by only 10 percent of the RPMs during the follow-up telephone survey.[15] It is clear, on a site-specific basis, that surrounding land use can play a major role in future land use selection. For the universe as a whole, however. it appears to play a less important role as compared to uncertainty and protection of ground water.

ROD Signature Date Does Not Appear To Play a Role in Future Land Use Selection. In order to determine if the future land use preferences changed from fiscal year to fiscal year, an analysis based on the ROD signature date was performed. Although conclusions must be tempered by the small number of RODs in most years, the ROD signature date does not appear to play a role in future land use selection. Fifty-five percent of the source control RODs were signed in fiscal years (FY) 1989 through 1993; 44 percent of these were residential future land uses. The remaining 44 percent of the source control RODs were signed in FY 1994 and 1995, 47 percent of these were residential future land uses. Conclusions of any trend, however, are difficult to support because the partial FY 1995 results may not be reflective of FY 1995 as a whole.

[15]As part of the follow-up survey, RPMs were asked how, in terms of geographic distance, they interpreted the term “surrounding” land use. Responses ranged from less than 1/4 mile to over 10 miles. The majority of the respondents assumed that surrounding meant about 1 mile or less.

3.4 Conclusions

The selection of a residential future land use is less frequently the driver behind remedy selection than current debate indicates. When a residential future land use is selected, factors that influenced that selection may have included minimal incremental cost of residential over industrial (or some other use) such that it appears 'worth while" to participants in the remedy process to eliminate future liabilities. Other important factors are State preference and uncertainty concerning the future use of the site. When residential land use is not a 'driver,' it is sometimes identified when a source is cleaned to below residential levels due to the need to protect ground water, or when the ground water itself is cleaned to drinking water levels. In these cases, cleanup to residential use is incidental to the remedy, but does not affect remedy selection.

APPENDIX A

FEDERAL FACILITY SUPERFUND SURVEY ON SIGNED RECORDS OF DECISION
BLANK SURVEY FORM AND INSTRUCTIONS

Federal Facility Superfund Survey
Signed Records of Decision

INSTRUCTIONS

Enclosed you will find the Federal Facility Superfund Survey for Signed Records of Decision. The survey contains 5 pages. The first page is a cover page for the survey and asks administrative questions concerning the name of the federal facility, its EPA CERCLIS Identification Number, the Operable Unit (OU) number, etc. The next three pages are more site specific and deal with factors that went into the ROD's development and the remedial activities that took place, or are planned to take place, at the site. The last page is a continuation sheet for all questions for which the answer is other (specify), or for answers where additional explanation or information would be helpful. Petroleum sites not managed under CERCLA should not be included in this survey. If you have any questions regarding the administration of the survey (e.g., due dates, etc.), please contact Jim Woolford at (202) 260-1606. Technical questions regarding the survey should be directed to John Newton of Versar, Inc. at (703) 642-6785.

The source of information for this Survey should be the appropriate decision document (e.g., ROD, explanation of significant differences, ROD amendment) or the various support documents containing more detailed information (e.g., RI/FS).

Part 1 - Federal Facility Superfund Survey Cover Page

Question	Information Required
1.	The CERCLIS ID Number for the federal facility.
2.	The Region in which the federal facility is located.
3.	The federal facility's Name.
4.	Has the federal facility appeared on any of the 1988, 1991, 1993, or 1995 Base Realignment and Closure (BRAC) lists?
5.	The Name of the EPA Remedial Program Manager (RPM).
6.	The RPM's phone number.
7.	The OU number.
8.	The name or a brief description of the OU.

9. The date of the ROD's signature.

10. For many federal facilities, OUs contain geographically distinct sites (i.e., landfills, spill sites, waste areas, etc.) that have been lumped together. If the OU in question contains more than one site, the answer to question 10 should be "Yes."

    If the answer to question 1 0 was "Yes," then identify the sites which make up the OU by providing a site number (i.e., 1, 2, LF10, etc.) and a short descriptor such as landfill, spill site, lagoon, etc.

Pages 2 through 4 are to be filled out for **each** of the sites identified in Question 10 that are **geographically distinct and have different land uses and remedies.** It is **not** necessary to fill out separate questionnaires for sites with identical answers. Again, it is also **not** necessary to fill out the survey for petroleum sites not managed under CERCLA. If the number of sites in the OU exceeds 1 0 and it is not possible to provide the required information, or an extension is needed, please contact Jim Woolford at (202) 260-1606.

Part 2 - Land Use and Basis for Cleanup Information

Question — Information Required

1. The CERCLIS ID number for the federal facility.

2. The OU number.

3. The site descriptor for the particular site (i.e., should be identical to the information provided on page 1).

4. The site number for the particular site (i.e., should be identical to the information provided on page 1).

5. Media/Material. This is a two-part question in which the media/materials addressed and of concern should be identified. Media/materials addressed include **only** those media/materials which were, or will be, remediated during remedial actions. The media/materials of concern include **all** media/materials that were contaminated at the site or which potential contamination drove the remedy, including those that are not addressed in the remediation itself. For example, if both soils and ground water are contaminated, but only the soils are remediated (e.g.,

Part 2 - Land Use and Basis for Cleanup Information cont.

Question	Information Required
	removal of contaminated **soils** and natural attenuation for the ground water), both would be of concern but only the soils would be addressed. Check all answers that are applicable.
6.	Current Land Use of Site or OU **at time of ROD signature.** How was the site being used as of the **ROD signature date?** Check all answers that are applicable.
7.	Current Surrounding Land Use at the time of ROD signature. How was the land surrounding the site being used **at the time of ROD signature?** Although no specific radius is specified, responses should include uses both on the off the facility which were sufficiently close to the site that such use may have effected the uses considered in the baseline risk assessment or the selected future land use on which the protectiveness of the remedy was based. Check all answers that are applicable.
8.	Basis for Cleanup. On what basis was a decision to remediate the site made? If there were more than one reason, choose all that are applicable, numbering them in sequential order from the most important factor to the least important to the degree practicable or known. *[Note: ff a human health risk assessment was the basis for cleanup, or a basis for cleanup, please identify whether a quantitative or qualitative human health risk assessment was conducted. For example, interim actions may be based on a qualitative rather than quantitative risk assessment.]*
9.	Future Land Use(s) Considered in Baseline Risk Assessment. Indicate all of the future use scenarios that were considered during the baseline risk assessment. Check all answers that are applicable.
10.	Future Land Use Decision on which Protectiveness of Remedy is Based. What future land use was chosen in the risk management process as the exposure scenario on which cleanup levels are based? Respondents should also indicate whether the selected future land use played a key role in the selection of the remedy. Check all answers that are applicable.
11.	What was the primary factor on which the future land use decision was based? Identify the factor (or several factors) which played the largest role in determining the future land use selected for the site. The "Final

Part 2 - Land Use and Basis for Cleanup Information cont.

Question	Information Required
	Reuse Plan" answer should only be chosen if a formal BRAC reuse plan has been finalized, not if the reuse plan is interim or draft. Check all answers that are applicable.
12.	Who is the presumed future user(s) of the site? Identify the agency or group(s) that will be occupying the site once remediation has been completed. The answer "New Federal Agency" should be chosen if a federal group, different than the current owner, is planning to utilize the site in the future. Choose the answer "McKinny Act" if the McKinny Act, which provides for use of the site by the homeless, played a role in determining the future user of the site. Check all answers that are applicable.

Part 3 - Remedy Information

Question	Information Required
14.	These questions are carried over from the previous page.
13.	Source Control for Soil/Surface Cleanup or Management. Indicate whether the cleanup remedy for the soil/surface (i.e., non-ground water) was an interim or a final source control remedial action.
14.	Source Control to Protect Ground Water. Indicate whether the cleanup remedy was an interim or a final source control remedial action intended primarily to protect the ground water.
15.	Ground-water Remediation. Indicate whether the cleanup remedy for the ground water was an interim or a final remedial action.
16.	Cleanup Levels - Carcinogens. If the (or a) cleanup level is based on risk due to carcinogens, indicate the cleanup level to be achieved for each media to be remediated. If the cleanup level is not based on carcinogenic risk, leave blank.
17.	Cleanup Levels - Noncarcinogens. If the (or a) cleanup level is based on noncarcinogenic risk, specify those media for which the cleanup level to be achieved is a hazard index or hazard quotient of less than 1. If the cleanup level is not based on noncarcinogenic risk, leave blank.

Part 3 - Remedy Information cont.

Question	Information Required
18.	Cleanup Levels - Other (Specify). If the (or a) cleanup level is based on something other than carcinogenic or noncarcinogenic risk (e.g., State soils cleanup levels), specify the cleanup level type/source and, if applicable, the cleanup level to be achieved for each media to be remediated. If this question is not applicable, leave blank.
19.	Site Remedy. Identify the remedy that was **selected** the site, as well as, those remediation alternatives that were **considered** in the detailed analysis of alternatives. Check all answers that are applicable.
20.	Cost of Remedy. What is the estimated cost of the selected remedial action?
21.	Estimated Cost Range of the Remedies Considered. Identify the range of costs for the various alternatives considered, if known (i.e., the bottom of the range should be the estimated cost of the least expensive alternative considered, and the top of the range should be the cost of the most expensive alternative considered).
22.	Was an innovative or alternative technology considered during the **development of alternatives?** Even if not formally considered, if an innovative technology was evaluated as a potential remedy, the response should be "Yes."
23.	Was an innovative alternative technology formally considered in the **detailed analysis of alternatives?**
24.	Human Heath Risk Assessment Performed? Was a human health risk assessment conducted? This question should be answered "Yes" even if the risk assessment was not the (or a) basis of cleanup.
25.	Ecological Risk Assessment Performed? Was an ecological risk assessment conducted?
26.	Did the site contaminants include Dense Non-Aqueous Phase Liquids (DNAPLs)? If "No," skip to Question 29. If "Yes," answer Questions 27 and 28.

Part 3 - Remedy Information cont.

Question	Information Required
27.	If DNAPLs were one of the site contaminants, was a Contingent ROD signed?
28.	If DNAPLs were one of the site contaminants, was a Technical Impracticability Waiver included in the ROD?
29.	Indicate whether the ground water at the site is a current and/or future drinking water source.
30.	O&M Cost. What is the **annual** Operation and Maintenance (O&M) cost for the selected remedy? Circle one answer, if known.
31.	O&M Years. How long will the selected remedy of the site have to be maintained? Circle one answer, if known.
32.	Principal Cost Driver of Cleanup. What factor(s) played the largest role(s) in determining the cost of the remediation? Check all answers that are applicable.
33.	Decision Document Source of Questionnaire. The information in this questionnaire should be based on the **most recent decision document issued for the site.** In response to this question, please do not identify support documents (e.g., RI/FS) which may have been the actual source of a specific piece of information. Instead, identify the latest decision document.

Federal Facility Superfund Survey
Signed Records of Decision

1. EPA ID Number: 2. Region

3. Facility Name:

4. Is This Facility on any of the BRAC Lists (Y/N)?

5. RPM Name:

6. Phone Number:

7. OU Number:

8. OU Name:

9. Date of ROD Signature:

10. Does this OU contain multiple sites (Y/N)?

If Y, please give the site number and a short descriptor for each of the sites (i.e. LF10 Landfill)

Site 1		Site 1 Descriptor:	
Site 2		Site 2 Descriptor:	
Site 3		Site 3 Descriptor:	
Site 4		Site 4 Descriptor:	
Site 5		Site 5 Descriptor:	
Site 6		Site 6 Descriptor:	
Site 7		Site 7 Descriptor:	
Site 8		Site 8 Descriptor:	
Site 9		Site 9 Descriptor:	
Site 10		Site 10 Descriptor:	

For each of the sites identified above that are geographically distinct areas and with different land uses and remedies, please fill out pages 2-4. Please make additional copies as necessary. It is not necessary to fill out a separate questionnaire if the answers are the same for each site within the OU. Petroleum sites not managed under CERCLA should not be included. If the number of sites in the OU exceeds 10 and it is not possible to provide the required information, or an extension is needed, please contact Jim Woolford at (202) 260-1606.

Note: Page 5 is a continuation sheet on which expanded responses can be written.

Note. This page is to be filled out for the entire OU.

1. EPA ID Number: ☐ 2. Operable Unit Number: ☐ 3. Site Descriptor: ☐ 4. Site Number: ☐

Land Use + Basis for Cleanup Information

5. Media / Materials
(Check All Applicable)

	Addressed	Of Concern
Air	☐	☐
Groundwater	☐	☐
Surface water	☐	☐
Sediment	☐	☐
Debris	☐	☐
Liquid Waste	☐	☐
Soil	☐	☐
Sludge	☐	☐
Solid Waste	☐	☐
Mixed Waste	☐	☐

6. Current Land Use of Site or OU
(Check All Applicable)

Agricultural ☐ Commercial ☐
Educational ☐ Industrial ☐
Residential ☐ Recreational ☐
Military ☐ Landfill ☐

If Military, is the site used as a
1. Fire Training Area
2. Radar
3. Ammunition Depot
4. Bombing Range
5. Aviation
6. Other (Specify) _____

Open Space / Nature Preserve ☐
Vacant ☐ If Vacant, former use: ☐
Other (Specify) ☐ ☐

7. Current Surrounding Land Use
(Check All Applicable)

Agricultural ☐ Commercial ☐
Educational ☐ Industrial ☐
Residential ☐ Recreational ☐
Military ☐ Landfill ☐

If Military, is the site used as a
1. Fire Training Area
2. Radar
3. Ammunition Depot
4. Bombing Range
5. Aviation
6. Other (Specify) _____

Open Space / Nature Preserve ☐
Vacant ☐ If Vacant, former use: ☐
Other (Specify) ☐ ☐

8. Basis For Cleanup
(Number in order of significance to remedy selection, with 1 first)

Human Health Quantitative Risk Assessment ☐
Human Health Qualitative Risk Assessment ☐
Ecological Risk Assessment ☐
MCL ☐
MCLG ☐
Federal ARAR ☐
Future User Concern ☐
Federal TBC ☐
State TBC ☐
State ARAR ☐
If State ARAR,
State MCL ☐
Other State GW Requirement ☐
State Soil Level ☐
State or Local Government Comments ☐
Citizen Comments ☐
Other (Specify) ☐ ☐

9. Future Land Use(s) Considered in Baseline Risk Assessment
(Check All Applicable)

Agricultural ☐ Commercial ☐
Educational ☐ Industrial ☐
Residential ☐ Recreational ☐
Military ☐ Landfill ☐
Open Space / Nature Preserve ☐

If Military, is the site used as a
1. Fire Training Area
2. Radar
3. Ammunition Depot
4. Bombing Range
5. Aviation
6. Other (Specify) _____

Vacant ☐ Other (Specify) ☐ ☐

10. Future Land Use Decision on which Protectiveness of Remedy is Based
(Check All Applicable)

Agricultural ☐ Commercial ☐ Open Space / Nature Preserve ☐
Educational ☐ Industrial ☐ Vacant ☐
Military ☐ Residential ☐ Landfill ☐
Recreational ☐

If Military, is the site used as a
1. Fire Training Area
2. Radar
3. Ammunition Depot
4. Bombing Range
5. Aviation
6. Other (Specify) _____

Other (Specify) ☐ ☐

Did the presumed Future Land Use have a strong influence on the selection of the remedy (Y/N) If "No", please explain? ☐ ☐

1. EPA ID Number: | 2. Operable Unit Number: | 3. Site Descriptor: | 4. Site Number:

Land Use + Basis for Cleanup Information

11. What was the primary factor on which Future Land use decision was based?

- ☐ Active facility plans for Future use of site
- ☐ Final reuse plan for a closing facility
- ☐ Current use of the site
- ☐ Use of land surrounding the site
- ☐ Potential current or future plans for closure of the facility
- ☐ Need to be protective in the face of uncertainty
- ☐ Community concerns
- ☐ State concerns
- ☐ Other (Specify)

12. Who is the presumed future user of the site?

- ☐ Current User
- ☐ Tennant Activity
- ☐ New Federal Agency
- ☐ State Government
- ☐ Local Government
- ☐ Private
- ☐ McKinny Act
- ☐ Native American
- ☐ Other (Specify)

1. EPA ID Number: ☐ 2. Operable Unit Number: ☐ 3. Site Descriptor: ☐ 4. Site Number: ☐

Remedy Information

13. Source Control for Soil /Surface Cleanup or Management (Circle one) — 1. Interim 2. Final

14. Source Control to Protect Groundwater (Circle one) — 1. Interim 2. Final

15. Groundwater Remediation (Circle one) — 1. Interim 2. Final

16. Cleanup Levels - Carcinogens

	Soil / Surface	Groundwater	Surface Water	Air
Above 10-4	☐	☐	☐	☐
10-4	☐	☐	☐	☐
10-5	☐	☐	☐	☐
10-6	☐	☐	☐	☐
Below 10-6	☐	☐	☐	☐

17. Cleanup Levels - Noncarcinogens

	Soil / Surface	Groundwater	Surface Water	Air
HI / HQ >1?	☐	☐	☐	☐

18. Cleanup Levels - Other (Specify)

Soil / Surface	☐	
Groundwater	☐	
Surface Water	☐	
Air	☐	

19. Site Remedy (Check all that apply)

	Selected	Considered
1. GW - Pump + Treat	☐	☐
2. GW - Pump + Discharge	☐	☐
3. GW - Biological Treatment	☐	☐
4. GW - Chemical/Physical Treatment	☐	☐
5. GW - Natural Attenuation	☐	☐
6. GW - Containment	☐	☐
7. GW - Engineering Controls	☐	☐
8. On-site Disposal	☐	☐
9. Off-site Disposal	☐	☐
10. On-site Treatment	☐	☐
11. Off-site Treatment	☐	☐
12. Recover and Reuse	☐	☐
13. On-site Containment (Capping)	☐	☐
14. Off-site Containment	☐	☐
15. Institutional Controls	☐	☐
16. Resident Relocation	☐	☐
17. Other	☐	☐
Specify:	☐	☐
18. No Further Action	☐	☐
19. No Action	☐	☐

20. Cost of Remedy ($) ☐

21. Estimated Cost Range of Remedies Considered ($) ☐

22. Was an innovative alternative technology considered in the development of alternatives? (Y/N) ☐

23. Was an innovative alternative technology formally considered in the detailed analysis of alternatives? (Y/N) ☐

24. Human Risk Assessment Performed? (Y/N) ☐

25. Ecological Risk Assessment Performed? (Y/N) ☐

26. Were DNAPLs Involved? (Y/N) ☐

27. If the answer to Ques. 26 is "Y", was a Contingent Rod signed? (Y/N) ☐

28. If the answer to Ques. 26 is "Y", was a Technical Impracticability Waiver included in the ROD? (Y/N) ☐

29. Is the groundwater a drinking water source? (Y/N)	Current	Future
	☐	☐

30. Annual O+M Cost (If known, circle one)
1. $0
2. $500-$1,000
3. $1,000-$10,000
4. $10,000-$20,000
5. $20,000-$40,000
6. $40,000-$60,000
7. >$60,000

31. O+M Years (If known, circle one)
1. 0-3
2. 4-10
3. 11-20
4. 21-30
5. >30

32. Principal Cost Driver of Cleanup (Check all that apply)
- ☐ 1. Large Volume of Soil/Sludge/Solid Waste
- ☐ 2. Large Volume of Groundwater
- ☐ 3. Munitions
- ☐ 4. Complex Hydrology
- ☐ 5. Complex Mixture of Contaminants
- ☐ 6. High Cost of Treatment
- ☐ 7. Radioactive Waste
- ☐ 8. Off-site Disposal / Treatment
- ☐ 9. Biological / Chemical Weapons Waste
- ☐ 10. Hazardous Waste
- ☐ 11. Other (Specify) ☐

33. Decision Document Source of Questionnaire Information (Check all that apply)
☐ Record of Decision (ROD) ☐ Explanation of Significant Differences ☐ Final Reuse Plan
☐ ROD Amendment ☐ Other (Specify) ☐

1. EPA ID Number: _____ 2. Operable Unit Number: _____ 3. Site Descriptor: _____ 4. Site Number: _____

Federal Facility Superfund Survey
Signed Records of Decision

Continuation Sheet (Identify corresponding question number)

APPENDIX B

RODs INCLUDED IN THE FFSS DATA BASE

Region	EPA ID	Name	OU	SITE
1	MA2570024487	OTIS AIR NATIONAL GUARD	2	
1	MA2570024487	OTIS AIR NATIONAL GUARD	7	7
1	MA7210025154	FORT DEVENS	4	
1	ME8170022018	BRUNSWICK NAVAL AIR STATION	1	SITES1&3
1	ME8170022018	BRUNSWICK NAVAL AIR STATION	2	
1	ME8170022018	BRUNSWICK NAVAL AIR STATION	3	SITES 5&6
1	ME8170022018	BRUNSWICK NAVAL AIR STATION	4	
1	ME8170022018	BRUNSWICK NAVAL AIR STATION	6	
1	ME9570024522	LORING AIR FORCE BASE	2	
1	ME9570024522	LORING AIR FORCE BASE	6	1
1	ME9570024522	LORING AIR FORCE BASE	7	OU7
1	NH7570024847	PEASE AIR FORCE BASE	1	
1	NH7570024847	PEASE AIR FORCE BASE	2	
1	NH7570024847	PEASE AIR FORCE BASE	3	
1	NH7570024847	PEASE AIR FORCE BASE	5	ALL
1	NH7570024847	PEASE AIR FORCE BASE	8	ALL
1	NH7570024847	PEASE AIR FORCE BASE	9	ALL
1	RI6170022036	DAVIS NAVAL CONSTRUCTION BATTALION	2	SITES12&14
1	RI6170085470	NAVAL EDUCATION & TRAINING CENTER	1	0
1	RI6170085470	NAVAL EDUCATION & TRAINING CENTER	2	0
2	NJ2210020275	FORT DIX LANDFILL SITE, NJ	1	
2	NJ3210020704	PICATINNY ARSENAL	1	NA
2	NJ7170023744	NAVAL AIR ENGINEERING STATION, LAKEHURST, NJ.	1	SITE 16
2	NJ7170023744	NAVAL AIR ENGINEERING STATION, LAKEHURST, NJ.	2	SITE 32
2	NJ7170023744	NAVAL AIR ENGINEERING STATION, LAKEHURST, NJ.	3	1,7,8,9
2	NJ7170023744	NAVAL AIR ENGINEERING STATION, LAKEHURST, NJ.	3	18
2	NJ7170023744	NAVAL AIR ENGINEERING STATION, LAKEHURST, NJ.	3	30
2	NJ7170023744	NAVAL AIR ENGINEERING STATION, LAKEHURST, NJ.	3	40
2	NJ7170023744	NAVAL AIR ENGINEERING STATION, LAKEHURST, NJ.	3	AREA L
2	NJ7170023744	NAVAL AIR ENGINEERING STATION, LAKEHURST, NJ.	5	A&B(GW IRA
2	NJ7170023744	NAVAL AIR ENGINEERING STATION, LAKEHURST, NJ.	6	44
2	NJ7170023744	NAVAL AIR ENGINEERING STATION, LAKEHURST, NJ.	7	5,19,21
2	NJ7170023744	NAVAL AIR ENGINEERING STATION, LAKEHURST, NJ.	9	2
2	NJ7170023744	NAVAL AIR ENGINEERING STATION, LAKEHURST, NJ.	9	38
2	NJ7170023744	NAVAL AIR ENGINEERING STATION, LAKEHURST, NJ.	10	AREAS A&B
2	NJ7170023744	NAVAL AIR ENGINEERING STATION, LAKEHURST, NJ.	11	SITE 14
2	NJ7170023744	NAVAL AIR ENGINEERING STATION, LAKEHURST, NJ.	12	I/J
2	NJ7170023744	NAVAL AIR ENGINEERING STATION, LAKEHURST, NJ.	13	I&J
2	NJ7170023744	NAVAL AIR ENGINEERING STATION, LAKEHURST, NJ.	14	32
2	NJ7170023744	NAVAL AIR ENGINEERING STATION, LAKEHURST, NJ.	15	31
2	NJ7170023744	NAVAL AIR ENGINEERING STATION, LAKEHURST, NJ.	16	I/J
2	NJ7170023744	NAVAL AIR ENGINEERING STATION, LAKEHURST, NJ.	17	29 SOIL
2	NJ9690510020	FAA TECHNICAL CENTER	1	
2	NJ9690510020	FAA TECHNICAL CENTER	2	
2	NJ9690510020	FAA TECHNICAL CENTER	3	
2	NJ9690510020	FAA TECHNICAL CENTER	4	2
2	NJ9690510020	FAA TECHNICAL CENTER	4	AREA M
2	NJ9690510020	FAA TECHNICAL CENTER	4	1
2	NJ9690510020	FAA TECHNICAL CENTER	5	1
2	NJ9690510020	FAA TECHNICAL CENTER	5	2
2	NY4571924774	PLATTSBURGH AFB	1	
2	NY4571924774	PLATTSBURGH AFB	2	
2	NY4571924774	PLATTSBURGH AFB	3	
2	NY4571924774	PLATTSBURGH AFB	4	
2	NY4571924774	PLATTSBURGH AFB	9	
3	DE8570024010	DOVE AIR FORCE BASE	1	
3	DE8570024010	DOVE AIR FORCE BASE	2	

Region	EPA ID	Name	OU	SITE
3	DE8570024010	DOVE AIR FORCE BASE	3	
3	DE8570024010	DOVE AIR FORCE BASE	4	
3	MD2210020036	ABERDEEN PROVING GROUNDS (EDGEWOOD AREA)	4	
3	MD2210020036	ABERDEEN PROVING GROUNDS (EDGEWOOD AREA)	5	
3	MD3210021355	ABERDEEN PROVING GROUNDS (MICHAELSVILLE LF)	1	
3	MD3210021355	ABERDEEN PROVING GROUNDS (MICHAELSVILLE LF)	4	
3	PA2210090054	LETTERKENNY ARMY DEPOT, PDO AREA	1	
3	PA6170024545	NAVAL AIR DEVELOPMENT CENTER (8 AREAS)	1	
3	PA6170024545	NAVAL AIR DEVELOPMENT CENTER (8 AREAS)	4	
3	PA6213820503	LETTERKENNY ARMY DEPOT, SE AREA	1	
3	WVD980713036	WEST VIRGINIA ORDNANCE WORKS	1	
3	WVD980713036	WEST VIRGINIA ORDNANCE WORKS	2	
4	AL3210020027	ANNISTON ARMY DEPOT	1	
4	FL6170024412	NAVAL AIR STATION JACKSONVILLE	1	PSC 26, 27
4	FL6170024412	NAVAL AIR STATION JACKSONVILLE	2	B
4	FL6170024412	NAVAL AIR STATION JACKSONVILLE	2	A
4	FL7570024037	USAF HOMESTEAD AFB	3	
4	FL7570024037	USAF HOMESTEAD AFB	4	
4	FL7570024037	USAF HOMESTEAD AFB	6	SS-3
4	GA1570024330	ROBINS AIR FORCE BASE	1	
4	GA1570024330	ROBINS AIR FORCE BASE	2	
4	GA7170023694	USMC LOGISTICS BASE	1	PSC 3
4	GA7170023694	USMC LOGISTICS BASE	3	PSC 16,17
4	GA7170023694	USMC LOGISTICS BASE	5	PSC 8
4	KY8890008982	PADUCAH GASEOUS DIFFUSION PLANT	2	
4	KY8890008982	PADUCAH GASEOUS DIFFUSION PLANT	3	
4	KY8890008982	PADUCAH GASEOUS DIFFUSION PLANT	6	
4	KY8890008982	PADUCAH GASEOUS DIFFUSION PLANT	8	
4	NC6170022580	USMC CAMP LEJEUNE	1	B
4	NC6170022580	USMC CAMP LEJEUNE	1	A
4	NC6170022580	USMC CAMP LEJEUNE	2	SITES 1-3
4	NC6170022580	USMC CAMP LEJEUNE	3	SITE 45
4	NC6170022580	USMC CAMP LEJEUNE	6	SITE 2
4	SC1890008989	DOE SAVANAH RIVER SITE	1	
4	SC1890008989	DOE SAVANAH RIVER SITE	2	
4	SC1890008989	DOE SAVANAH RIVER SITE	3	
4	SC1890008989	DOE SAVANAH RIVER SITE	6	
4	SC1890008989	DOE SAVANAH RIVER SITE	7	
4	SC1890008989	DOE SAVANAH RIVER SITE	8	
4	SC1890008989	DOE SAVANAH RIVER SITE	9	
4	SC1890008989	DOE SAVANAH RIVER SITE	29	
4	SC1890008989	DOE SAVANAH RIVER SITE	30	
4	SC1890008989	DOE SAVANAH RIVER SITE	33	
4	SC1890008989	DOE SAVANAH RIVER SITE	34	
4	SC1890008989	DOE SAVANAH RIVER SITE	35	
4	TN0210020582	MILAN ARMY AMMUNITION PLANT	1	
4	TN0210020582	MILAN ARMY AMMUNITION PLANT	2	
4	TN0210020582	MILAN ARMY AMMUNITION PLANT	14	
4	TN3890090003	OAK RIDGE RESERVATION	1	
4	TN3890090003	OAK RIDGE RESERVATION	2	
4	TN3890090003	OAK RIDGE RESERVATION	3	
4	TN3890090003	OAK RIDGE RESERVATION	6	
4	TN3890090003	OAK RIDGE RESERVATION	8	
4	TN3890090003	OAK RIDGE RESERVATION	10	
4	TN3890090003	OAK RIDGE RESERVATION	11	
4	TN3890090003	OAK RIDGE RESERVATION	16	
4	TN3890090003	OAK RIDGE RESERVATION	17	

Region	EPA ID	Name	OU	SITE
4	TN3890090003	OAK RIDGE RESERVATION	18	
5	IL3210020803	SAVANNA ARMY DEPOT ACTIVITY	1	
5	IL8143609487	SANGAMO ELECTRIC DUMP / CRAB ORCHARD	1	15,22,29
5	IL8143609487	SANGAMO ELECTRIC DUMP / CRAB ORCHARD	2	ALL
5	MN3170022914	NAVAL INDUSTRIAL RESERVE ORDNANCE PLANT (NIROP)	1	
5	MN7213820908	NEW BRIGHTON / ARDEN HILLS (TCAAP)	3	
5	MN7213820908	NEW BRIGHTON / ARDEN HILLS (TCAAP)	6	
5	MN7213820908	NEW BRIGHTON / ARDEN HILLS (TCAAP)	7	
5	MN7213820908	NEW BRIGHTON / ARDEN HILLS (TCAAP)	8	
5	MN7213820908	NEW BRIGHTON / ARDEN HILLS (TCAAP)	9	
5	MN8570024275	TWIN CITIES AIR FORCE BASE (SMALL ARMS RANGE LF)	1	
5	OH6890008976	U.S. DOE FEED MATERIALS PRODUCTION CENTER	1	
5	OH6890008976	U.S. DOE FEED MATERIALS PRODUCTION CENTER	2	
5	OH6890008976	U.S. DOE FEED MATERIALS PRODUCTION CENTER	3	
5	OH6890008976	U.S. DOE FEED MATERIALS PRODUCTION CENTER	4	
5	OH6890008984	U.S. DOE MOUND PLANT	1	
5	OH7571724312	WRIGHT PATTERSON AFB	1	LF8,10
5	OH7571724312	WRIGHT PATTERSON AFB	1	LF8,10
6	OK1573724391	TINKER AFB	1	ALL
6	OK1573724391	TINKER AFB	2	
6	TX6213820529	LONGHORN ARMY AMMUNITION PLANT	2	ALL
7	MO3210090004	WELDON SPRING SITE REMEDIAL ACTION PROJECT	1	SITES 1-3
7	MO3210090004	WELDON SPRING SITE REMEDIAL ACTION PROJECT	4	
7	NE2213820234	CORNHUSKER ARMY AMMUNITION PLANT	1	
8	CO1571524130	LOWRY AFB	1	IRA-2
8	CO1571524130	LOWRY AFB	1	IRA-1
8	CO5210020769	ROCKY MOUNTAIN ARSENAL	1	
8	CO5210020769	ROCKY MOUNTAIN ARSENAL	17	
8	CO5210020769	ROCKY MOUNTAIN ARSENAL	18	
8	CO5210020769	ROCKY MOUNTAIN ARSENAL	19	
8	CO5210020769	ROCKY MOUNTAIN ARSENAL	20	
8	CO5210020769	ROCKY MOUNTAIN ARSENAL	21	
8	CO5210020769	ROCKY MOUNTAIN ARSENAL	22	
8	CO5210020769	ROCKY MOUNTAIN ARSENAL	23	
8	CO5210020769	ROCKY MOUNTAIN ARSENAL	26	1-4
8	CO5210020769	ROCKY MOUNTAIN ARSENAL	27	
8	CO5210020769	ROCKY MOUNTAIN ARSENAL	28	
8	CO5210020769	ROCKY MOUNTAIN ARSENAL	29	
8	CO7890010526	ROCKY FLATS PLANT	1	119.1
8	SD2571924644	ELLSWORTH AIR FORCE BASE	1	1
8	SD2571924644	ELLSWORTH AIR FORCE BASE	4	1
8	UT0571724350	HILL AIR FORCE BASE	2	
8	UT0571724350	HILL AIR FORCE BASE	3	SD34,WP6
8	UT0571724350	HILL AIR FORCE BASE	3	WP05
8	UT0571724350	HILL AIR FORCE BASE	3	ST18
8	UT0571724350	HILL AIR FORCE BASE	3	ST04
8	UT0571724350	HILL AIR FORCE BASE	4	OT20,41,42
8	UT0571724350	HILL AIR FORCE BASE	4	LF12
8	UT0571724350	HILL AIR FORCE BASE	4	LF11
8	UT3213820894	TOOELE ARMY DEPOT (NORTH AREA)	5	17
8	UT3213820894	TOOELE ARMY DEPOT (NORTH AREA)	5	33
8	UT3213820894	TOOELE ARMY DEPOT (NORTH AREA)	6	18
8	UT3213820894	TOOELE ARMY DEPOT (NORTH AREA)	6	9
8	UT3213820894	TOOELE ARMY DEPOT (NORTH AREA)	7	5
8	UT3213820894	TOOELE ARMY DEPOT (NORTH AREA)	10	41
8	UT3890090035	MONTICELLO MILL TAILINGS SITE	1	1
8	UT3890090035	MONTICELLO MILL TAILINGS SITE	2	

Region	EPA ID	Name	OU	SITE
8	UT9210020922	OGDEN DEFENSE DEPOT	1	1
8	UT9210020922	OGDEN DEFENSE DEPOT	2	1
8	UT9210020922	OGDEN DEFENSE DEPOT	3	1,2,3
8	UT9210020922	OGDEN DEFENSE DEPOT	4	4A-E
8	UTD980667208	MONTICELLO RADIOACTIVE CONTAMINATED PROPERTIES	1	OUA
8	WY5571924179	F.E. WARREN AIR FORCE BASE	1	SS1-7
8	WY5571924179	F.E. WARREN AIR FORCE BASE	4	
8	WY5571924179	F.E. WARREN AIR FORCE BASE	5	
9	AZ0570024133	LUKE AIR FORCE BASE	2	DP05
9	AZ0570024133	LUKE AIR FORCE BASE	2	DP23
9	AZ0570024133	LUKE AIR FORCE BASE	2	ST18
9	AZ7570028582	WILLIAMS AIR FORCE BASE	1	SD10
9	AZ7570028582	WILLIAMS AIR FORCE BASE	1	DP13
9	AZ7570028582	WILLIAMS AIR FORCE BASE	1	LF04
9	AZ7570028582	WILLIAMS AIR FORCE BASE	2	ST12
9	AZ7570028582	WILLIAMS AIR FORCE BASE	2	ST12
9	CA0210020780	SACRAMENTO ARMY DEPOT ACTIVITY (SADA)	1	
9	CA0210020780	SACRAMENTO ARMY DEPOT ACTIVITY (SADA)	2	
9	CA0210020780	SACRAMENTO ARMY DEPOT ACTIVITY (SADA)	3	
9	CA0210020780	SACRAMENTO ARMY DEPOT ACTIVITY (SADA)	4	
9	CA0210020780	SACRAMENTO ARMY DEPOT ACTIVITY (SADA)	5	
9	CA2170090078	NAVAL AIR STATION MOFFETT FIELD (MFA)	2	ALL
9	CA2570024453	GEORGE AFB	1	WP26
9	CA2570024453	GEORGE AFB	1	SD25
9	CA2570024453	GEORGE AFB	1	3
9	CA2890012584	LAWRENCE LIVERMORE NATIONAL LABORATORY MAIN SITE	1	ALL SITES
9	CA3570024551	CASTLE AFB	2	
9	CA3570024551	CASTLE AFB	3	
9	CA4570024337	MCCLELLAN AIR FORCE BASE	1	BASEWIDE
9	CA4570024337	MCCLELLAN AIR FORCE BASE	2	ALL
9	CA4570024345	NORTON AIR FORCE BASE	1	1
9	CA4971520834	DDRW - TRACY	2	
9	CA7210020676	FT ORD	3	
9	CA7210020676	FT ORD	4	ALL
9	CA7210020676	FT ORD	5	ALL
9	CA7210020759	RIVERBANK ARMY AMMUNITION PLANT	1	4
9	CA7210020759	RIVERBANK ARMY AMMUNITION PLANT	1	3
9	CA7210020759	RIVERBANK ARMY AMMUNITION PLANT	1	1
9	CA7210020759	RIVERBANK ARMY AMMUNITION PLANT	1	2
9	CA8210020832	DDRW SHARPE SITE (SHARPE ARMY DEPOT)	1	
9	CA8570024143	MATHER AIR FORCE BASE	2	6
9	CA8570024143	MATHER AIR FORCE BASE	2	2,3,4
9	CA8570024143	MATHER AIR FORCE BASE	2	5
9	CA8570024143	MATHER AIR FORCE BASE	3	AC&W
10	AK4170024323	NAVY AIR FACILITY ADAK	0	
10	AK4170024323	NAVY AIR FACILITY ADAK	0	
10	AK8570028649	ELMENDORF AIR FORCE BASE	1	
10	AK8570028649	ELMENDORF AIR FORCE BASE	2	ST 41
10	AK8570028649	ELMENDORF AIR FORCE BASE	4	
10	AK8570028649	ELMENDORF AIR FORCE BASE	5	ST 37
10	AK8570028649	ELMENDORF AIR FORCE BASE	8	
10	ID3572124557	MOUNTAIN HOME AIR FORCE BASE	2	
10	ID3572124557	MOUNTAIN HOME AIR FORCE BASE	4	
10	ID4890008952	IDAHO NATIONAL ENGINEERING LABORATORY	1	
10	ID4890008952	IDAHO NATIONAL ENGINEERING LABORATORY	4	
10	ID4890008952	IDAHO NATIONAL ENGINEERING LABORATORY	5	
10	ID4890008952	IDAHO NATIONAL ENGINEERING LABORATORY	8	

Region	EPA ID	Name	OU	SITE
10	ID4890008952	IDAHO NATIONAL ENGINEERING LABORATORY	12	
10	ID4890008952	IDAHO NATIONAL ENGINEERING LABORATORY	14	
10	ID4890008952	IDAHO NATIONAL ENGINEERING LABORATORY	18	
10	ID4890008952	IDAHO NATIONAL ENGINEERING LABORATORY	19	8-07
10	ID4890008952	IDAHO NATIONAL ENGINEERING LABORATORY	19	8-05,8-06
10	ID4890008952	IDAHO NATIONAL ENGINEERING LABORATORY	22	
10	ID4890008952	IDAHO NATIONAL ENGINEERING LABORATORY	23	
10	ID4890008952	IDAHO NATIONAL ENGINEERING LABORATORY	107	
10	ID4890008952	IDAHO NATIONAL ENGINEERING LABORATORY	708	
10	OR6213820917	UMATILLA ARMY DEPOT	1	
10	OR6213820917	UMATILLA ARMY DEPOT	2	
10	OR6213820917	UMATILLA ARMY DEPOT	3	
10	OR6213820917	UMATILLA ARMY DEPOT	4	
10	OR6213820917	UMATILLA ARMY DEPOT	5	
10	OR6213820917	UMATILLA ARMY DEPOT	6	
10	OR6213820917	UMATILLA ARMY DEPOT	7	
10	OR6213820917	UMATILLA ARMY DEPOT	8	
10	WA1170023419	NAVAL UNDERSEA WARFARE CENTER, KEYPORT	2	AREA 9
10	WA1170023419	NAVAL UNDERSEA WARFARE CENTER, KEYPORT	2	AREA 5
10	WA1170023419	NAVAL UNDERSEA WARFARE CENTER, KEYPORT	2	AREA 3
10	WA1170023419	NAVAL UNDERSEA WARFARE CENTER, KEYPORT	2	AREA 2
10	WA1170023419	NAVAL UNDERSEA WARFARE CENTER, KEYPORT	2	AREA 8
10	WA1890090078	HANFORD 200-AREA (USDOE)	0	
10	WA1890090078	HANFORD 200-AREA (USDOE)	1	
10	WA1891406349	BONNEVILLE POWER ADMINISTRATION/ROSS COMPLEX	1	
10	WA1891406349	BONNEVILLE POWER ADMINISTRATION/ROSS COMPLEX	2	C
10	WA1891406349	BONNEVILLE POWER ADMINISTRATION/ROSS COMPLEX	2	D
10	WA1891406349	BONNEVILLE POWER ADMINISTRATION/ROSS COMPLEX	2	E
10	WA1891406349	BONNEVILLE POWER ADMINISTRATION/ROSS COMPLEX	2	B
10	WA1891406349	BONNEVILLE POWER ADMINISTRATION/ROSS COMPLEX	2	A
10	WA3890090076	HANFORD 100-AREA USDOE	0	
10	WA4170090001	PORT HADLOCK DETACHMENT - USN	0	A
10	WA4890090075	HANFORD 1100-AREA (USDOE)	0	
10	WA5170027291	NAVAL SUBMARINE BASE, BANGOR	2	F91
10	WA5170027291	NAVAL SUBMARINE BASE, BANGOR	2	F94
10	WA5170027291	NAVAL SUBMARINE BASE, BANGOR	3	1 & 2
10	WA5170027291	NAVAL SUBMARINE BASE, BANGOR	3	16,24,25
10	WA5170027291	NAVAL SUBMARINE BASE, BANGOR	6	D
10	WA5170090059	NAS WHIDBEY ISLAND, AULT FIELD	1	A
10	WA5170090059	NAS WHIDBEY ISLAND, AULT FIELD	1	6
10	WA5170090059	NAS WHIDBEY ISLAND, AULT FIELD	1	B
10	WA5170090059	NAS WHIDBEY ISLAND, AULT FIELD	2	A
10	WA5170090059	NAS WHIDBEY ISLAND, AULT FIELD	2	D
10	WA5170090059	NAS WHIDBEY ISLAND, AULT FIELD	2	E
10	WA5170090059	NAS WHIDBEY ISLAND, AULT FIELD	2	C
10	WA5170090059	NAS WHIDBEY ISLAND, AULT FIELD	2	B
10	WA5170090059	NAS WHIDBEY ISLAND, AULT FIELD	3	
10	WA5210090096	HAMILTON ISLAND	0	
10	WA6170090058	NAS WHIDBEY SEAPLANE BASE	4	
10	WA7210090067	FORT LEWIS LOGISTICS CENTER	1	2
10	WA7210090067	FORT LEWIS LOGISTICS CENTER	1	1
10	WA7210090067	FORT LEWIS LOGISTICS CENTER	1	3
10	WA7210090067	FORT LEWIS LOGISTICS CENTER	2	1
10	WA7210090067	FORT LEWIS LOGISTICS CENTER	2	2
10	WA8570024200	MCCHORD AFB WASHRACK TREATMENT AREA	1	
10	WA9214053465	FORT LEWIS (LANDFILL #5)	1	
10	WA9571924647	FAIRCHILD AFB	1	

Region	EPA ID	Name	OU	SITE
10	WA9571924647	FAIRCHILD AFB	2	PS2
10	WA9571924647	FAIRCHILD AFB	2	FT1
10	WA9571924647	FAIRCHILD AFB	2	IS1
10	WA9571924647	FAIRCHILD AFB	2	WW1
10	WA9571924647	FAIRCHILD AFB	2	SW1,PS6&8
10	WA0980833065	MCCHORD AFB AMERICAN LAKE GARDENS TRACT	1	
		Total	291 sites	
Shaded areas denote No Action RODs				

APPENDIX C

FEDERAL FACILITIES TELEPHONE FOLLOW-UP SURVEY QUESTIONNAIRE AND INTERVIEW RESULTS

Federal Facilities Telephone Questionnaire Follow-up

1. In an effort to better understand choices related to residential land use,

   a. What were the factors that drove the selection of the future land use upon which the protectiveness of the remedy is based?
   - State, EPA, Local government or community, Base decision, Marginal cost increase of the remedy, already cleaning soil-to-ground water pathway, surrounding land use...
   - what role did EPA, versus the State, versus the Base play in making the decision?

   b. If there were multiple sites for this OU, were the remedies and land use choices the same for each site, or were the answers provided for the OU in a summation of site-specific answers?

   c. If multiple future land uses were identified as scenarios for which the remedy is protective, is it correct to assume that the most stringent land use (residential) can be met throughout the site or OU?

   d. What is the distance you used to delimit the surrounding land use?
   Is it activity
      - *immediately adjacent to the site?*
      - *within a near radius on the base (e.g., 114 mile, 112 mile, etc.)?*
      - *off base, near the fenceline?*
      - *off base, away from the fenceline?*

   e. What role did protecting the ground water play on the selection of future land use?
   Did the need to clean the site to protect ground water cause the selection of a residential use, since low cleanup levels were required?

2. In an effort to better define the relationship of land use to remedy selection,

   a. What was the influence of the future land use on the remedy selected?
   - Was the remedy chosen because of the need to cleanup to residential use, or was the remedy driven by engineering considerations, but would result in residential levels anyway?
   - Were other land uses seriously considered?

   b. The presumed future user(s) at your site was (were) _____. How did this impact the remedy selection? If the presumed user was not the current user, what was the basis for the presumed future user(s)?

3. In an effort to better understand the relationship between the basis of cleanup at a site and the remedy selected,

   a. Please describe how the different factors identified were used as the basis for cleanup *(e.g., MCLS, Health Risk Assessment, etc.).*

   b. If Human Health Risk Assessment and MCLs were chosen as the basis of cleanup, regardless of the order they were selected, what information was derived from the risk assessment that was not readily seen from the cleanup to MCLS?

   c. If state regulators pushed for residential land use, were ARARs involved?

4. What role did cost play in the selection of the remedy?

   a. Did cost play a factor in eliminating remedies for consideration? For selection?

   b. What was the cost differential between the highest-costing and the lowest-costing realistic remedies?

   c. If other and uses (nonresidential) were seriously considered, what would have been the cost?

Telephone Interview Summaries

Site 1: Pease AFB, OU 8 **Date of Interview:** 30 NOV 95
RPM: Michael Daly

Synopsis:

OU 8 consists of multiple sites: a municipal waste landfill, a dump, a ditch, and a hobby shop. The remedy consisted of digging up the landfill and disposing of it in another site on the base. The dump was capped, and its cover maintained. The remedy driver was ensuring that the leachate from the landfill did not contaminate the ground water. MCLs were the basis of cleanup, not a human health risk assessment. A future land use of residential was chosen because the GW was to be kept clean to MCL standards, not because the site would ever be used for residential purposes. The future reuse plan calls for the site to be open space. A future land use of commercial was also chosen because of surrounding land use in the area. Remedial cost for the site is driven by the O&M cost.

Site 2: Paducha Gaseous Diffusion Plant, OU 8 **Date of Interview:** 1 DEC 95
RPM: Tony Able

Synopsis:

OU 8 is an interim action site consisting of a uranium and TCE contaminated landfill and a closed RCRA landfill (no further action site). The landfill was capped to prevent leaching of contaminants to GW, which is being handled as a separate OU due to contamination from various sites at the facility. Because the GW will be protected to MCLS, the site cleanup is to residential levels; however, no future residences are anticipated. Multiple future land uses the result of the impact of surrounding land use. Remedial cost for the site includes O&M costs.

Site 3: Oak Ridge Reservation, OU 2 **Date of Interview:** 1 DEC 95
RPM: Tony Able

Synopsis:

OU 2 is an interim action site designed to reduce the mercury contamination from three tanks from entering nearby SW. Hazardous waste, water, and sediment were sent offsite for storage and/or treatment. Residential future land use was chosen because the cleanup standards for the nearby SW were based on NPDES limits, which were at a residential level. The site is considered to be industrial and will remain that way.

Site 4: Elmendorf AFB, OU 4 **Date of Interview:** 7 DEC 95
RPM: Marcia Combe

Synopsis:

OU 4 is a final action site that contains an asphalt drum storage area, a fire training area, and several aircraft maintenance hangars. Residential future land use was chosen because Region 10 guidance requires sites to evaluate residential future land use to establish a baseline or worst case scenario. If the human health risk for such a scenario falls between 10' and 10-', decisions are then based on a residential land use. Residential future land use is being considered across the base at Elmendorf. Another driving factor of the residential future land use scenario was the location of the site. The site is near Anchorage and is considered prime real estate if the base should ever close. However, if the base should continue to operate as scheduled, the site will not be residential because it is near the end

of a runway. State ARARs and MCLs were established as cleanup levels because they are clear and established levels.

With regard to GW, although the State considers all GW aquifers a source of drinking water, the shallow aquifer at Elmendorf is not considered a future DW source because it is contaminated and does not have a high yield.

Cost played a large role in the choice of remedies. The difference in costs between the chosen remedy for GW (natural attenuation) and alternatives was millions of dollars; however, cost was not a factor in the choice of future land use.

Current surrounding land use (CSLU) choices were determined for locations adjacent to the site.

Site 5: Ft. Lewis Logistics Center, OU 2 **Date of Interview:** 7 DEC 95
RPM: Bob Kievit

Synopsis:

OU 2 consists of a landfill and a solvent refined coal pilot project (SRCPP). The driving factor in the choice of the remedy at the landfill site was GW contamination. The area is close to a drinking water source. Soil was cleaned so as to prevent further GW contamination, and the GW was allowed to naturally attenuate to MCL levels. Future land use did not play a role in the selection of the remedy; however, at the SRCPP, the site was cleaned for unlimited use based on a future land use decision by the facility. CSLU choices were determined for locations in the immediate vicinity.

Site 6: Tinker AFB, OU 2 **Date of Interview:** 7 DEC 95
RPM: Susan Webster

Synopsis:

OU 2 is surface water contamination to Soldier Creek that runs off base through a number of residential and recreational areas. Future land use was determined based on the surrounding areas (residential and recreational) that the creek runs through. A risk assessment was performed, and no threat to human health was determined. Currently, an ecological risk assessment is being performed. CSLU was determined for the area near the base fenceline. Cost was not a factor for the selection of remedies at this site.

Site 7: Ogden Defense Depot, OU 1 **Date of Interview:** 7 DEC 95
RPM: Sandra Bourgeios

Synopsis:

OU 1 consists of a canal and two burial sites where the fill used was contaminated. Future land use of residential is consistent throughout the Ogden Defense Depot because it is very likely that the site will be used for future residential use. The remedy for the site consisted of excavating the contaminated fill and sending it to a hazardous waste facility. GW is treated by a pump and treat unit. The State and local government played a minimal role in the selection of the future land use. EPA was considered the main driving force behind the decision. Future land use based on residential land use scenario was based on Region 8 policy, which has been passed down from EPA HQ. Cost was an important factor in the selection of the remedy. CSLU was considered on the outskirts of the site.

Site 8: Naval Undersea Warfare Center, OU 2 **Date of Interview:** 7 DEC 95
RPM: Patricia McGrath

Synopsis:

OU 2, Area 8 was the site of plating shop operations that had contaminated the surrounding soil. The remedy for the site was soil excavation and GW monitoring. When the BRAC lists were developed, the facility was chosen for realignment. There was some concern that the facility would close in the future. Due to this uncertainty of the base's future and to protect the GW in the event that it should be used as a future DW source, a future land use of residential was chosen. The State played a major role in the selection of the remedy and the future land use because of concerns about the facility's future. Cost played a major role in the selection of the remedy. Because the GW confining layer was relatively deep (> 150 feet), GW treatment was not considered appropriate. Removal of the soil causing GW contamination, and GW monitoring were considered the most cost-effective way to treat the site. CSLU was considered directly next to the site.

Site 9: Sharpe Army Depot, OU 1 **Date of Interview:** 7 DEC 95
RPM: Richard Seraydarian

Synopsis:

Site was a source control to protect the GW site, which involved only a GW pump and treat remedy. Future land use did not play a significant role in the selection of the remedy. The contaminant plume had migrated offsite. A future land use of residential was chosen because the GW was used as a source of DW and because of the off-site property use. Cleanup was to MCLS. The State played a significant role not in the selection of the remedy, but in the treatment levels from the GW treatment facility.

Site 10: Sacramento Army Depot, OU 3 **Date of Interview:** 7 DEC 95
RPM: Marlon Mezquita (discussion with Richard Seraydarian)

Synopsis:

OU 3 is a tank area where the tanks had leaked and caused soil contamination. The remedy for the site was soil vapor extraction (SVE). The future land use did not play **a** role in the selection of the remedy. SVE was considered the best remedy for cleaning up the soil, regardless of its land use, based on its implementability. The SVE treatment worked so well and so quickly that the system was used to clean up beyond the human health risk levels that had been established. The cost of the remedy had no impact on the remedy selection.

Site 11: Williams AFB, OU 1 **Date of Interview:** 7 DEC 95
RPM: Ramone Mendoza

Synopsis:

OU 1 consists of a closed landfill and a series of no action sites. The landfill has been capped, and GW monitoring is in place. A human health risk assessment was conducted, and a future land use of residential was chosen because there were no guarantees that the site would not be used for residential purposes in the future, because the site is being handed over to the surrounding Native American community. Cost played a factor in the selection of the remedy. Initially, an impermeable cap was proposed, costing millions of dollars. A more inexpensive soil cover was chosen for the selected remedy and implemented. State ARARs were the driving factor in the selection of the GW monitoring requirements. CSLU was based on activities bordering the site.

Site 12: Fairchild AFB, OU 1 **Date of Interview:** 8 DEC 95
RPM: Cami Grandinetti

Synopsis:

OU 1 consists of an old landfill that lies approximately 4 blocks off base. TCE contamination from the landfill caused the local aquifer, a sole source aquifer used as DW, to become contaminated. A cap was placed over the landfill, and a GW containment barrier was constructed. Future land use of residential was driven by the MCLs and GW protection. CSLU was evaluated within 1/2 mile of the site.

Site 13: New Brighton / Arden Hills, OU 8 **Date of Interview:** 8 DEC 95
RPM: Tom Barounis

Synopsis:

OU 8 consists of PCB contaminated soil (approximately 1,400 cubic yards) that was removed and incinerated. The site was then capped, and an ISV system installed after the capping. At the time the ROD was signed, there was some concern that the site may have unrestricted access and that it should be cleaned to residential land use standards. Both the Army and EPA concurred on this. Since that time, however, there has been a change in the philosophy at the facility. Future land use for the remaining sites at the facility will be considered industrial because of surrounding land use. The future land use of this site will also probably be industrial.

There was no real cost differential in the choice of cleanup to residential versus industrial future land use. Cost did play a role in the remedy selection though, because an intermediate-cost remedy was selected. CSLU was considered to be around the site's perimeter.

Site 14: Loring AFB, OU 2 **Date of Interview:** 15 DEC 95
RPM: Mike Nalipinski

Synopsis:

Site is a combination of two landfills, one 9 acres, the other 17 acres. The future land use for the site will probably be recreational (snowmobile area), although there are residential and commercial buildings surrounding the site. Possible trailer park could be placed on the fringes of the site. The site, however, is not to be cleaned to unrestricted use. The remedy consisted of construction of a RCRA Level C cap to protect the GW. GW contamination is being handled in another ROD. Cost was not a factor in the selection of the remedy for this site in that the site would have to be capped; however, the remedy consists of placing excavated soils from other sites in the landfills. This impacted the base-wide remedy cost, reducing it by $10 million. CSLU was considered to be within 1/2 mile of the site.

Site 15: Ellsworth AFB, OU 1 **Date of Interview:** 15 DEC 95
RPM: Peter Ismert

Synopsis:

The site is a fire protection training area. The surrounding land use includes residential. A developer wants to make the land directly south of the site residential. This, coupled with future uncertainty about the site, led the RPM to select a future land use of residential. The remedy consists of SVE and GW pump and treat. This remedy is an interim action, with the final action just being an expansion of the interim action. Cost was not a factor in the selection of the remedy. Long-term O&M costs, however, would have been higher if the site had not been remediated and GW

containment had been selected as the remedy. The site is being cleaned up to unrestricted use levels. This is driven by the AF and is only true if the land is released from AF custody. If the AF continues to maintain the site, the site would be under restricted use. The State ARARs and State soil levels are for petroleum (TPH) cleanup and are being used to protect the GW to MCLs. CSLU was considered to be within 1 mile of the base.

Site 16: Weldon Springs Site Remedial Action Project, OU 1 **Date of Interview:** 15 DEC 95
RPM: Dan Wall

Synopsis:

Site is a former processing plant and consists of pits, a chemical plant, and wildlife areas. The future land use is anticipated to be only recreational. This is the cleanup criteria for the site; however, the cleanup goal of the site is to test the technological capabilities and limitations of the remedy and clean the site to unrestricted use levels (a residential scenario). A re-evaluation of the site, the remedy's treatment performance, and the potential risk the site poses will be conducted after the site has been cleaned. A general consensus among the concerned parties on the residential future land use was considered to be the impetus for such cleanup levels. In general, all parties felt a need for unrestricted use on the site because of uncertainty in the site's future use. Cost of the remedies made off-site cleanup prohibitive. So, the site went with the cheapest remedy that would meet the cleanup goals. The on-site disposal cell is still under construction. The State played a large role in most aspects of the remedial process. CSLU was considered to be within 3 miles of the site.

Site 17: West Virginia Ordnance Works, OU 2 **Date of Interview:** 18 DEC 95
RPM: Bill Arguto

Synopsis:

Site was formerly used for TNT manufacturing, consisting of a red water acids pond and a yellow water pond. The land was deeded to the State as a wildlife refuge (2,300 of 8,000 acres used by the wildlife). The ponds were capped and the site cleaned up to residential levels, but the land use is not unrestricted. Currently, the remedy consists of GW pump and treat. The construction is nearly complete. Capping the site was risk driven, and the future land use of residential was used to determine the remedy for the site. Initially, a future land use of residential was used to determine the baseline risk and the remedy. 'The sites could be used for residential purposes, although industrial was considered the most prevalent future land use. The GW is also a possible drinking water source. The ROD for the site will have to be amended because the cap is not suitable for such high levels of GW contamination. The CSLU was a conglomeration of what was surrounding the OU and the base.

Site 18: Savannah Army Depot Activity, OU 1 **Date of Interview:** 18 DEC 95
RPM: David Seely

Synopsis:

Site is a TNT washout lagoon with contaminated soils. The future land use of residential was chosen based on base closure uncertainties as well as access to the site if the base were to remain operational. This, coupled with an incremental cost to clean up the soils to residential cleanup levels, drove the remedy selection. The remedy for the site is incineration of the soils and backfilling the lagoons with clean fill. This would make the site cleaned to unrestricted levels; however, GW restrictions would be in place because the GW situation is scheduled to be looked at in the future. Cost played no role in the selection of the remedy. Federal ARARs referred to in the survey stem from the fact that the soils excavated from the lagoon were considered RCRA hazardous waste and needed to be treated before they could be landfilled. CSLU was

difficult to determine because the site is 13,000 acres. The CSLU is a combination of operations on surrounding the base and was considered within 1 mile.

Site 19: Idaho National Engineering Lab, OU 18 **Date of Interview:** 18 DEC 95
RPM: Wayne Pierre

Synopsis:

The site is a contaminated pit used by DOE to treat radioactive waste. The future land use for the site is considered residential after 100 years. For the next 100 years, however, the base, the State, and a site-specific advisory board agree that the site will remain a DOE site. Cost played a small role in the selection of the remedy. All wastes initially were to be hauled offsite, regardless of cost; however, the remedy at the site is a technology development project involving a plasma torch and robotic measures. The CSLU was considered around the facility.

Site 20: USMC Logistics Base, OU 5 **Date of Interview:** 17 JAN 96
RPM: Robert Pope

Synopsis:

The site consists of a grit disposal area and a wastewater treatment plant located at a Marine logistics base. A future land use of residential was agreed upon by EPA, the State, and the base, but was driven primarily by the State due to future uncertainties as to the site's use. A residential future land use was considered the most protective and the cleanup levels were easy to attain, because the remedy was excavation was off-site disposal. GW was not involved in the cleanup. The impact of cost on the remedy selection was unknown (the ROD was signed prior to the current RPM's involvement). Cleanup levels were based on a human health risk assessment. CSLU was considered next to the site.

APPENDIX D

FFSS STUDY METHODOLOGY

APPENDIX D

FFSS STUDY METHODOLOGY

METHODOLOGY

INTRODUCTION

This Appendix presents the methodology used to generate the data upon which the conclusions and observations contained in the body of this report are based.

Appendix A contains a copy of the Federal Facilities Superfund Survey (FFSS) form that was sent to the various regional Remedial Project Manager (RPMS) to obtain information on the 251 Federal Facility Operable Units (OUs) for which Records of Decision (RODS) had been signed as of June 30, 1995. An additional 17 surveys for OUs not contained on the mailing list (7 of which had ROD signature dates @r June 30, 1995) were also returned and incorporated into the study. Appendix B provides a listing of the RODs that were included in the FFSS. Appendix C is a copy of the questionnaire used during the follow-up telephone interviews (to be discussed later in this appendix).

As mentioned above, the FFSS form was sent to the regional RPMs to obtain information on 251 Federal Facility OUs with signed (interim or final) RODS. The survey was divided into three sections: a general section; a land use and basis for cleanup section; and a remedy section. The general section requested facility-specific information about the OU, including the number of sites that comprised the OU and the designation for the respective sites. The land use and basis for cleanup section and the remedy section requested site-specific information on the land use and remedies that were selected at each site. RPMs were requested to fill out additional surveys when the land use information for the sites that made up an OU were different.

Prior to sending the FFSS to the regional RPMS, the survey was pretested on an RPM from the U.S. Environmental Protection Agency's Region 1. The pretest was performed to determine the clarity of the questions that were being posed and the ability of the survey to obtain the desired information. Comments and suggestions on how to better improve the survey were obtained from the pretested RPM and were incorporated into the final version of the survey.

The FFSS was conducted during the late summer and fall of 1995. Two hundred and ninety-seven surveys, detailing information on 245 OUs, and 85 facilities, were returned for analysis. The information from the FFSS was placed into three separate data base files using **a Microsoft Access v. 2.0 format.** The first data base file (called **FED**) contained information from the general section of the FFSS form. The second and third data base files (called **Land Use** and **Remedy,** respectively) contained the site-specific information on the OU's land use and remedy. Each record in the **Land Use** and **Remedy** data bases was given **a** unique identification number so that the two files could be linked at a later time for analysis.

After the information was input into the data base, 10 percent (29) of the surveys were randomly selected from the files and were given quality assurance/quality control checks (QA/QC) to determine the amount of error occurring from data entry. Because the questions contained in the land use and basis of cleanup and the remedy sections were those used for trend analysis, they were the only questions counted in determining the error rate due to data input. There were a total of 29 questions in these two sections, allowing for 841 data entries. Fifteen data entry errors were detected during the QA/QC process, accounting for a 1.8 percent error rate. Because the error rate due to data entry was less than 5 percent, a more detailed QA/QC was deemed unnecessary.

Surveys that pertained to petroleum sites not managed under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) or sites with unsigned RODs were removed from the analysis. Six surveys were removed from the data base on this basis, resulting in a data base containing information on 291 sites.

No Action and No Further Action sites were removed from the data base files and placed in a separate category. These sites were identified by examining the **Remedy** data base and searching for those records which identified No Action or No Further Action as the selected remedy. Sixty-five No Action or No Further Action sites were identified.

In an attempt to identify trends that may be occurring among Federal Facilities, the remaining sites were divided into three subdivisions of categories for analysis: BRAC and Non-BRAC facilities; DOD, DOE, and Other government agencies; and Source Control for Soils, Source Control for Soils and Ground Water, and Source Control of Ground Water. BRAC and Non-BRAC facilities were identified readily by answers on the general section of the questionnaire. DOD, DOE, and Other facilities were identified by using information from CERCLIS data base.

The third grouping (Source Control for Soils, Source Control for Soils and Ground Water, and Source Control for Ground Water) was divided by examining answers to Questions 13, 14, and 15 of the Remedy section of the questionnaire. Those sites that answered interim or final source control for soil/surface cleanup (Question 13) and did not answer interim or final source control to protect the ground water (Question 14) and did not answer interim or final ground-water remediation (Question 15), were placed in the Source Control for Soils category. Those sites that answered interim or final for Questions 14 and/or 15 and did not answer interim or final for Question 13 were placed in the Source Control for Ground Water category. Those sites that answered interim or final to Question 13 and interim or final for Questions 14 and/or 15 were placed in Source Control for Soils and Ground Water group.

A fourth grouping, Ground-water Treatment Only sites, was also identified. These sites were identified by examining the remedy selected and the media addressed questions in the remedy and land use sections of the questionnaire. Ground-water Treatment Only sites were identified as sites where "Ground Water" was the only medium addressed or of concern, and where the site remedy selected or considered only involved "Ground Water - Pump and Treat," "Ground Water - Pump and Discharge," "Ground Water - Biological Treatment," "Ground Water - Chemical Treatment," Ground Water - Natural Attenuation," "Ground Water - Containment," or Ground Water - Engineering Controls." Because these sites involved only ground-water treatment, and did not involve a form of source control (i.e., soil removal or treatment), one would not expect a relationship between land use and the remedy selection. Therefore, these sites were removed for land use analysis, but were retained for remedy analysis. Sixty-one sites were removed from land use analysis because they were identified as Ground-water Treatment Only sites.

Profiles of the category breakdowns for land use analysis and for remedy analysis are provided below.

Table 1. Category Breakdowns

Category	Number of Sites Land Use Analysis	Number of Sites Remedy Analysis
BRAC	53	68
Non-BRAC	112	158
DOD	109	159
DOE	42	51
Other	14	16

Table 1 (continued)

Category	Number of Sites Land Use Analysis	Number of Sites Remedy Analysis
Source Control for Soils	44	44
Source Control for Ground Water	103	103
Ground-water Remediation	15	15
Ground-water Treatment Only	-	61

LAND USE AND BASIS FOR CLEANUP SECTION METHODOLOGY

The land use and basis for cleanup section of the FFSS attempted to determine the specific nature of the land use decisions that were being made at Federal Facility sites. The section focused questions on: media/materials addressed at the site; media/materials of concern at the site; the current, current surrounding, and future land uses at the site; the basis for cleanup at the site; factors that influenced the future land use decision at the site; and the presumed future use of a site.

Land Use. Four categories of land use were captured in the analysis: the current land use of the site; the current surrounding land use at a site; the future land use for a site considered in the baseline risk assessment; and the future land use for a site on which the protectiveness of the remedy is based. Again, if an OU consisted of more than one site, and the land use data were different for these sites, RPMs were asked to fill out a form for each site.

Because multiple land uses were frequently reported, a hierarchy of land uses was created that established how the findings were grouped. The hierarchy was: residential, educational, military, commercial, industrial, recreational, landfill, agricultural, other, open space/nature preserve, vacant, and do not know.

To simplify matters further, these land uses were then grouped into five categories: residential, military, industrial, other, and do not know. The breakdown of the categories was as follows:

- Residential category included residential land use and educational land use;
- Military category included military land use;
- Industrial category included commercial and industrial land uses;
- Other category included the recreational, landfill, agricultural, other, open space/nature preserve, and vacant land uses; and
- Do not know category included the do not know land use.

State and regional land use analyses were performed by using the facility's CERCLIS number and by using regional information contained in the general section of the survey.

Basis for Cleanup. The Basis for Cleanup portion of the survey asked the RPM to identify, in order of significance, the basis for cleanup at the site, whether it be the risk assessment, maximum contaminant levels

(MCLs), Federal or State ARARS, or other influences. When RPMs provided multiple answers, but did not rank them in order of significance, a ranking of 1 was given to all choices selected.

Raw counts were tallied for the basis of cleanup answers, which were ranked as a 1, 2, or 3. The raw counts were then grouped into six categories: health risk assessment, MCLS, State ARARS, future user concerns, ecological risk assessment, and other. The breakdown of the categories was as follows:

- Health risk assessment included human health quantitative and qualitative risk assessments. If a site had both answers in the top three rankings, the health risk assessment category was only counted once to prevent double-counting.
- MCLs included MCLs and maximum contaminant level goals (MCLGs).
- State ARARs included State ARARS, as well as looking at the breakdown of the State ARAR, whether it be a State MCL, a State soil level, or some other form of State ground-water requirement.
- Future user concerns included future user concerns.
- Ecological risk assessment included ecological risk assessment.
- Other included all Federal and State to be considered (TBCs), Federal ARARS, State or local government comments, citizen comments, or other concerns.

REMEDY SECTION METHODOLOGY

The remedy section of the FFSS was designed to elicit information about the remedies considered and implemented at the site. This section asked questions about: cleanup levels; remedies considered and selected; remedy cost; O&M data; the principal cost driver of the cleanup; and other miscellaneous information about the remedy (e.g., risk assessments performed, dense nonaqueous phase liquids (DNAPL) status, drinking water considerations, etc.).

Raw counts were tallied for the information from this section. Remedial trends that may have occurred for sites with the same type of future land use were also examined. As mentioned earlier, unique identification numbers were used to link information in the land use data base with information about the remedies for these sites. Trends in future land use versus cleanup levels, future land use versus cost, and future land use versus cost drivers were all analyzed.

Cost analysis was also performed on **a** remedy basis. Sites were categorized into one of four remedial action groups: sites with active ground-water treatment remedies (e.g., pump and treat, pump and discharge, biological treatment, and chemical treatment); sites with passive ground-water treatment remedies (e.g., natural attenuation, containment, and engineering controls); sites that only treated soil or surface waste; and No Action RODS. Cost analyses included determining the minimum and maximum of the estimated cost range of the remedies considered, as well as the minimum, maximum, and average costs for the remedies chosen. Remedy costs with zero values were removed when determining the minimum and average values for the estimated cost range of the remedies considered and the cost of the remedy chosen.

FOLLOW-UP TELEPHONE INTERVIEWS

Because of conflicting answers in a number of surveys and in an effort to better understand the logic that RPMs were using when filling out the FFSS, 20 sites of the surveys with a future land use of residential were chosen for follow-up telephone interviews. Sites were chosen randomly, but reflected the number of surveys received by region and the number of sites with ground-water contamination. The questionnaire used during the follow-up interviews is contained in Appendix C.

APPENDIX E

COST EFFECTS OF LAND USE ASSUMPTIONS

(This paper was prepared under
EPA Contract No. 68-D3-0013, Task 10)

COST EFFECTS OF LAND USE ASSUMPTIONS

OVERVIEW

A methodology has been developed for estimating the possible cost reduction benefits of increased soil cleanup levels as would be possible by using an industrial land use scenario. These increased cleanup levels could, presumably, result from alternative exposure assumptions (i.e., industrial versus residential). The cost savings resulting from increasing cleanup levels is equal to the sum of the savings resulting from treating a reduced volume plus the potential cost reduction associated with achieving a less stringent treatment standard.

Changes in unit cost are beyond the scope of the approach described here. The several factors that could affect the unit cost of treatment (including disposal) are discussed briefly below under Other Cost Reduction Issues.

The methodology, therefore, is intended to illustrate possible soil volume reduction benefits associated with increasing cleanup levels. Obviously, for any given site where contaminant distribution has been determined, the actual volume reduction can be calculated. For a hypothetical site or to arrive at an estimate of reductions at an actual site without a detailed analysis, however, contaminant distribution must be assumed.

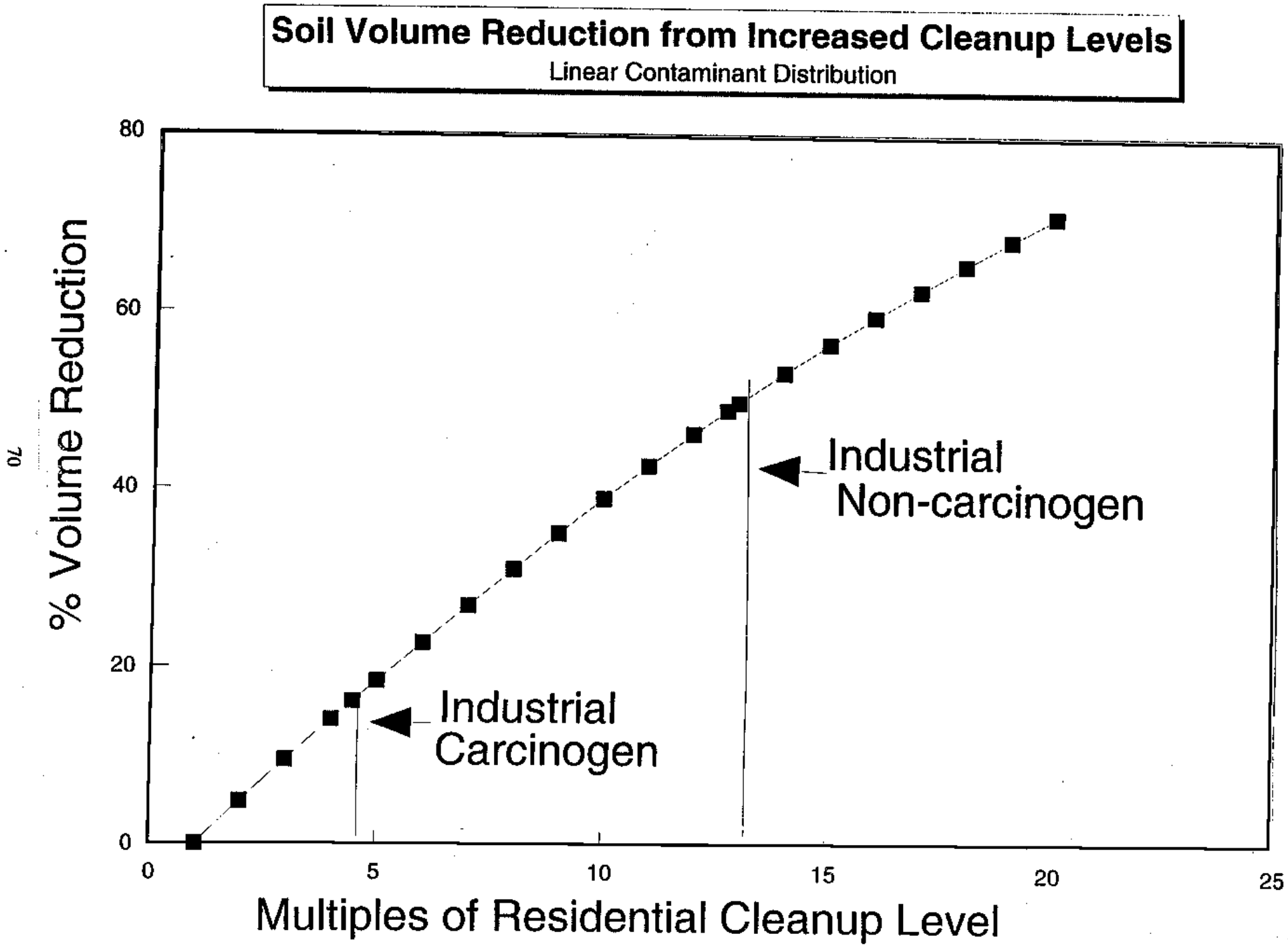
ASSUMPTIONS

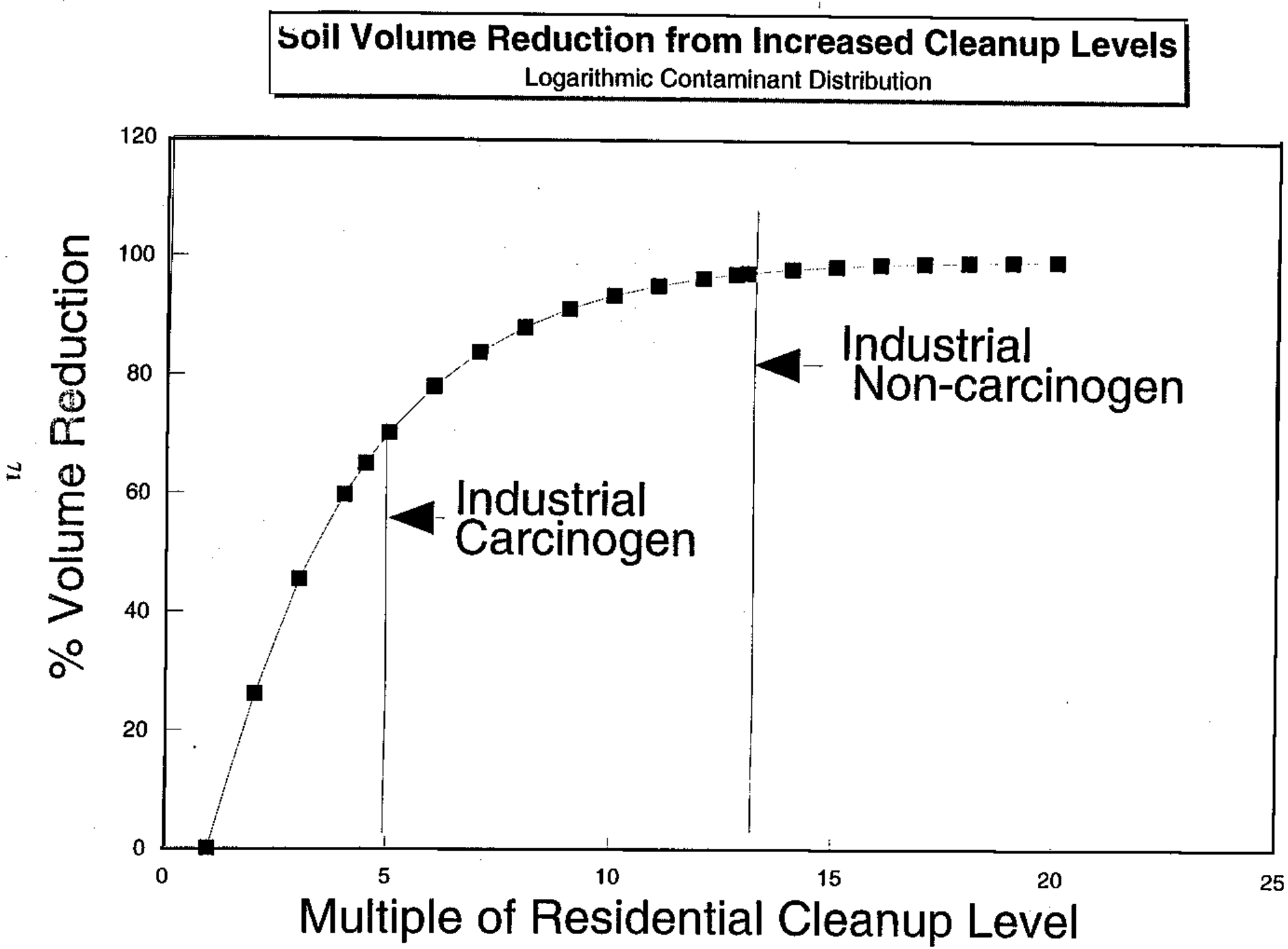
- Contaminated soils comprise one contiguous area with the maximum contamination at the center and decreasing to the cleanup level at the perimeter. For ease of calculation, the shape of the contaminated soil area is assumed to be a circle of unit thickness. The result of increasing the cleanup level, then, is to reduce the size of the circle. The band between the circle representing the higher (industrial exposure) represents the area or volume reduction.

- The distribution of contamination from a maximum at the center of the circle to the cleanup level at the perimeter was assumed to take two different shapes for the purposes of comparison, linear and logarithmic. These types of distribution seem logical if contamination was deposited at the center of the site and migrated by natural means over time.

Assumptions were tested for hypothetical site situations to evaluate the effect of size of site, ratio of maximum contamination to cleanup level, and distribution of contamination. Those analyses illustrated that the assumptions related to distribution of contamination had a significant impact on the result. (It may be possible, however, to make reasonable contaminant distribution assumptions with minimal site information; i.e., site history, contaminants of concern).

Based on the methodology described above, Figure 1 is a curve representing percent volume reduction versus increased cleanup levels represented as multiples of the original cleanup level if the contaminant level decreases logarithmically from the center. Figure 2 is the same plot for a linear or straight line contaminant level decrease. It is readily apparent that contaminant distribution has a significant effect on the volume reduction achievable from increased cleanup levels. For the logarithmic distribution, a five times increase results in a 70 percent reduction; for the linear case, it results in only an 18 percent reduction. The logarithmic case can be considered representative of sites with a large area of contamination only slightly above the cleanup level. The linear distribution may be appropriate for a site where contamination decreases quickly to zero from the maximum value.


Soil Volume Reduction from Increased Cleanup Levels
Linear Contaminant Distribution
% Volume Reduction
0
20
40
60
80
0
5
10
15
20
25
Multiples of Residential Cleanup Level
Industrial
Carcinogen
Industrial
Non-carcinogen


Soil Volume Reduction from Increased Cleanup Levels
Logarithmic Contaminant Distribution
% Volume Reduction
120
100
80
60
40
20
0
0
5
10
15
20
25
Multiple of Residential Cleanup Level
Industrial
Carcinogen
Industrial
Non-carcinogen

RISK SCENARIOS

Residential versus Industrial. The general form of the equation for carcinogenic risk or a noncarcinogenic hazard quotient as described in Risk Assessment Guidance for Superfund (RAGS) is usually used to calculate cleanup levels. If only the ingestion pathway is assumed, which is not uncommon for surface soil cleanups, the ratio of cleanup levels for residential versus industrial scenarios is equal to the ratio of soils ingested under each scenario. Using the standard assumptions, this ratio is 4.47 for carcinogens and 12.76 for noncarcinogens. These multiples are identified on Figures I and 2 to illustrate the impact of choice of land use. If only the ingestion pathway is considered, these ratios apply, regardless of chemical or site conditions. If, however, an inhalation pathway is also considered, the ratio would be chemical-specific because the equation would become a polynomial with two independent dose-response relationships.

Range of Risk. The acceptable risk range for Superfund remediation, from the National Contingency Plan, is 10^{-4} to 10^{-6}. Figures 1 and 2 assumed a 10^{-6} risk for residential as well as industrial scenarios; however, the impact of increasing the risk level is obvious from these figures. For example, 10^{-5} risk is 10 times the action level calculated at 10^{-6} and 10^{-4} is 100 times.

OTHER COST REDUCTION ISSUES

In order to evaluate the total effect on cost of increased cleanup levels, other factors must be evaluated that could have the effect of reducing or conversely increasing cost reduction benefits.

1. Reducing the volume to be treated or disposed will increase the unit cost, because many costs are fixed (e.g., design or mobilization). This will reduce the cost reduction benefit.

2. An increased cleanup level may allow the use of an alternative less-costly technology or reduce the cost of the application of a technology, thereby increasing the cost benefit of volume reduction. Altered unit cost can be applied to adjusted volumes to obtain the additional cost savings attributable to the different technology.

3. If the waste is RCRA listed waste, treatment levels based on best demonstrated available technology (BDAT) may be well below cleanup levels, thereby negating any possible treatment cost benefits. These off-sets to cost reduction are outside the scope of this methodology.