Understanding Superfund

A Progress Report

Jan Paul Acton
This research is supported by The Institute for Civil Justice.

ISBN: 0-8330-1006-9

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Published by The RAND Corporation
1700 Main Street, P.O. Box 2138, Santa Monica, CA 90406-2138
Understanding Superfund

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Jan Paul Acton

1989
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Foreword

Public policy objectives have provided the underlying dynamic behind much of the expansion of liability that has taken place over the last few decades. Policymakers, responding to a variety of policy problems, have relied on the liability system to assign responsibility to private parties for rectifying these problems and their potential consequences. The results have often been controversial. A particularly interesting case in point is the federal Superfund program which Congress established to deal with the problem of closed or abandoned hazardous waste sites.

The rationale for governmental action was clear. Public awareness of the potential dangers of hazardous wastes was growing, sparked by the discovery of closed landfills like Love Canal. This public concern assumed an immediate and vociferous quality since what was at stake was not simply a matter of aesthetics but rather an unknown but potentially significant threat to public health and the environment. Neither private action nor government regulation alone were likely to rectify the problem. Many of the closed sites had been in operation for decades. The identities of many of the responsible parties were unknown as were the contents of the landfills and the hazards they posed. Finally, the scale of the remedies required and their costs were uncertain.

In response to this situation, Congress established the Superfund program to deal with emergencies arising from abandoned wastes and waste sites, to provide long-term solutions to the most serious sites, and to encourage more responsible treatment of hazardous wastes in the future. Starting with the premise that those who caused the problem should pay for its solution, Superfund relied on a liability approach to facilitate its objectives.

After nearly a decade of operation, the Superfund program remains controversial. Critics of all stripes have focused on the program’s lack of accomplishments and, depending upon their perspective, assigned the blame either to EPA’s administration or the program’s basic design. But given the program’s complexity and the lack of consistent and complete data about both its operation and its direct and indirect
effects, a comprehensive assessment of the program has been impossible.

This report, representing the results of the first phase of the ICJ’s ongoing research on Superfund, lays the foundation for a more complete understanding of the Superfund program, its accomplishments, and the effects of its various incentives and provisions. It describes the program, its motivations, and operation. It pulls together data that, although publicly available, has not heretofore been analyzed to appraise the program’s operation. It discusses the implications of Superfund’s design and administration for the pace, cost, and nature of the remedies selected. And it raises key issues for future study.

As the initial volume in an ongoing research effort, this report is almost certain to tantalize and perhaps disappoint the reader since it raises more questions than it can answer. The EPA data that it analyzes, for example, can provide only part of the picture since they supply only limited information on the actions and expenditures of private parties who, by design, bear principal responsibility for cleanup. Similarly, it only begins to disentangle the effects of the program’s different components on the pace, costs, and efficacy of cleanup at various types of sites. Finally, given Superfund’s broader objectives, the report’s exclusive focus on Superfund sites requires additional information on how the program has affected waste disposal procedures more generally.

Nonetheless, by supplying a basic description of the program and its progress to date, and by identifying the key issues for assessing the program’s success, the report provides an essential first step for a more comprehensive analysis. It also serves as an important contribution to the ICJ’s ongoing program of research aimed at understanding the wider social and economic implications of expanded liability.

Kevin F. McCarthy, Director
The Institute for Civil Justice
Summary

Congress established the Superfund program with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and reauthorized the program in 1986 with the Superfund Amendments and Reauthorization Act (SARA). The program is intended to handle emergencies arising from the release of hazardous wastes, to provide long-term cleanup for a limited number of other sites, and to encourage more responsible disposal of hazardous wastes in the future. After nearly a decade of operation, Superfund remains controversial from many perspectives—particularly its accomplishments, its financing, its management by the Environmental Protection Agency (EPA), and the way in which it assigns costs and responsibility. Because the program is complex and data describing its accomplishments are inconsistent and incomplete, policymakers have lacked the basis for understanding the net effects of Superfund’s various incentives and provisions.

This report lays the foundation for a comprehensive assessment by describing the Superfund program and presenting some preliminary measures of its performance, based on federal data. This analysis reflects the initial stage of ongoing ICJ work designed to identify the effects of Superfund’s liability-based approach and administrative procedures on the pace and costliness of the program and the nature of the remedies selected, and to determine how large the legal and administrative costs are relative to the costs of remedy and cleanup.

HOW SUPERFUND WORKS

Superfund provides for two types of site cleanup. Its emergency response component provides for the immediate removal of spills or abandoned materials such as abandoned drums of toxic wastes that pose an imminent threat to human health or to the environment. Its remediation component provides for the long-term cleanup and restoration of abandoned toxic waste sites. Superfund uses a liability approach to finance cleanups. If the EPA can identify potentially responsible parties (PRPs), it tries to persuade them to undertake
cleanup themselves; alternatively, EPA pays for cleanup from the Superfund trust fund, then tries to recover costs by taking the PRPs to court. If no potentially responsible parties can be identified, Superfund pays for cleanup.

Superfund’s legal basis is the doctrine of strict, joint-and-several, and retroactive liability. In practice, this means that the EPA seeks to make any and all parties that have ever handled waste materials now in a hazardous waste site potentially responsible for part or all of the cleanup cost. The intent of the liability provisions of CERCLA is for responsible parties to pay 100 percent of the cost of cleanup—including the EPA’s investigation and oversight expense—for sites that are deemed most hazardous.

Site cleanup entails a complex series of administrative and legal steps. Candidate sites are investigated and their hazard assessed; those considered sufficiently hazardous are placed on the National Priorities List (NPL). Further investigations and feasibility studies yield a strategy and projected price tag for cleanup. More detailed plans and finally the actual cleanup follow.

The cleanup process also entails a series of related but independent legal steps involving the search for PRPs, the assignment of shares of cleanup costs, and potentially civil or criminal litigation. Under the doctrine of joint-and-several liability, PRPs may file a number of cross-claims and suits. Since sites may involve hundreds of PRPs, the communication and coordination burden may be quite substantial.

The potential change of lead between EPA and private parties, combined with the ever-present possibility that Superfund-related issues may ultimately be taken to court for civil or criminal resolution, renders the program particularly complex and the effects of its provisions difficult to determine. Sites may also change from state to federal jurisdiction, depending on which agency initiates the action, and states retain a role in approving final remedy selection.

SUPERFUND MAY PROVIDE CONFLICTING INCENTIVES

The incentives embedded in the program’s design may run at cross purposes and significantly affect the cost and pace of its achievements. For example, when the EPA identifies financially viable PRPs, it may opt for a relatively rapid, elaborate, and expensive remedy because the agency will not bear the costs of remediation. However, if no PRP is identified, the agency may elect to proceed more slowly in efforts to conserve the program’s federally financed Trust Fund. Private parties face conflicting incentives as well; if they feel they are only partially
responsible for the cleanup of a given site, they may prefer a slower pace until other parties can be identified to share in the cost. Yet if they do not actively participate in selecting a remedy—including, perhaps, volunteering to take over lead responsibility—EPA may select a remedy that the private parties regard as unnecessarily elaborate or expensive.

The program’s liability-based approach also provides potentially conflicting incentives and inefficiencies. For example, both the EPA and private parties proceed in an atmosphere in which they are legal adversaries; at the same time, they are encouraged to cooperate to identify suitable remedies. State and local governments may prefer a different pace of activities and type of remedy—especially if they feel more direct community concern about potential health hazards at a site and if they expect the EPA or private parties to bear most or all of the costs of the remedy. Because the EPA needs evidence strong enough to support liability claims in court, its site investigations are elaborate and expensive. And Superfund’s provisions for unlimited liability may discourage some polluters from cooperating.

WHAT SUPERFUND HAS ACCOMPLISHED SO FAR

Federal data provide some measure of Superfund’s operating record through September 1988.

- When Congress passed CERCLA in 1980, it authorized $1.6 billion for Superfund’s first five years; SARA, approved in 1986, provided another $8.5 billion through 1991. If lawmakers had appropriated proportional amounts, Superfund would have gotten $5.3 billion through September 1988, but the program actually received $4.5 billion in congressional appropriations.
- Of that $4.5 billion, the EPA paid out $2.6 billion, with the balance representing obligations for future expenditures ($1.5 billion) or uncommitted amounts ($0.4 billion). Of the $2.6 billion actually paid out to date, only $1.6 billion went for site-specific activities—investigating and remedying sites. The other 38 percent of Superfund outlays went for general overhead—administrative, laboratory, management, and litigation costs. The distinction between site-specific and general costs is important because the EPA attempts to collect only some of its overhead from private parties.
- The EPA promises to spend considerably more in the years ahead. As of September 1988, cumulative obligations for Superfund activities totaled $4.1 billion, with 59 percent earmarked
for site work. Obligations have increased threefold since the program was reauthorized in 1986, although they are a less reliable measure of activity since they can be adjusted or canceled and may depend on funds available to the EPA. Still, if the agency is to meet this growing financial burden without significantly more federal funds, it will be pressured to force private parties to assume more of the costs.

- EPA conducted 963 emergency removals at non-NPL sites during its first eight years. These incidents, which are not judged to need major site/remedial action, accounted for 80 percent of EPA's removal work.

- Of about 30,000 sites identified as potential Superfund targets, 1,193 were proposed for the program's National Priorities List. Managers in the program's 10 regions approved plans for cleanup work at 433 of those sites, but remedial action was underway at only 177. Only 18 of the 1,193 sites were removed from the list, and some sites declared clean were later re-opened for additional work. At present, 1,175 sites are on the proposed or final list.

- On average, eight years elapsed between the time a site came to the EPA's attention and remedial work began. Current EPA Administrator William K. Reilly has said that this process may require 13 years for sites now on the priorities list to complete the investigation process.

- On the enforcement front, the EPA reported that it recovered $230 million of past outlays through partial or full settlement at 328 sites. It may seek to recover another $824 million at 366 sites in the future. EPA has determined that it will not pursue cost recovery representing $483 million at another 920 sites. Beyond cost recovery, another 488 settlements provided for private-party takeover of clean-ups at a projected cost of $1 billion; however, these projections are uncertain and EPA does not monitor actual outlays by private parties.

It is difficult to know why these site-specific outlays and cost recoveries appear to be small. Possible reasons include reluctant leadership at the outset of the program; the need for time to elapse before certain sites "mature" to the stage at which major expenditures are warranted; the program's emphasis on liability and cost recovery; and program rigidities and its efficiency of operation. However, the EPA's pattern of combined public and private activities induced by the Superfund program may not be adequately reflected in the agency's own activities. For example, if the liability-based system is inducing a
substantial amount of voluntary private cleanup activities, then the agency's nonremediation expenses may be modest in comparison with the total national cleanup effort. Similarly, if the emphasis on strict liability is inducing significant changes in private behavior that are protective of health and the environment—for example, more waste reduction and more careful disposal—then society may be reaping benefits that are not captured in the Superfund remedial data.

SUPERFUND'S FUTURE

Critics have faulted the EPA for lacking a vigorous enforcement program and for failing to make full use of the enforcement tools with which it was provided in CERCLA and SARA. In a recently released report, the current EPA administrator announced a number of changes, including a stepped-up enforcement program that would add 500 employees to the Superfund enforcement effort. At this point, it is unclear whether increasing this effort will accelerate the pace of program activities, increase private funding, and improve the remedies selected or, alternatively, whether the program is already so mired in litigation that increasing enforcement would only further delay program activities.

One question asked about Superfund is whether the dollars being spent on the legal and administrative costs of the program are buying appropriately large amounts of cleanup. The next phases of this research will provide a comprehensive basis for that assessment and help anticipate the likely effects of the proposed program changes.
Acknowledgments

Preparation of this report would not have been possible without the generous assistance and patient work of many individuals. Superfund is a complex program, and it is in a state of constant change. As a result, one cannot consult a single source for comprehensive and consistent descriptions and measures of accomplishments. Data need to be gathered from many sources, cross-checked, and discrepancies resolved.

Since this report focused primarily on the EPA component of the process, the most extensive effort was provided by individuals within that agency. Lew Crampton and Terry Davies were generous with their time, questions, and encouragement for the work. Bruce Diamond, Robert Duprey, Mike Feldman, Gary Katz, Walt Kovalick, Henry Longest, and Elaine Stanley guided me to relevant offices, provided explanation, and coordinated review comments on earlier drafts of the report. Any listing of individuals who provided detailed information runs a real risk of omitting key individuals, but I would like to especially acknowledge the assistance of Bob Alwein, Frank Biros, Beth Craig, Carl Dolinka, Emil Knutti, Terry Ouverson, Tom Sheckells, and David Swack.

The most extensive discussions and suggestions for improvement came from my RAND colleagues and from the formal reviewers for the report. Peter Reuter began ICJ’s work in understanding the effects of the Superfund program better and raised many of the questions addressed in this report. Kevin McCarthy and Deborah Hensler commented on several drafts. The formal reviewers, Frank Camm of RAND, and Bob Hahn of the Council of Economic Advisors, were extremely helpful in sharpening the discussion and challenging the support for several elements in earlier drafts. Steve McKenney provided conscientious research assistance and Pat Williams carefully revised more versions of this report than I can recall. Andi Fellows and Mary Vaiana contributed extensively to the rewrite and clarity of expression throughout the text and briefings.
I have benefited from the assistance of each of these individuals but—perhaps more in this report than in most—the interpretations and conclusions are mine and not necessarily shared by these individuals.
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I. INTRODUCTION

The Superfund program has become one of the most visible and most controversial parts of our national environmental policy. The program had its origins in the late 1970s, following the publicity over the discovery of the Love Canal landfill and the problems in the surrounding area. Love Canal was the harbinger of the more general discovery that prior toxic waste disposal practices had created a significant threat to health and to the environment—one that could be reduced at some sites only through substantial remedial effort.

In December 1980, the last month of the Carter administration, Congress responded to these events by enacting sweeping legislation in the form of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, or CERCLA—popularly known as Superfund. CERCLA, which was amended in 1986 by the Superfund Amendments and Reauthorization Act, or SARA, contained provisions for emergency response as well as for the identification and cleanup of the most hazardous closed and abandoned waste sites.

The Superfund program is based on a notion of strict liability for the present site owner, for the past owner at the time of disposal, and for all parties that have generated or transported waste, selected a disposal site, or disposed of waste at a site. Indeed, courts have held subsequent owners of the property to be liable for cleanup costs even if they acquired the property after it ceased to be used as a waste site.\textsuperscript{1} This broad liability often results in the identification of several hundred potentially responsible parties (PRPs) at a single hazardous waste site, many of whom contest their liability for a share of the cleanup costs. Some critics attribute a significant portion of the costs and slow pace of the program to this litigious atmosphere.

After eight years, the Superfund program\textsuperscript{2} remains the focus of substantial controversy and uncertainty. We are not yet certain how many sites will ultimately require attention, what the appropriate remedies are, or what the cost of these remedies will be. Some

\textsuperscript{1}The major provisions of CERCLA, along with key court interpretations, are reviewed in Grad (1985), Harvard Law Review (1986), Connolly (1986) reviews CERCLA and SARA and an extensive set of legal interpretations. Casler and Ramsey (1985) and Nott et al. (1987) provide nontechnical reviews of the major provisions and a summary of the manner in which they are often implemented.

\textsuperscript{2}In this report, we will generally refer to the overall program by its popular name, the Superfund program, to indicate its legislative basis and the administrative practices adopted to implement it.
estimates place the eventual federal cost of the program at $100 billion and its total private and governmental cost at $500 billion, further maintaining that it will require at least 50 years to deal with the set of closed hazardous waste sites (Office of Technology Assessment, 1985 and 1988).

The Superfund program has been criticized at once as too ambitious and not strong enough; as too expensive and too wasteful. Critics feel it has accomplished little; defenders contend that it has made substantial progress toward its goals. Of those who have criticized the program to date, some feel that tougher implementation and greater effort are needed, while others maintain that the approach is fundamentally flawed and that a different approach is warranted.

Most prior discussions of CERCLA, however, have been hampered by a lack of systematic data regarding costs, pace, or reasons for the outcomes to date. Parties other than the Environmental Protection Agency (EPA) are not required to report their cleanup expenditures. Further, some EPA data themselves deal with only part of the Superfund program, making it difficult to gain an accurate picture even of federal costs and accomplishments. The purpose of this report is to describe the Superfund program and to provide a preliminary sketch of some indicators of its activities, costs, and pace to date. We will then identify key issues in the program that may account for its successes or shortfalls, focusing especially on the effects of Superfund’s liability-based approach. We will conclude with a sketch of further research that is needed.

FOCUS OF THE STUDY

Our focus on Superfund dictates that we limit our discussion to the most hazardous closed or abandoned sites that receive some formal review or expenditure by the EPA. These sites merit our attention not only because they currently number almost 1,200, but also because they entail significant remedial and transaction costs and, at least by some measures, represent some of the most serious threats currently posed to human health and to the environment. In addition, the Superfund program creates spillover effects on other hazardous waste activities—e.g., by creating precedents and by competing for common scarce resources. A more comprehensive examination of hazardous waste policy could encompass sites that are handled exclusively by states or private parties, sites that are still operating underground petroleum storage tanks, and nuclear waste sites, since the different programs compete for scarce resources, and activities at one type of site may intentionally or unintentionally affect the others.
OVERVIEW OF THE REPORT

Section II of the report provides an overview of the Superfund program, its legal basis, and its sources of funds. Section III presents a concise description of incentives and the major administrative steps taken in its application. Section IV is the heart of the report, wherein we provide an overview of the major indicators of program effect based on public data available from the EPA and other selected sources. Section V presents a short interpretation of some of the most interesting or puzzling findings from Sec. IV. Section VI concludes with a sketch of proposed further research that goes beyond the level of national statistics and attempts to capture costs and activities for each of the major participating groups in the Superfund process.
II. BACKGROUND FOR THE SUPERFUND PROGRAM

If we are to understand some of the principal issues surrounding the Superfund program and to interpret the evidence regarding its accomplishments, we must first describe the basic provisions of the legislation and its implementation.

Superfund provides both for emergency response to spills and abandoned hazardous material and for the investigation, planning, and implementation of site remediation. Our principal focus is on investigation, planning, and remediation, since these are the most time-consuming and expensive aspects of the program, but measures of expenditure and accomplishments for emergency activities will be included in our analysis as well.

The Superfund program also attempts to alter future waste-handling and disposal practices by sending a clear message that responsible parties will be compelled to provide remedy, and perhaps compensation, for prior waste disposal practices. By raising present expectations of future remedial and compensation costs in this manner, the program hopes to encourage generators, transporters, and disposers to engage in safer practices than they would otherwise undertake at this time.

This “polluter pays” principle has a foundation in notions of both efficiency and justice. On efficiency grounds, the prospect of paying for cleanups (or the more expensive production practices needed at present to reduce the need for cleanups) leads to higher costs for goods and services. In response, consumers adjust their purchases so that the “right” amount of pollution control is produced.1 The “justice” argument holds that the polluter should pay for damage inflicted on the environment—that the polluter is to be punished for bad behavior. We will now describe the motivation underlying the Superfund program, delineate its legal basis, and outline the steps through which a site may proceed if it enters the Superfund program.

MOTIVATION FOR THE SUPERFUND PROGRAM

The late 1970s marked a substantial change in our awareness of the significance of previous waste disposal practices. The discovery of sites

1See Fisher (1981) for a discussion regarding the notion of internalizing external costs into the prices producers and consumers face.
such as Love Canal in New York, Times Beach in Missouri, and Valley of the Drums in Kentucky raised broad concerns about disposal practices that had once been regarded as acceptable. The public became acutely aware that land disposal did not offer an unlimited repository for hazardous wastes and that the earth could not be relied on to contain these wastes or to render them harmless. In some instances, known carcinogens were found in water supplies or flowing across boundaries of closed sites.²

Little was known, however, about the characteristics of these sites or about their health significance. We did not have a good idea of precisely how many potentially hazardous sites there were, where these sites were located, or how many such sites constituted a threat to health or to the environment. Nor did we have a clear idea of the remedies that could reduce such risks to an acceptable level. And we had no knowledge of how many people might already have been harmed by exposure to these sites—no significant symptoms had yet been manifested. Indeed, eight years after creating CERCLA, we still lack a clear understanding of these matters.

At the same time, it often proved difficult to determine which parties had contributed what share of the hazard to a given hazardous waste site. In general, these sites received waste from many generators—waste that was often handled by transporters who were not the generators. Further, many sites were operated by several individuals or organizations through the course of active operation. Hence, the volume of individual substances and the health hazard that they posed were often unknown—at least with respect to the contributing parties. The interaction of some of these chemical substances at the waste sites increased their potential hazard, further confounding the issue of causal responsibility.

The problem of closed or abandoned waste sites posed a particularly acute challenge for policymakers. In many cases, such sites had been closed for several years. Thus, the parties that had originally handled and disposed of the wastes were often unavailable to help determine site characteristics. In some instances, the original operators had gone into bankruptcy. From a cost recovery or liability perspective, these sites often presented no obvious responsible parties from whom to compel a remedy or seek compensation.

These factors combined to limit the applicability of some traditional legal remedies in the face of a harmful situation. Several scholars have commented on the failure of common-law relief for damages that may be caused by toxic wastes (see, for example, Baurer, 1980; Ginsberg and

²See, for example, Reisch (1983), cited in Connolly (1986) for legislative history.
Weiss, 1981; or Note, 1981, cited in Connolly, 1986). Both private and public tort actions may be difficult to support for many reasons, including:

1. Delays in associating an alleged injury to exposure at a particular site;
2. The difficulty of establishing a causal link to a single source of harm;
3. The free-rider problem, which occurs if a large number of individuals may have been exposed and it is expensive to initiate litigation;
4. Poor records about the contributors to the site; and
5. The fact that many sites were operated in a manner that was considered appropriate at the time—in some cases, in a manner specifically authorized by public agencies.

LEGAL BASIS FOR SUPERFUND

Faced with these difficulties, Congress declared that a broad class of parties may be held fully liable for the remedy of closed and abandoned hazardous waste sites. Specifically, CERCLA, as interpreted by the courts, declared that all generators, transporters, and waste site owners and operators could face strict, joint-and-several, and retroactive liability for the cleanup of that site.

- **Strict liability** meant that no matter how prudent a practice may have seemed initially, responsible parties would be held liable if that practice was now considered harmful. That is, liability applies even without intent or negligence.
- **Joint-and-several liability** signified that all contributors would be responsible for cleanup and that each one individually would be responsible for cleanup. In practice, this meant that the EPA could declare a single party responsible for the entire cleanup of a site that may have involved hundreds of parties. That single party could in turn seek to recover part of its costs from other parties, but the burden would be on that party, not on the government, to establish third-party involvement.
- **Retroactive liability** meant that these provisions would apply to acts that may have taken place before CERCLA was passed, where the effect of these actions continues.

The intention of the liability provision of CERCLA was that responsible parties would pay 100 percent of the costs of cleanup—including
the EPA's investigation and oversight expense—for sites that are deemed most hazardous.

CERCLA applies to virtually every party that may ever have had anything to do with a hazardous waste site. First, it includes all generators of materials that were sent to a site; indeed, some courts have affirmed that a party may be included even if it disposed of substances considered nonhazardous in a site that contains other hazardous substances. Second, it encompasses transporters of these materials who selected the disposal site; often the materials are handled by a transporter that is not the same as the generator when materials are disposed off the premises of the generator. Third, it applies to the operators and subsequent owners of the property where a hazardous waste site is located. This includes subsequent owners even if they acquired the property when it was no longer being used as a waste site (Connolly, 1986).

FINANCING THE PROGRAM

The Federal Share

Congress established a Trust Fund as part of the implementation of CERCLA. This fund was originally financed primarily from a feedstock tax on petroleum and selected chemical products, but it now includes a broader tax on manufacturers and general revenues. The Trust Fund serves a number of important functions in the Superfund program. First, it finances the share of the investigation and remedial activities that would otherwise be attributed to parties that cannot be compelled to contribute financially. These may include the financial share of bankrupt parties or parties that cannot be identified—so-called orphan shares. Second, it finances some of the preliminary investigation and hazard assessment activities that the government undertakes before a site is included on the National Priorities List (NPL), the federally compiled list of sites deemed hazardous enough to warrant expenditure of federal money. Third, it helps fund some common costs, such as administrative and research-and-development expenses.

Congress intended through Superfund that responsible parties would pay for the full costs of investigation and cleanup at individual sites. If possible, the EPA persuades responsible parties to assume costs at Superfund sites from the outset so that no federal monies need be expended—in which case sites are designated enforcement lead. If necessary, the EPA can expend money from the Trust Fund and seek
to recover the outlays from responsible parties at a later stage, in which instance sites are designated fund lead. Therefore, with the exception of orphan shares (really orphan sites under a concept of joint-and-several liability), the Trust Fund could operate essentially as a revolving fund. In principle, over the long term, the fund would be fully reimbursed by cost recoveries.

When CERCLA was passed in 1980, the Trust Fund was set at $1.6 billion for the first five years of the program. When it was reauthorized in October 1986, the fund was increased to $8.5 billion. Under CERCLA, the largest source of revenue was a petroleum tax. Under SARA, the petroleum tax (on both domestic crude oil and imported crude and petroleum products) continues as the largest single source of revenue—projected at $2.75 billion over the five-year period of 1986 to 1991. A general environmental tax imposed on corporations is projected to raise another $2.5 billion. The remaining taxes include a chemical feedstock tax (expected to generate $1.4 billion) and appropriations from the general fund ($1.25 billion). Interest on the Trust Fund and costs recovered from responsible parties are expected to generate approximately $600 million over the five-year period of 1986 to 1991.

The act provides that if the unobligated balance in the Trust Fund exceed $3.5 billion, no taxes could be imposed (see Subsection (d) of Section 4611 of the Internal Revenue Codes of 1986).

The State Share

Both CERCLA and SARA provide for a state share in the expenditures. In 1980, the EPA interpreted the act to mean that the federal Trust Fund would finance 90 percent of the capital expenditure at a site (when responsible parties were not financing it from the outset) and that the states would finance 100 percent of the ongoing operation and maintenance (O&M) expense.\(^3\) Capital activities include excavation, construction of facilities or containment devices, and stabilization of materials. Ongoing O&M activities include pumping and filtering operations, maintenance of facilities, monitoring, and the like. In 1986, SARA provided that the states would finance 10 percent of the capital expenditure as well as 100 percent of the O&M. States vary widely in the manner in which they fund their share. A recent survey of states

\(^3\)This interpretation was the subject of some discussion during reauthorization in the Senate on April 11, 1984, when some members of the Senate Committee on Environment and the Public Works stated that they had intended for the EPA to pay 90 percent of capital and 90 percent of O&M costs. (See U.S. Senate Committee on Environment and Public Works, 1984).
found that 41 states have established funding mechanics for non-NPL and NPL cleanup activities. Thirty-nine states report that they collect an average of $298 million per fiscal year to pay for hazardous site cleanup activities. Nine states were identified in the survey as having no funding mechanism to support site cleanups.⁴

PATHS NOT TAKEN

Congress consciously chose not to adopt some alternative approaches that might have been considered for dealing with closed and abandoned hazardous waste sites. Among the most obvious alternatives not selected were those founded on pure private torts, public works, and criminal liability. In some instances, there was discussion at the time these alternatives were rejected; in others, we can speculate about likely reasons.

The principal reasons underlying the rejection of an approach based purely on private tort claims have been reviewed above. They include the difficulties that individuals may have in knowing that they have been harmed; the delays that would occur in awaiting evidence of such harm and in securing court determination; difficulties in demonstrating direct causality; and the public goods nature of the remedies being sought.

The public works approach was also rejected by the drafters of CERCLA. Possible reasons include the potential cost to the U.S. Treasury if it were a federally financed program as well as the policy judgment that the polluter should pay.

A program based on criminal liability was also rejected, possibly because of the acknowledgment that some of the originally responsible parties may have acted in good faith on the basis of what was then acceptable practice. Furthermore, although a threat of criminal liability may be useful in influencing future waste handling practices, it is not directly productive in achieving remedy for past actions and achieving cleanup.

THE ISSUE OF FAIRNESS

CERCLA took the point of view that the polluter should bear primary responsibility for financing cleanups. As a matter of policy, Congress could have decided that those who benefit from a reduced risk to health or the environment should pay.

⁴See Association of State and Territorial Solid Waste Management Officials (1988).
Who Benefits?

By and large, the health, environmental, and aesthetic consequences of a hazardous waste facility are highly localized, as are the beneficiaries of site remediation. Unlike the atmosphere or major bodies of water, pollutants generally do not disperse widely. Consequently, the beneficiaries of a cleanup are often confined to a single community—perhaps even a small part of that community. In a few instances, however, a major drinking water supply (e.g., Jackson Township and Stringfellow) or a harbor (Chemical Control, New Jersey, or Boston Harbor) may be affected—in which case the beneficiaries of cleanup are more widely distributed.

Who Pays?

With the exception of cost sharing for orphan shares, Congress chose not to finance Superfund from local or state sources. The petroleum and chemical feedstock tax was apparently selected on the premise that these industries provide inputs to the majority of substances that currently result in hazardous wastes. There is, of course, a temporal difference between the production of chemicals and other substances found in hazardous waste sites and the present-day production of similar petroleum products and other substances; in many cases, the owners (or stockholders) of the firms have changed, as have the consumers who used the original products as well as the workers in those industries. In funding the Trust Fund, Congress made no attempt to return to the parties who benefited economically from the original economic activity—and it would probably have been unduly cumbersome to do so.

The legal, administrative, and financing features of the Superfund set up a number of intended and unintended incentives for behavior that are discussed in the next section.
III. STEPS AND INCENTIVES IN THE SUPERFUND PROGRAM

CERCLA identified a number of goals for the Superfund program and provided guidelines and legal authority to achieve them. SARA expanded on the goals and legal authority and introduced a tight schedule for achieving milestone events at a certain number of sites. This enabling legislation, in combination with the administrative structure and procedures that the EPA has established for implementation, set up a number of incentives for behavior by the various private and governmental parties. In this section, we first sketch the principal steps through which a site may pass under the Superfund program, and then summarize some of the most important incentives facing the different parties under this program.

FLOW CHART OF STEPS IN THE PROCESS

To a first approximation, we can think of the Superfund cleanup program as a linear process. In the next subsection, we characterize these sites from the perspective of which institution has the lead responsibility and what provisions of the administrative process are employed. Figure 3.1 indicates the major steps in this process.

1. The federal government must become aware of a site for it to enter the Superfund process. Sites generally come to federal attention because of citizen complaints or nomination by states. If a site is handled exclusively by the state or by a private party—or if it has not yet been discovered—it does not enter the Superfund process.

2. Next, a preliminary site assessment is made. The EPA attempts to determine how the site was used and what wastes were disposed there. At this stage, many sites are judged sufficiently harmless to merit no further attention by the EPA.

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1In this discussion, we are ignoring the emergency response component of Superfund, where abandoned or leaking wastes constitute an immediate threat to health or to the environment. These emergencies can be isolated instances—for example, a barrel of toxic material discovered at a roadside—or an emergency leak or runoff from a waste site. But an abandoned drum of waste at the side of a freeway or an emergency removal rarely becomes a site unless there is other hazard involved. We include emergency response activities in our analysis of program activities and outlays in Sec. IV.
3. A fraction of these sites then receive a site inspection, which provides added information about the site condition, including proximity to population, evidence of damage, possible contact with groundwater, and the like. At this stage as well, many sites are judged sufficiently harmless to merit no further attention by the EPA.

4. If appropriate, the site goes through a formal hazard-ranking process. This process considers a number of characteristics, such as the proximity of a site to a groundwater supply and whether that site is located near occupied housing. The product of this process is a numerical score which, if above the cutoff number (currently 28.5), puts the site on the NPL.\(^2\) With the exception of emergency removals, only those sites that are on the NPL are eligible for the expenditure of Superfund monies.

5. The site then enters a process of a formal remedial investigation and feasibility study (RI/FS). Although these steps are technically separate, they are often undertaken in combination. During this RI/FS process, investigators try to determine the characteristics of the sites, the wastes that are in it, what suitable remedies/alternatives exist, what the projected costs would be, and what the resulting risk would entail.

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\(^2\)The hazard-ranking system score is retained for the site. In principle, the cutoff value of 28.5 may be changed in the future—an action that would affect the number of sites receiving additional attention under the Superfund program.
6. At the conclusion of this investigation and planning process, the EPA issues a record of decision (ROD) that is signed by the regional administrator. Before final approval, the regional administrator invites comments from the community and from state and local governmental officials. This ROD is a watershed event. Up to this point, the EPA has been determining what to do (as, perhaps, have responsible parties and local and state agencies). After the ROD is approved, actual remediation can begin.

7. Remedial design occurs next. This is a more detailed design for the principal remedy identified in the record of decision.

8. The remedial action follows, although some activities may be conducted concurrently with some remedial design activities.

9. When the site work is complete, the site is eligible to be delisted from the NPL.

Unfortunately, the process is not as simple as Fig. 3.1 implies. As Fig. 3.2 illustrates, sites can change in terms of which organization has lead responsibility, or whether the approach is based on fund financing or enforced private financing. The EPA often reports Superfund activities in terms of which organization is taking lead responsibility for contracting and supervising site-specific activities. Given the legislation, however, when a private party addresses a site it does so under an order or agreement, and the activity is, strictly speaking, an enforcement action. In “fund lead” sites, the EPA hires contractors itself, often using organizations that have been preselected for work on a task-order basis at many sites. For “state lead” sites, the process takes place under the direct supervision of state authorities, generally with partial funding provided by the EPA through a cooperative agreement with the state. In state lead actions, the EPA maintains an overall supervisory role. “PRP lead” (or responsible party lead) allows PRPs to conduct response actions themselves or through contractors, but with the EPA retaining the right to monitor and approve the actions taken. In the case of remedial actions, the agreed-upon remedy is generally a part of the record of decision. “Mixed fund lead” authorizes the EPA to enter into agreements with PRPs to conduct response actions in which the EPA reimburses PRPs for actions that the EPA has agreed to finance and that PRPs have agreed to perform. Under mixed funding, the EPA may agree to limit PRP liability, including future liability.

At any point in the process, it can be decided that something was not technically correct, and some steps can be repeated. We have often found that what appeared to be a reasonable solution on the basis of
Fig. 3.2—Changes in lead responsibility through the course of the Superfund process

the remedial investigation proves to be unworkable once remedial action begins. If this is the case, planners may return to the RI/FS stage to consider a new set of alternatives, culminating in a new record.

3For example, preliminary investigation may have indicated that solid rock underlay the site, and the selected remedy relied on this fact. Upon excavation, workers may discover fractured or porous bedrock that will not contain the hazardous material.
of decision. Further ambiguity is introduced by the EPA’s use of operable units within a single Superfund site. The operable unit may designate different parts of the site or different aspects that need remedial action (for instance, surface lagoons at one part of the site as well as soil contamination and groundwater contact at another part). The use of operable units permits separate time schedules for investigation, RODs, and remedial action at different operable units. Among other things, this repetition of steps and use of separate operable units may mean that a site has one action with one organization taking the lead and a second action with a different organization taking the lead. For example, one RI/FS may be fund lead and a second RI/FS may be enforcement lead with private-party action.

Overlaying this complexity in terms of lead organization and the use of separate operable units is a set of legal considerations. At any point in the process, some of the parties can seek to raise certain issues in court—possibly requesting an injunction that would stop activity until an issue is resolved. Among other things, the courts could be used to attempt to compel (or prevent) a particular action at a site, to challenge a proposed action, to seek a declaration of responsibility for costs of investigation or remedy, or to seek a declaration of the applicability (or nonapplicability) of insurance coverage to an aspect of the case. In some instances, it is not clear what court is most appropriate to hear a case, so parties may pursue action in more than one court. In addition to overlapping jurisdictions that may involve both state and federal courts, parties sometimes seek hearing before a court (1) where a company is incorporated, (2) where a company does business, or (3) where the site is located.

Adding to these legal considerations there is the potential for considerable variability in the stage at which a particular party may be brought into a Superfund case. In some instances, the EPA, the state, or another entity knows the identity of a PRP at the earliest stage of the process and notifies the party of its potential involvement. In other instances, some parties may be identified only after a site has gone through several steps of the Superfund process, perhaps after considerable time has passed. In some instances, the EPA (or other agencies) may know the identity of a PRP well before the time at which that party is formally included in the administrative or legal proceeding.

Illustration of Length of Time for the Process

In Sec. IV, we go into greater detail about the accomplishments of the Superfund program. Figure 3.3 illustrates the average time that
elapses between the major steps of the Superfund process. These are averages per activity, so if a site receives the same activity twice, it enters the average both times. Further, these figures represent low (or "conservative") estimates of elapsed time, since the averages include sites where a particular activity has not been completed. These averages are based on a complete record of sites considered for the Superfund program through spring 1989.

Figure 3.3 shows that an average of 43 months elapsed from the time the EPA was made aware of a site to the time that site reached the NPL. The program has been in existence for only a little over eight years at the time of this calculation, so these values cannot exceed 100 months. On average, it took another 20 months from the time sites entered the NPL to the point at which the remedial investigation and feasibility study began. The RI/FS took three years for the sites on the NPL, although 61 percent of these activities are not yet complete.

To date, the average time spent on remedial designs has been 18 months, but 49 percent of these designs are not yet complete. Remedial actions have averaged 25 months to date, but 64 percent are not yet complete.

This schedule for investigation and remediation creates substantial political tension. When a site comes to the attention of the federal government, it may already be known to the local community or to the states, and the states may already have initiated some action at the site. On average, it takes over eight years from the time these sites

![Diagram showing the average time between principal steps in the Superfund process.](image-url)
entered the federal process to the time definitive cleanup work begins. This delay often creates strong pressure from some parties to proceed rapidly, expend whatever monies seem needed (assuming that costs will ultimately be borne by others), and worry about cost recovery at a later stage.

INCENTIVES OF THE CURRENT PROGRAM

The legislation and associated administrative procedures for implementing the Superfund program set up a number of incentives that alter or influence the behavior of various governmental and private parties. These incentives may affect the cleanup of old waste sites, disposal practices at future sites, or even behavior in areas not obviously covered by the provisions of the programs. In this subsection, we identify some of the most important of these incentives and provide a brief sketch of their potential effects. This conceptual framework will help guide data collection and interpretation in this and future work.

The Superfund program has created both intended and unintended incentives. It is not necessary, however, for Congress or the EPA to have intended that a particular incentive effect be established; we are interested only in factors that ultimately influence behavior and outcomes. Nor do we mean to imply that any particular incentive leads inevitably to a particular outcome; rather, it is a matter of identifying factors that may increase the likelihood that some parties will behave in a particular fashion. Finally, many of these incentives work in opposite directions, so their net effect cannot easily be assessed. The relative importance of a set of incentives is likely to vary from one situation to another, so we can expect a variety of outcomes.

Legislative Goals

Congress articulated a number of objectives in establishing the Superfund program in 1980. The SARA amendments extended these and added some new ones. Among its prominent objectives are to:

1. Clean up the most hazardous sites;
2. Require responsible parties to finance the cleanups;
3. Encourage voluntary settlements with responsible parties;
4. Encourage appropriate and timely cooperation by potentially responsible parties (in such matters as providing information and agreeing to take over lead and financing for the activities);
5. Consider efficient, cost-effective means of cleanup;
6. Select permanent as opposed to temporary remedies where possible (a provision added by SARA); and
7. Select remedies that conform to a number of other federal and state environmental regulations and standards if those standards are more stringent and legally applicable. The term employed in SARA is "applicable or relevant and appropriate requirements" (ARARs), but the precise implementation is still being interpreted in courts.

In addition to these program-wide goals, the 1986 amendments set up a timetable to encourage the EPA to initiate steps in the process at a faster pace. These targets count the number of activities undertaken and are not stated in terms of specific goals for protection of health or the environment. SARA established goals for certain preliminary activities:

- Completion of preliminary assessments for all facilities in the EPA data system as of the date of enactment by January 1, 1988 (the EPA estimates that this encompasses 4,700 sites);
- Completion of site inspections for all facilities where determined necessary by January 1, 1989; and
- Evaluation of the hazard ranking score (HRS), where determined necessary for all facilities in the data system, as of the date of enactment within four years of enactment. (For facilities listed in the data system after enactment, evaluation is to take place within four years after listing if determined necessary.)

The EPA is required to publish an explanation if these goals are not achieved.

In addition to these goals, SARA contains mandatory schedules for new RI/FSs and new remedial actions. The EPA is to commence new RI/FSs at facilities on the NPL in the following fashion:

- 275 RI/FSs within three years of enactment.

If this schedule is not met, SARA requires:

- An additional 175 RI/FSs within four years of enactment;

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4This summary is taken from a description of major provisions prepared at the time of reauthorization (congressional mimeograph, no date, no author).
• An additional 200 within five years of enactment; and
• A total of 650 by five years of enactment.

SARA also imposes a mandatory schedule “for commencement of substantial and continuous physical on-site new remedial actions at facilities on the NPL” that dictate the following:

• 175 such actions during the first three years after enactment; and
• An additional 200 during the following two years.

Because the EPA must implement Superfund, both the explicit and the implicit policies of that agency also create incentives for the various participants. This combination of legislative provisions and administrative implementation leads to a variety of behavioral incentives.

We can further characterize the incentive effects of Superfund as either specific or general. Specific incentives operate on parties at hazardous waste sites. General incentives, which are similar to general deterrence in the legal literature on criminal behavior, are expected to influence a broader range of activities.

Site-Specific Incentives

Specific incentives attempt to induce voluntary cleanup of the sites by declaring a strict and a retroactive liability. If the PRPs do not voluntarily take over the process, the EPA can compel a particular remedy—or, if necessary, federal administrative representatives can expend public money to clean up a site and then take the responsible party to court with the intention of recovering later. The 1986 SARA amendments also provide for fines of up to $25,000 per day if private parties fail to carry out an action under a settlement agreement (Section 122). Specific incentives may also affect the likelihood that parties settle or take over remedial activities at other hazardous waste sites.

General Incentives

General incentives are expected to affect future disposal practices. By exposing firms to unlimited liability for prior waste handling, Superfund sets up strong signals that equally stringent regulations will operate in the future as well. This should lead to more conservative waste-handling practices both today and in the future and may lead business to reduce its use of toxic materials—and to increase recycling of these substances. It may also affect activities beyond those strictly
involving hazardous wastes, such as the transfer of land or the financing of new activities.

The broad liability provisions of Superfund may also create an incentive to obscure the relationship between a particular firm's generation, transport, storage, or disposal of materials and the ability of investigators to subsequently track responsibility to the originally responsible party. This could be accomplished through physical means (transformation, false labels on containers, or disposal) or through bookkeeping and other business practices (false invoices or shell corporations to handle the materials). Although we cannot estimate the magnitude of such a problem (if indeed it exists), we must recognize that when the costs of legally and properly handling wastes are increased, business will make many responses, including, in some cases, initiating or increasing illegal activity.6

The law may also induce parties to undertake voluntary preventive cleanups before they come under the federal purview. Motivations for voluntary cleanups may be to avoid the listing, delay, and expense associated with the Superfund process; to circumvent future liability exposure; or to satisfy a sense of public responsibility.

We also expect Superfund to have an influence on long-term financial and other behavior. The broad liability provisions of CERCLA may lower the value of properties that have had waste disposal activities in the past. This may lower sales prices and reduce their value as security for loans. For example, anecdotes suggest that lenders who might previously have foreclosed on a delinquent loan now check to see if the site may involve hazardous wastes that may open them to a significant environmental lawsuit. The way this law has been interpreted, subsequent owners may be held fully liable for this remedy.

Finally, the broad liability of Superfund may lead waste-handling firms to transfer assets at the conclusion of their business activity so that they cannot be called upon in the future to provide site remediation or compensation.

**Unintended or Conflicting Incentives**

Both specific and general incentives present internal and external conflicts that may operate at cross purposes and thus complicate the Superfund process. For example, the federal Trust Fund was established in part to cope with general costs and orphan shares. Yet the EPA apparently feels both self-imposed and external pressure to

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conserve that fund.\footnote{See, for example, the written statement by William K. Reilly, in releasing the EPA’s review of Superfund to the Senate Committee on Environment and Public Works, June 15, 1989. He argued that holding back part of the Trust Fund money increased the agency’s strength in bargaining with private parties to force them to take over the financing of site-specific activities because it makes it credible that the EPA could perform the remedy and recover costs plus punitive damages at a later stage.} Proceeding slowly and conserving the Trust Fund, however, may run counter to the pressure brought to bear on the EPA to provide rapid, permanent remedies. A responsible party facing a large expected share of the costs might also wish to proceed at a slower pace, which would engender conflicts with the federal government.

In many cases, PRPs and insurers protest their liability for certain of the cleanups that are requested. This creates a legal conflict and a litigious atmosphere among the very parties that the EPA is trying to encourage to take over the lead for investigation and remedy at a hazardous waste site.

In other instances, responsible parties may raise the objection that a given EPA solution is excessively expensive; they may think they have much more cost-effective and equally protective alternatives. As long as the EPA expects to have the cleanup financed by responsible parties, EPA administrative representatives have no obvious incentive to select inexpensive remedies. Indeed, given the EPA’s mandate to favor permanent remedies as well as those that are protective of health and the environment, there is an incentive to err on the side of excessively detailed investigation and studies, or overly elaborate and expensive remedies if such remedies are viewed as potentially protective.

Many parties may also be concerned about the leverage effect that settling a Superfund site may have on personal injury claims. To date, there have been very few—and perhaps no—completed cases that involve a personal injury associated with a hazardous waste site,\footnote{A few cases have settled before reaching a verdict (terms are confidential) and a number of other cases seem to be under way.} but if there is an agreement to, say, 40 percent of the costs for cleaning up a site physically, the parties may be exposing themselves to 40 percent of the costs if individuals with cancer or other health problems can establish a causal relationship to a hazardous waste site.

**Note on Settlements**

In the early years of the Superfund program, the EPA’s policies placed substantial barriers before PRPs who sought to settle a case or to take over lead responsibility. The goal of the EPA’s settlement guidelines was
to secure 100 percent of the costs of cleanup from parties that represented at least 75 percent of the waste by volume.\footnote{See Brown (1983) and Anderson (1985).}

In recent years, however, the agency seems to have relaxed its threshold by requiring only that parties representing 50 percent of the waste be represented in order to discuss settlement. The 1986 amendments specifically provided that small-volume contributors could be permitted to settle their liability and be given a release on future liability. These \textit{de minimus} contributors must have contributed no more than 1 percent of the waste by volume, and they are typically asked to pay some multiple of their proportional share of the projected costs of remediation. For example, a 1 percent contributor might be asked to pay 1.5 percent of the projected costs contained in the remedy identified in the record of decision. In exchange, the party is granted a release from future liability even if the EPA modifies the remedy at some point in the future.\footnote{Conversations with selected individuals at firms involved in NPL cleanups suggests that the \textit{de minimus} process is not working as smoothly as this suggests. For example, when there is responsibility party (RP) lead at a site, a \textit{de minimus} contributor may have difficulty (1) knowing what party to sign the agreement with (each RP, the RP committee, the EPA, etc.); (2) reaching agreement with the RP for its payment if the cost of the remedy is not known; and (3) securing release from future expenses if the lead party is uncertain about the ultimate cost of remedy.} Actual implementation of this provision seems to be based on a "covenant not to sue" granted by the EPA, but with a "reopener clause" that permits the EPA to come for added monies under some circumstances. Perhaps because of these qualifications, there seems to have been relatively little use of the \textit{de minimus} settlement provisions to date.
IV. SOME INDICATORS OF EFFECT

THE METHODOLOGICAL CHALLENGE

The measurement and documentation of the accomplishments of the Superfund program pose a significant methodological challenge. Among the indicators that could be used for this purpose are those that measure inputs, such as dollar expenditure, or those that gauge outputs, such as the number of sites cleaned up. Fundamentally, we might like to know the effects of the program expressed in terms of reduced risk to human health or the environment—but this is not the form in which the CERCLA and SARA legislation is stated, and the EPA does not measure its program effects by amount of risk reduction.

Thus, we will instead provide preliminary indicators of program accomplishments in terms of selected input and output measures. These include:

1. **Numbers of sites by stage in the Superfund process.** We can enumerate the number of sites that reach various milestones in the process described in the previous section. These include milestones such as numbers of sites with a hazard-ranking score, numbers with RODs, numbers delisted from the NPL, and the length of time needed to reach these milestones. Recall that some sites progress to a certain stage in the process and then repeat earlier program stages, so there may be double counting at selected points. Furthermore, since the program has been in existence for only a relatively short period, few sites have completed the process; thus, estimates of elapsed time are concentrated in the earlier stages, and we cannot observe elapsed times greater than the eight years during which the program has existed.

2. **Amount spent by government agencies.** This input measure is particularly useful in situations where end points are not well defined or may change through time. It serves to indicate the level of effort expended and may also be helpful in comparing the efficiency, or cost-effectiveness, of alternative undertakings. Recall that in the present analysis, we are able to

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1In the present analysis, we confine our discussion to the effects of sites that fall within the Superfund program, not the universe of all hazardous waste sites in the present analysis. The methodological challenge would increase in a consideration of the larger set of sites.
account only for federal expenditures. Clearly, the amounts spent by state and local governments and by private parties are important in providing a complete picture, and we thus hope to include them in future analyses.

3. *Amount of cost recovery.* One approach of the Superfund program has the federal government expending monies and then recovering them from responsible parties at a later stage (the fund lead approach). The amounts of costs recovered will be an indicator of activity in this aspect of the program.

4. *Amount of settlements and transfer to responsible-party lead.* Another approach of the Superfund program is to try to shift the financing of site-specific activities to responsible parties at some stage in the process—perhaps at the outset (the enforcement lead approach). The number of settlements and the projected value of these settlements will provide some indicator of activity in this aspect of the program. It is important to note in this dimension that the costs will be projected, not actual, and will therefore be subject to potentially significant revision as actual activities take place. Actual expenditures will be incurred by private parties, not by the government, making their amounts less a matter of public record.³

5. *Comparing capital and operations expenses.* In the previous section, we identified a divergence in incentives that should lead the federal government to prefer site activities that are relatively intense in O&M expense and relatively frugal in capital expense; the states should prefer the opposite, since they are responsible for 100 percent of the O&M expense. We can examine the projected expenditure patterns for the relative intensity of capital and O&M expense.

6. *Numbers of legal actions brought against PRPs.* Both CERCLA and SARA contain provisions for civil and criminal actions against private parties. We can enumerate the actions initiated under the various provisions of the acts through time as another indicator of program effect.

7. *Numbers of emergency removals.* Both NPL and non-NPL sites may receive emergency attention under the provisions of Superfund. We can examine the numbers and costs of these emergency actions through time as a final indicator of effect.

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³Indeed, the EPA makes no attempt to determine the actual amount that private parties expend; it only monitors compliance with the approved remedy.
We Are Focusing on Part of the Hazardous Waste Site Universe

At this stage in the analysis, we are dealing only with sites that involve some aspect of the Superfund program; sites that have never received federal attention of any kind are currently not counted in our analysis. Essentially, then, we have a snapshot in time of a program that is constantly evolving and in which sites pass from one category to another. This leads to constantly changing numerators and denominators as we try to characterize patterns of activity or expenditure. For example, a site may have one lead for early activities (say, a federal fund lead) and may then be converted to another lead (e.g., federal enforcement) for subsequent activities. In such circumstances, one cannot easily compare, for example, the length of time associated with the fund lead approach with that of enforcement lead, since some sites have both.

Some sites in the federal Superfund program began as state-initiated or privately initiated activities. At present, these prefederal activities and expenditures are not captured in our data. Other sites may be transferred to state or private responsibility after some federal involvement. In general, we have an accounting of the numbers of such sites as well as projected outlays. In addition, some sites change their administrative or legal approach within the federal Superfund program. In general, we have a complete accounting of these activities and expenditures.

A final methodological note is that our analysis is based on information provided by the EPA or by other public documents. We have not collected primary data to verify the accuracy of these reported amounts.

Moreover, in this study we are sometimes forced to report data that apply to inconsistent time periods. This results from the fact that some EPA data sets end with fiscal year 1988, whereas others are current as of the date prepared—generally spring 1989.

NUMBERS OF SITES BY STAGE IN THE SUPERFUND PROCESS

By the end of fiscal year 1988, approximately 30,000 sites had been identified for possible inclusion on the National Priorities List (NPL). Almost 1,200 such sites have been placed on the proposed or final NPL

---

3Although these materials are all considered to be in the public domain, some seem to have received little attention for analytic purposes.
for Superfund activity. Of these, 18 have been declared "cleaned up" and have been removed from the list. Table 4.1 displays the distribution of sites at various milestones between these points in the process. At present, approximately 27,000 of the sites have received preliminary investigation and about 9,000 have had a site visit to determine if they merit serious review for possible addition to the NPL.

Figure 4.1 illustrates the differential status of sites on the NPL as of the end of September 1988. At this time, it can be seen that 1,175 sites were on the proposed or final NPL and were therefore eligible to receive Trust Fund money. Of these, about one-third were proposed, not final, listings. Proposed sites may receive federal expenditures under the Superfund program, but the EPA may not be able to recover its costs if such sites are not eventually placed on the final list.

Table 4.1

<table>
<thead>
<tr>
<th>Status of Sites</th>
<th>Number of Sites</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sites in the EPA information system</td>
<td>30,013</td>
</tr>
<tr>
<td>Preliminary assessments completed</td>
<td>26,959</td>
</tr>
<tr>
<td>Site inspections completed</td>
<td>9,107</td>
</tr>
<tr>
<td>Sites with no further action planned</td>
<td>11,119</td>
</tr>
<tr>
<td>Sites on the NPL</td>
<td></td>
</tr>
<tr>
<td>Final</td>
<td>797</td>
</tr>
<tr>
<td>Proposed</td>
<td>378</td>
</tr>
<tr>
<td>Total</td>
<td>1,175</td>
</tr>
<tr>
<td>Removal actions</td>
<td></td>
</tr>
<tr>
<td>NPL</td>
<td>259</td>
</tr>
<tr>
<td>Non-NPL</td>
<td>963</td>
</tr>
<tr>
<td>Total</td>
<td>1,221</td>
</tr>
<tr>
<td>Remedial investigation or feasibility study, cumulative starts</td>
<td>778</td>
</tr>
<tr>
<td>Remedial design, cumulative starts</td>
<td>254</td>
</tr>
<tr>
<td>Remedial action, cumulative starts</td>
<td>177</td>
</tr>
<tr>
<td>Site work completed</td>
<td>34</td>
</tr>
<tr>
<td>Delisted from the NPL</td>
<td>18</td>
</tr>
</tbody>
</table>


---

Fig. 4.1—Number of sites at major stages of the Superfund process, cumulative through September 1988
Removal actions may be performed at either Superfund sites (i.e., those on the NPL) or at sites requiring emergency response but that otherwise do not merit NPL status. Approximately 20 percent of removals occur at NPL sites, with the balance occurring at non-NPL sites. Figure 4.1 shows that as of September 30, 1988, 778 sites either were undergoing or had completed a remedial investigation and feasibility study. It can also be seen that a total of 254 sites had entered the remedial design stage by this date and that 177 sites had begun some remedial action.

Finally, the EPA reports, and Fig. 4.1 reflects, that as of September 1988 site work had been completed at 34 sites, 18 of which had been removed from the NPL. These last two numbers should be viewed with caution, however, since other sites have been declared clean only to be reopened later for additional remedial work.

History of Sites by Stages

As one might imagine, the time profile of numbers of sites by stage in the process has shifted since the program's inception and was heavily concentrated in the early stages of the Superfund process through most of this period. Table 2 presents the number of sites by stage for the most comprehensive listing we are able to assemble.\(^5\)

<table>
<thead>
<tr>
<th>Table 4.2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>HISTORY OF ACTIVITIES BY STAGE IN THE SUPERFUND PROCESS</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Removal action</td>
<td>33</td>
<td>50</td>
<td>88</td>
<td>204</td>
<td>353</td>
<td>196</td>
<td>270</td>
<td>273</td>
<td>1,221</td>
</tr>
<tr>
<td>Preliminary assessments</td>
<td>1,650</td>
<td>1,500</td>
<td>1,891</td>
<td>3,968</td>
<td>4,845</td>
<td>4,262</td>
<td>4,001</td>
<td>2,884</td>
<td>26,959</td>
</tr>
<tr>
<td>Site inspections</td>
<td>1,200</td>
<td>1,300</td>
<td>550</td>
<td>1,311</td>
<td>1,520</td>
<td>1,267</td>
<td>1,343</td>
<td>1,237</td>
<td>9,107</td>
</tr>
<tr>
<td>Net number of sites</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>797</td>
</tr>
<tr>
<td>added to NPL (final)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Final plus proposed</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RI/PSC(^c)</td>
<td>23</td>
<td>31</td>
<td>115</td>
<td>150</td>
<td>181</td>
<td>66</td>
<td>112</td>
<td>101</td>
<td>1,175</td>
</tr>
<tr>
<td>Remedial design(^d)</td>
<td>11</td>
<td>8</td>
<td>11</td>
<td>18</td>
<td>13</td>
<td>24</td>
<td>61</td>
<td>65</td>
<td>254</td>
</tr>
<tr>
<td>Remedial actions</td>
<td>1</td>
<td>14</td>
<td>6</td>
<td>13</td>
<td>54</td>
<td>23</td>
<td>32</td>
<td>58</td>
<td>177</td>
</tr>
</tbody>
</table>

**SOURCE:** EPA congressional budget justifications, various years, except as noted.

\(^a\)Not reported in budget justifications. Amount calculated from FY84 and FY86 amounts.

\(^b\)EPA Superfund Progress Report, March 1989.

\(^c\)Calculated from components in the years 1983 to 1988.

\(^d\)Calculated from components in the years 1986 to 1988.

\(^5\)Note that year-by-year amounts are drawn from the EPA's budget justifications; cumulative values are based on the EPA's Superfund Progress Report. The earlier dates
Preremedial activities, such as preliminary investigations and site inspections, have been highly active areas since the early years of the program. No sites were placed on the final list in these first two years of the program, but by the end of fiscal year 1983 over 400 sites had been placed on the NPL. By the end of fiscal year 1988, 797 sites were on the final list, with another 378 on the proposed list.

In contrast, the removal, investigative, and remedial aspects of the program began at a much slower pace. In the first three years of the program, the EPA reported 171 removal actions, compared with 1,221 at the end of the first eight years of the program. The RI/FS process can take place at sites on both the proposed and the final NPL. By 1983, the EPA was generally initiating over 100 remedial investigations or feasibility studies annually, and by the end of 1988 778 had been initiated.

Remedial designs are generally not undertaken before the RI/FS is completed and a ROD has been approved. Consequently, remedial designs have been initiated at a slower pace than have those other activities. The cumulative total of design starts in September 1988, 254, is approximately 22 percent of the number of sites listed in the proposed or final NPL. Remedial actions lag remedial designs by 30 percent, with 177 initiated by September 1988.

AMOUNT SPENT BY THE EPA ON SUPERFUND

The financial significance of the Superfund program may be represented in a variety of ways, depending on the terms being used. Different observers could each legitimately make the following statements regarding the federal program (i.e., not counting private activities or state and local governmental activities) at the end of fiscal year 1988:

- Superfund is a $10.1 billion program (the amount authorized by CERCLA and SARA);
- Superfund is a $5.3 billion program (the pro rata share of authorization through fiscal year 1988);
- The government has spent $4.5 billion on Superfund (the amount Congress has appropriated through fiscal year 1988);

in the budget justifications (especially for removal and remedial activities) seem to be less reliable than the cumulative values, but they provide a sense of the time profile of activities that is useful.
The EPA has spent $2.6 billion on Superfund (the amount of outlays by the EPA and other agencies through fiscal year 1988); and

The EPA has spent $4.1 billion on Superfund (the amount the EPA records show as obligated under the Superfund program).

Indeed, with the possible exception of the second item, each of these claims can be found in one or another public statement regarding the program. A careful distinction among these amounts over time yields valuable insights into the program's accomplishments to date and into likely outlays and achievements in the future.

Recall that the Trust Fund for the program had a ceiling of $1.6 billion from 1981 to 1985 and has a ceiling of $8.5 billion from 1986 to 1991. This is a revolving fund that is at least partially replenished as the EPA recovers prior outlays from responsible parties. Furthermore, interest earned on the unobligated portion of the Trust Fund, together with cost recoveries and fines, can increase the principal as well. In principle, then, the Trust Fund ceilings could represent a minimum level of expenditure on Superfund sites and related activities.

Total Outlays

In this discussion, we focus on outlays, not obligations, for three reasons. First, outlays reflect actual activities under the program and therefore provide a better measure of the pace of activities. In contrast, obligations, or projected future costs, are only estimates which, after the fact, are almost certainly going to be too high or low. Second, outlays reflect only the EPA's involvement; obligations and projected expenses may be shifted to private parties at a later date. Again, the actual expenditure under private control is likely to differ from that under federal control. Third, obligated activities and amounts can be modified at a future time through either augmentation or deobligation.

As Table 4.3 and Fig. 4.2 indicate, the actual appropriations and outlays by the EPA on Superfund sites fall short of Trust Fund ceiling amounts, with outlays lagging both authorizations and appropriations.6 At the end of fiscal year 1988, cumulative appropriations to the EPA for the Superfund program were $4.5 billion—about 86 percent of the pace for steady outlays from the Trust Fund and less than 53 percent of the $8.7 billion implied by the Trust Fund ceiling authorization.7

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6Fiscal year 1986 creates a problem because CERCLA authorization lapsed and the act was not renewed until October 1987. Congress appropriated $261.3 million under continuing resolutions during 1986.

7If the EPA had received appropriations of $1.6 billion during the first five years of the program and had received appropriations at a proportional rate of the $8.5 billion during the period 1987 to 1991 (and assuming no cost recoveries or interest payments to increase the Trust Fund), cumulative appropriations could have totaled $5.261 million by
Table 4.3
ANNUAL AND CUMULATIVE AUTHORIZATIONS, APPROPRIATIONS, AND OUTFAYS UNDER THE SUPERFUND PROGRAM
(In millions of dollars)

<table>
<thead>
<tr>
<th>Fiscal Year</th>
<th>Theoretical Ceiling&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Appropriations&lt;sup&gt;b&lt;/sup&gt;</th>
<th>Outlays&lt;sup&gt;c&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Year Cumulative</td>
<td>Year Cumulative</td>
<td>Year Cumulative</td>
</tr>
<tr>
<td>1981</td>
<td>320   320</td>
<td>74.7</td>
<td>8.4</td>
</tr>
<tr>
<td>1982</td>
<td>320   640</td>
<td>26.6</td>
<td>101.3</td>
</tr>
<tr>
<td>1983</td>
<td>320   960</td>
<td>210.0</td>
<td>311.3</td>
</tr>
<tr>
<td>1984</td>
<td>320   1,280</td>
<td>460.0</td>
<td>771.3</td>
</tr>
<tr>
<td>1985</td>
<td>320   1,600</td>
<td>606.1</td>
<td>1,377.4</td>
</tr>
<tr>
<td>1986&lt;sup&gt;d&lt;/sup&gt;</td>
<td>— 1,861&lt;sup&gt;e&lt;/sup&gt;</td>
<td>261.3</td>
<td>1,638.7</td>
</tr>
<tr>
<td>1987&lt;sup&gt;f&lt;/sup&gt;</td>
<td>5,100 6,961&lt;sup&gt;f&lt;/sup&gt;</td>
<td>1,411.3</td>
<td>3,050.0</td>
</tr>
<tr>
<td>1988&lt;sup&gt;f&lt;/sup&gt;</td>
<td>1,700 8,661&lt;sup&gt;f&lt;/sup&gt;</td>
<td>1,497.0</td>
<td>4,547.0</td>
</tr>
</tbody>
</table>

<sup>a</sup>Assuming that the Trust Fund is funded on a pro rata annual basis over five-year authorizations.

<sup>b</sup>Actual prior-year amounts reported in annual budget justification submitted by the EPA to Congress.

<sup>c</sup>Superfund obligations and outlays for fiscal years 1981 to 1988, Financial Management Division, EPA, April 1988.

<sup>d</sup>Amount of ceiling unclear in this year because CERCLA authorization had lapsed.

<sup>e</sup>Prior-year cumulative amount plus current year appropriation.

<sup>f</sup>Includes a two-year repayable advance permitted by SARA.

The actual cumulative outlays under the entire program were $2.6 billion through this date. Thus, outlays amount to 57 percent of appropriations and 49 percent of the pro rata share of the Trust Fund (including the fiscal year 1986 actual amount). The outlays represent slightly less than 30 percent of the theoretical ceiling if the EPA had made full use of its borrowing authority.
Fig. 4.2—Comparing cumulative authorizations, appropriations, and outlays in Superfund's first eight years

**Proportion of Outlays for Site-Specific Activities**

The Superfund program can pursue its goals through direct expenditures on individual sites (for investigations, studies, remedial activities, and the like) or through indirect and general expenditures (such as research and development and general administration). Some expenditures are necessary to make the overall program function successfully; others are common costs that apply to more than one site. Despite these challenges, distinguishing site-specific from other expenditure amounts is a useful tool for monitoring and policy analysis.

In the early years of the program, contractors who worked on more than one site were not required to itemize their billings to the EPA on a site-specific basis. In order to produce site-specific outlay histories, the EPA and its contractors had to reconstruct billings and transfer amounts that were in some cases substantial.

The distinction between site-specific and other outlays by the EPA is not simply a matter of academic interest; it has practical significance
for cost recoveries as well. The EPA attempts to recover site-specific outlays from the parties determined to be responsible for the site. In addition to the outlay amounts that were directly assigned to a site, the EPA attempts to recover certain amounts of general supervision, management, and other overhead costs. A region-specific formula assigns a certain dollar "burden rate" per hour of direct staff time that is charged to site-specific activities to reflect these expenses.\textsuperscript{9} In cost recovery actions against responsible parties, the EPA attempts to recover both directly assigned costs and these imputed amounts.

Table 4.4 and Fig. 4.3 present outlays on a year-by-year basis using major groupings of activities. The outlays in Table 4.4 are assigned as site-specific or non-site-specific according to the EPA's accounting. The adjustments include the historic reassignments discussed above. Before adjustment, site-specific outlays account for less than half of all outlays in the period 1981 to 1988. After adjustment, the amount is almost 64 percent of all outlays. Research and development is a non-site-specific expenditure and accounts for approximately 6 percent of outlays over the first eight years of the program.

Remedial program expenses include site discovery and other preremedial activities (as well as RI/FS, remedial design, and remedial action). To date, remedial activities account for almost 37 percent of outlays, while the removal program accounts for about 17 percent of outlays through fiscal year 1988. Enforcement activities, including amounts spent by the Department of Justice, account for about 10 percent of outlays. General management and support plus laboratory analysis accounts for almost 31 percent of outlays. As Fig. 4.3 illustrates, removal and remedial activities account for slightly over half of the EPA's outlays to date.

**Comparing Outlays and Obligations by Major Category of Activity over Time**

Although cumulative outlays to date are substantially below what is implied by the Trust Fund authorization or by appropriation, the EPA's obligations—especially in the last two years—have been substantial. The obligations data presented in Table 4.5 and Fig. 4.4 suggest that the EPA may be facing significant outlays for Superfund activities in the future.\textsuperscript{10} In total, outlays from fiscal years 1981

\textsuperscript{9}Currently, the average burden rate is approximately $57 per hour of staff time. It ranges between $51 and $63.

\textsuperscript{10}We must again regard obligation figures with caution, since actual experience will depart from these obligation amounts as remedies are revised, costs change, or private takeover is achieved.
## Table 4.4

ANNUAL OUTLAYS FOR SITE-SPECIFIC AND NON-SITE-SPECIFIC ACTIVITIES
(In millions of dollars)

<table>
<thead>
<tr>
<th>Activity</th>
<th>FY81</th>
<th>FY82</th>
<th>FY83</th>
<th>FY84</th>
<th>FY85</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Non-site</td>
<td>Site</td>
<td>Total</td>
<td>Non-site</td>
<td>Site</td>
</tr>
<tr>
<td>Research and development</td>
<td>0.9</td>
<td>0</td>
<td>0.9</td>
<td>13.4</td>
<td>0</td>
</tr>
<tr>
<td>Remedial program</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.1</td>
<td>4.8</td>
</tr>
<tr>
<td>Removal program</td>
<td>0.2</td>
<td>5.2</td>
<td>5.4</td>
<td>10.9</td>
<td>13.6</td>
</tr>
<tr>
<td>Enforcement</td>
<td>0.1</td>
<td>0</td>
<td>0.1</td>
<td>0.4</td>
<td>1.5</td>
</tr>
<tr>
<td>General management</td>
<td>1.9</td>
<td>0</td>
<td>1.9</td>
<td>35.2</td>
<td>0</td>
</tr>
<tr>
<td>and support &amp; Lab annual support</td>
<td>3.1</td>
<td>5.3</td>
<td>8.4</td>
<td>60.0</td>
<td>19.9</td>
</tr>
<tr>
<td>Totals</td>
<td>(46.9)</td>
<td>46.9</td>
<td>(69.2)</td>
<td>69.2</td>
<td>(115.0)</td>
</tr>
<tr>
<td>Adjustment</td>
<td>55.4</td>
<td>89.5</td>
<td>144.9</td>
<td>76.1</td>
<td>178.3</td>
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</table>
### Table 4.4—continued

<table>
<thead>
<tr>
<th>Activity</th>
<th>FY86 Non-site</th>
<th>Site</th>
<th>Total</th>
<th>FY87 Non-site</th>
<th>Site</th>
<th>Total</th>
<th>FY88 Non-site</th>
<th>Site</th>
<th>Total</th>
<th>Totals FY81-FY88 Non-site</th>
<th>Site</th>
<th>Total</th>
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<tbody>
<tr>
<td>Research and development program</td>
<td>11.3</td>
<td>—</td>
<td>11.3</td>
<td>19.2</td>
<td>0</td>
<td>19.2</td>
<td>41.2</td>
<td>0</td>
<td>41.2</td>
<td>147.8</td>
<td>0</td>
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<tr>
<td>Remedial program</td>
<td>65.2</td>
<td>121.9</td>
<td>187.1</td>
<td>56.9</td>
<td>162.1</td>
<td>219.0</td>
<td>68.8</td>
<td>216.9</td>
<td>285.7</td>
<td>268.2</td>
<td>675.7</td>
<td>943.9</td>
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<tr>
<td>Removal program</td>
<td>20.1</td>
<td>50.1</td>
<td>70.2</td>
<td>23.7</td>
<td>64.2</td>
<td>87.9</td>
<td>28.7</td>
<td>97.5</td>
<td>126.1</td>
<td>95.0</td>
<td>340.1</td>
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<td>Enforcement</td>
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<td>68.8</td>
<td>49.9</td>
<td>63.2</td>
<td>113.1</td>
<td>126.7</td>
<td>134.3</td>
<td>261.0</td>
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<tr>
<td>General management and support &amp;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lab annual support</td>
<td>99.4</td>
<td>3.4</td>
<td>102.7</td>
<td>97.5</td>
<td>37.6</td>
<td>135.1</td>
<td>144.7</td>
<td>79.5</td>
<td>224.2</td>
<td>669.9</td>
<td>121.9</td>
<td>791.8</td>
</tr>
<tr>
<td>Totals</td>
<td>221.1</td>
<td>195.6</td>
<td>416.7</td>
<td>233.3</td>
<td>296.7</td>
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<td>790.4</td>
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<td>1,272.0</td>
<td>2,579.6</td>
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<td>76.6</td>
<td>—</td>
<td>(52.9)</td>
<td>52.9</td>
<td>—</td>
<td>(14.2)</td>
<td>14.2</td>
<td>—</td>
<td>(374.8)</td>
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<td>790.4</td>
<td>932.8</td>
<td>1,646.8</td>
<td>2,579.6</td>
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</tbody>
</table>


*In 1987 and 1988, we have included in site-specific amounts, the EPA projected recoveries that will be sought for expenditures presently not assigned to the site-specific account (the "zx" accounts).
through 1988 amount to about $2.6 billion, whereas obligations total about $4.1 billion. This increase in obligation reflects large percentage increases in all major activities following SARA. More than half of the cumulative obligations under the program were made in fiscal years 1987 and 1988; they reflect an almost fourfold increase between fiscal years 1986 and 1988. Compared with fiscal year 1986, 1988 obligation increased more than fivefold for research and development and remedial activities and increased over threefold for laboratory and general management and support. Obligation for the removal program and enforcement activities increased about 2.5-fold during this period.

In contrast, outlays increased, but not as dramatically, between fiscal years 1986 and 1988. Overall, outlays were 1.9 times larger in fiscal year 1988 than in fiscal year 1986. Outlays on the remedial and removal program activities increased 50 and 80 percent over 1986, while the other program activities more than doubled.

The largest absolute difference between obligations and outlays, however, lies with the remedial program. In fiscal year 1988, obligations for remedial activities were 2.9 times the magnitude of the outlays,
<table>
<thead>
<tr>
<th>Activity</th>
<th>FY81</th>
<th>FY82</th>
<th>FY83</th>
<th>FY84</th>
<th>FY85</th>
<th>FY86</th>
<th>FY87</th>
<th>FY88</th>
<th>FY80-FY88</th>
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</thead>
<tbody>
<tr>
<td>Research and development</td>
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<td>21.5</td>
<td>17.1</td>
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<td>10.9</td>
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<td>78.0</td>
<td>172.7</td>
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<td>168.1</td>
<td>469.9</td>
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<td>67.0</td>
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<td>49.4</td>
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<tr>
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<td>165.8</td>
<td>198.6</td>
<td>385.7</td>
<td>437.2</td>
<td>384.4</td>
<td>990.0</td>
<td>1,462.3</td>
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<th>FY82</th>
<th>FY83</th>
<th>FY84</th>
<th>FY85</th>
<th>FY86</th>
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<th>FY88</th>
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<td>Research and development</td>
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<td>45.4</td>
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<td></td>
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<tr>
<td>Lab annual support</td>
<td>1.9</td>
<td>35.2</td>
<td>73.8</td>
<td>104.0</td>
<td>115.0</td>
<td>102.7</td>
<td>135.1</td>
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<td>791.8</td>
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<tr>
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<td>80.0</td>
<td>144.9</td>
<td>254.5</td>
<td>354.9</td>
<td>416.7</td>
<td>530.0</td>
<td>780.4</td>
<td>2,579.6</td>
</tr>
<tr>
<td>Ratio of obligations to outlays</td>
<td>4.6</td>
<td>2.1</td>
<td>1.4</td>
<td>1.5</td>
<td>1.2</td>
<td>0.9</td>
<td>1.9</td>
<td>1.9</td>
<td>1.6</td>
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</table>

representing a difference of over $500 million. Over the first eight years of the program, obligations for remedial activities were more than twice as large as outlays, yielding a difference of $1,013 million.

In summary, these obligation histories suggest that the Superfund program is entering a more expensive phase, with planned remedial activities representing a large expected outlay. If this pattern continues as more sites mature to the remedial stage, the EPA will face strong pressure to achieve sharply increased private takeover and financing if it is to meet these obligations within currently forecasted authorization levels.

**Level of Obligations Implied by Records of Decision**

By examining the RODs, we can make a rough calculation of some components of the future obligations that the Superfund program faces. Recall that a ROD is issued at the end of the remedial investigation and feasibility study—in general, before the remedial design and
action begins. These records will be highly uncertain estimates of the EPA's actual future outlays in that (1) there is little experience to date with which to calibrate their accuracy; (2) the precise details of remedies are developed during remedial design and remedial action, as more is learned about the site that may affect the remedy and its costs; (3) the technologies and performance standards are not agreed upon for site remediation, so remedies may be respecified in the future; (4) when cases are settled and the EPA agrees to private takeover, the agency does not always make a projection of the value of the settlement; and (5) the share of costs between the EPA, the states, and private parties is not always specified.\textsuperscript{11} In a few cases, we have estimated the present discounted value of O&M expense; in most cases, the ROD states the present discounted value.\textsuperscript{12}

With all these cautions in mind, Table 4.6 gives an indication of the amounts contained in the rods that have been approved through fiscal year 1988. There were no records in 1981, the first year of the program. Four decisions were approved in the second year, valued at $33 million. At the end of fiscal year 1988, cumulative projected costs totaled $3.9 billion. Over the period 1982 to 1988, the average (current) value of a remedy was $9 million per site—using each ROD as the denominator. That value has risen from an average of $6.1 million in the period 1982 to 1985 to $10.2 million in the period 1986 to 1988. Much of these projected costs are for activities that have not yet begun. Nevertheless, they suggest a growing momentum of commitments for future expenditure on Superfund-related activities.

**Share of Expense to Capital or Operations and Maintenance**

Recall that the current Superfund policy requires that states pay 10 percent of capital expenditure and 100 percent of O&M when private parties are not financing the activities.\textsuperscript{13} Although the primary initiative for federal lead Superfund activities—including remedy selection—lies with

\textsuperscript{11} Adding to the difficulty that we face in projecting federal outlays from RODs is the fact that we cannot accurately project total costs, since other private costs associated with the remedy are generally not recorded.

\textsuperscript{12} When annual values are stated, we assume that the expenditure will continue for 20 years and apply an 8 percent discount value. Twenty years lies in the middle of the range of estimates of O&M when such values are given. If we had assumed that O&M outlays continue forever, the present discounted value increases by 27 percent. This difference would have only a small effect on the total given in Table 4.6.

\textsuperscript{13} The 10 percent capital share was increased from zero by the Superfund reauthorization in 1986.
Table 4.6

NUMBERS AND PROJECTED COSTS IN RECORDS OF DECISION BY YEAR

<table>
<thead>
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<th>Year</th>
<th>Records of Decision</th>
<th>Value (in millions of dollars)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Capital</td>
<td>O&amp;M&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>1982</td>
<td>4</td>
<td>12</td>
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<td>1983</td>
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<td>1986</td>
<td>81</td>
<td>632</td>
</tr>
<tr>
<td>1987</td>
<td>75</td>
<td>429</td>
</tr>
<tr>
<td>1988&lt;sup&gt;b&lt;/sup&gt;</td>
<td>152</td>
<td>1,280</td>
</tr>
<tr>
<td>Total</td>
<td>433</td>
<td>2,893</td>
</tr>
</tbody>
</table>

<sup>a</sup>Present value of O&M using the EPA value if stated and calculated from annual values if a present value is not stated.

the EPA, the states are asked to concur in the remedy selected. Depending on how strongly this right of concurrence is asserted, the states could attempt to slant the remedy selection to favor a time schedule or expenditure profile that was attractive to them. Table 4.6 presents an estimate of the share of capital and O&M expense projected in the RODs approved annually since 1982. To make this calculation, we examined the ROD summary for each of the 433 decisions approved through 1988. In some records, the present discounted value of the O&M expense is given; in others, annual amounts are projected over a 20-year period. Overall, the projected capital cost accounted for 74 percent of the total, and the present discounted value of O&M accounted for the balance. Although there is year-to-year variation, there is no clear pattern in these aggregate values that seems to favor capital-intensive projects over those with a greater share in O&M. Clearly, these averages are very crude and do not

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<sup>14</sup>The courts are asked to certify RODs. SARA declares that the remedy shall meet applicable or relevant and appropriate regulations (ARAR, in the EPA’s nomenclature). The courts have interpreted this to include applicable state regulations.
control for site-specific considerations that might have favored one type of remedy over another. Nor do they account for differences among states, some of which may have participated more aggressively in remedy selection than have others.

**ENFORCEMENT ACTIONS: COST RECOVERY, SETTLEMENTS, AND PRIVATE-PARTY TAKEOVER**

Enforcement activities are an integral part of the Superfund program. As the term is used by the EPA, enforcement actions refer to any activities that are not fund-financed. These include voluntary and mandated takeovers by private parties to finance or carry out activities at sites. Enforcement actions can be administrative or judicial. Enforcement expenditures by the EPA include its costs in oversight for an activity supervised by a PRP.

Table 4.7 presents some indicators of the number of administrative and judicial enforcement actions by year. These data are not always

<table>
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<tr>
<th>Fiscal Year</th>
<th>Cumulative, 9/30/86</th>
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<td>Administrative orders of enforcement</td>
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<td>NPL sites</td>
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<tr>
<td>Non-NPL sites</td>
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</tr>
<tr>
<td>Judicial enforcement (total)</td>
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</tr>
<tr>
<td>Enforcement referrals (Sect. 106)b</td>
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<td>Cost recovery referrals (Sect. 107)b</td>
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<tr>
<td>Criminal referrals</td>
<td>1</td>
</tr>
<tr>
<td>SOURCE: EPA congressional budget justifications, various years, except as noted.</td>
<td></td>
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<tr>
<td>*Not reported in budget justifications. Amount is calculated from fiscal year 1984 and 1986 amounts.</td>
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</tbody>
</table>
| bNumber of cases may involve double counting, according to the EPA, because both sections may be cited in one action.
presented on a consistent basis, leading to gaps in some series. The EPA reports that as of January 1989 there were 653 sites "where an administrative order (unilateral or consent) has been issued to PRPs for either a Removal Action, an Expedited Response Action, a Remedial Investigation, a Feasibility Study, a Remedial Design, or a Remedial Action." Roughly half were at NPL sites.

The EPA further reports that a total of 121 civil actions had been referred to the Department of Justice seeking PRP response action under Section 106 of CERCLA; 75 of the referrals were for NPL sites. These are actions requesting that PRPs fund and carry out activities.

The EPA reports, in addition, that a total of 265 sites had been referred to the Department of Justice seeking reimbursement of Trust Fund money under Section 107 of CERCLA. About half (130) were at NPL sites, representing a value of $222 million. The time profile for some of these activities is also shown in Table 4.7.

The data on criminal referrals under the Superfund program present a contradictory picture. In one year, the EPA reported in its budget justification that there had been seven criminal referrals. In later years, it reports that the cumulative number of referrals is one. In any case, such referrals seem to be a small part of actual judicial activity.

Table 4.8 presents a brief summary of settlements reported by the EPA at the end of fiscal year 1988. This summary reports 117 settlements for cost recovery that average almost $1 million per settlement. It also reports a total of 488 settlements for private takeover. Presumably these data represent the number of settlements and not the number of sites, since there may be more than one settlement per site.

**Distribution of Lead Responsibility at Sites**

One objective of Superfund is to encourage private takeover of the lead responsibility for activities at sites. The EPA reports that at the end of fiscal year 1988 it had achieved settlement for private parties to conduct clean up activities at 488 sites (see Table 4.8). Table 4.9 presents a more detailed display of site activities by organization taking

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16Ibid., item 21. This amount excludes referrals with settlements. The EPA cautions that there is some double counting of sites that also cite Section 107 of CERCLA.
17Ibid., item 19. This does not include referrals with settlement. There may be double counting with Section 106 referrals.
the lead responsibility. The Trust Fund exclusively finances 75 percent of removal actions, with responsible parties financing part or all of the remaining sites. For other activities—RI/FS, remedial designs, and remedial actions—the fund has lead responsibility for between 56 and 59 percent of the sites over the first eight years of the program. PRPs have lead responsibility in 25 percent of RI/FS activities and in a somewhat higher percentage of sites that have progressed to remedial design or action.

It is difficult to report accurately the value of the settlements that the EPA achieves for private takeover of the lead—in part because these projections are subject to revision and in part because these values have not been systematically collected and reported for all activities since the program’s inception. Table 4.10 presents a breakdown by major type of activity, but only post-SARA—i.e., since October 1986. The total value, $1.073.9 million for the period post-SARA, is greater than the amount reported in Table 4.8 for the entire period of 1981 to 1988. We do not know the reason for this difference.

Note: March values are contained in App. A.
### Table 4.9

**DISTRIBUTION OF LEAD RESPONSIBILITY ACROSS SITES**

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<td>Removal actions&lt;sup&gt;a&lt;/sup&gt;</td>
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<td>65</td>
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<tr>
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<td>PRP-financed only</td>
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<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Federal facilities</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1</td>
<td>14</td>
<td>6</td>
<td>13</td>
<td>23</td>
<td>32</td>
<td>58</td>
<td>191</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>

**SOURCE:** EPA congressional budget justifications, various years, except where noted. Budget justifications did not report site activities for the year 1985.

**NOTE:** Cumulative amounts vary from the sum of individual years owing to incomplete data in some years.

<sup>a</sup>Calculated from components in years 1983 to 1988.

<sup>b</sup>Calculated from components in years 1986 to 1988.

### Cost Recovery

The CERCLA and SARA legislation provides for actions against PRPs to recover the EPA outlays that were made from the Trust Fund. The EPA has made outlays of $261 million for its enforcement activities since 1980. Table 4.11 and Fig. 4.5 provide a summary of some aspects of the EPA’s cost recovery activity. Some form of enforcement action has been undertaken at a significant fraction of the sites. Table 4.11 shows that 328 sites have some amount of successful cost recovery to date, averaging about $700,000 in recovered amounts
Table 4.10

ESTIMATED VALUE OF SETTLEMENTS FOR PRP WORK BY ACTIVITY
(Post-SARA, through April 26, 1989)

<table>
<thead>
<tr>
<th>Activity</th>
<th>Amount (in millions of dollars)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Removals</td>
<td>93.6</td>
</tr>
<tr>
<td>RI/FS</td>
<td>198.5</td>
</tr>
<tr>
<td>Remedial design/remedial action</td>
<td>714.6</td>
</tr>
<tr>
<td>Multiple response</td>
<td>67.2</td>
</tr>
<tr>
<td>Total</td>
<td>1,073.9</td>
</tr>
</tbody>
</table>

NOTE: The EPA states that there are $112.8 million in PRP responses not counted where settlements were referred in fiscal year 1988 but have not been lodged with the court as of April 26, 1989.

*Multiple response* refers to situations in which a PRP will perform more than one response action under one settlement.

per site. At the majority of these sites, additional parties or amounts may be pursued for recovery.

At 366 sites, the EPA has filed enforcement actions, the case has been referred, or the agency plans to refer the case for enforcement action. Among filed cases, the average amount sought is almost $1 million per site. For sites referred to headquarters or to the Department of Justice or sites that are planned for referral, the planned amount sought is listed as about $2.8 million per site.

Finally, the EPA plans no further action at approximately 900 sites and has determined that 24 cases are “bad cases” that do not merit enforcement action.

We cannot determine from these site counts how many parties are involved or what fraction of potential liability they represent, but it would appear that a large number of sites have received some attention under the EPA’s enforcement process.
Table 4.11
COST RECOVERY UNDER SUPERFUND THROUGH MARCH 1989
(In millions of dollars)

<table>
<thead>
<tr>
<th>Nature of Case</th>
<th>Number of Sites</th>
<th>Amount Recovered</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sites with Cost Recovery Achieved</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fully settled</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(no further recovery attempt planned)</td>
<td>70</td>
<td>23.0</td>
</tr>
<tr>
<td>(Category 5)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Partial settlement (additional amounts exist; no decision made yet to pursue)</td>
<td>191</td>
<td>121.1</td>
</tr>
<tr>
<td>(Category 9)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Partial settlement with ongoing recovery (additional amounts currently being sought)</td>
<td>67</td>
<td>86.4</td>
</tr>
<tr>
<td>(Category 11)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>328</td>
<td>230.5</td>
</tr>
<tr>
<td>Sites with Action Filed or Referred</td>
<td></td>
<td>Sought</td>
</tr>
<tr>
<td>Filed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Category 6)</td>
<td>116</td>
<td>$114.0</td>
</tr>
<tr>
<td>Referred to HQ or DOJ</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Category 7)</td>
<td>65</td>
<td>124.7</td>
</tr>
<tr>
<td>Planned (through FY'90)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Category 8)</td>
<td>185</td>
<td>585.0</td>
</tr>
<tr>
<td>Total</td>
<td>366</td>
<td>823.7</td>
</tr>
<tr>
<td>Bad and No-Action Cases</td>
<td></td>
<td>Obligations^a</td>
</tr>
<tr>
<td>Bad cases</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Category 4)</td>
<td>24</td>
<td>12.0</td>
</tr>
<tr>
<td>No action (no farther action currently planned)</td>
<td>896</td>
<td>470.8</td>
</tr>
<tr>
<td>Total</td>
<td>920</td>
<td>482.8</td>
</tr>
</tbody>
</table>

^aData include only extramural-contract amounts obligated.
Fig. 4.5—Enforcement outlays and cost recovery in the Superfund program through September 1988
V. INTERPRETATION OF THE ANALYSIS

SUMMARY OF PROGRAM PACE AND COST IN THE FIRST EIGHT YEARS

The Superfund program has grown substantially since its inception in December 1980. As of September 1988, over 30,000 sites had been identified for possible action under Superfund, and 27,000 had received preliminary assessment to determine their eligibility for action and further expenditure under the program. On September 30, 1988, 1,175 hazardous waste sites were on the National Priorities List; these sites were thus eligible to receive federal funds for remedial investigation and action and were receiving some type of attention from governmental or private parties. Federal outlays totaled almost $2.6 billion since 1980, and private parties have agreed to assume responsibility for at least some activities at several hundred sites. The EPA had declared site work completed at 34 sites and had removed 18 sites from the NPL.

Along with these accomplishments, however, are some striking shortfalls. The Trust Fund established by the act could have allowed federal commitments—excluding cost recoveries—of $1.6 billion in the period 1980 to 1985 and another $8.5 billion in the period 1986 to 1991, for a total of $10.1 billion. This would have permitted commitments of between $5.3 and $8.7 billion by fiscal year 1988. Depending on the success of cost recovery efforts, the gross dollar commitments could be considerably greater than these amounts. Congress did not appropriate the full Trust Fund amount to the EPA. Cumulative appropriations through fiscal year 1988 were $4.5 billion, about 86 percent of the pro rata share of the Trust Fund. Since obligations cannot exceed appropriations, the EPA is constrained to the lower amount.

The EPA’s own outlays have lagged appropriations. Outlays represent actual payments by the EPA, whereas obligations represent contractual commitments to make payments at some point in the future. At the end of fiscal year 1988, the agency had total outlays of about $2.6 billion, representing 57 percent of the appropriated amount. Obligations through fiscal year 1988 were $4.1 billion, although these amounts are subject to revision as remedies change or as private

1The lower value would reflect pro rata appropriations against the five-year authorized level, and the upper value would include borrowing against anticipated Trust Fund revenues as permitted by SARA.
parties agree to takeover site activities and financing. Furthermore, 64 percent of outlays and only 59 percent of obligations have been for site-specific activities. And outlays for the remedial portion of the program—which includes site discovery, remedial investigation (exclusive of laboratory), remedial study, design, and remedial action—have constituted 37 percent of the EPA’s total outlays to date.

At the same time, the EPA’s cost recovery activities seem thus far to have had only a modest yield. The EPA has spent $261 million on enforcement. Approximately $230 million of past expenditures have been recovered since the program’s inception, representing less than 10 percent of the agency’s cumulative outlays since the program began.

What explains the pace of the program to date, the fraction allocated to site-specific activities, the fraction allocated to remedial activities, and the outcomes of cost recovery activities to date? We cannot provide a complete understanding with only aggregate program-wide statistics, but we conjecture that these factors contribute to the achievements to date:

- First, it could simply be that the EPA has not pursued Superfund very aggressively, and the number of sites and expenditures to date reflect that fact.
- Second, a program of this complexity may require a substantial startup period during which legal interpretations are clarified, administrative procedures are worked out, and sites are identified.
- Third, it may take considerable time for sites to mature to the stage at which they require substantial expenditures; the activities to date (site identification, preliminary assessment, remedial investigation, and the record of decision) may be relatively inexpensive in relation to the remedial action that takes place in the later phases of site activity.
- Fourth, the program structure and guidelines may be excessively rigid—sometimes interfering with program pace or activities causing unnecessary activities to be undertaken.
- Fifth, the litigious atmosphere surrounding Superfund—between the EPA and private parties and among private parties—may engender significant delay and inefficiency at various stages of the process.
- Sixth, technical and legal uncertainty about appropriate remedies—and uncertainty about whether these remedies will be considered acceptable in the future—may contribute delay and costs to the process.
• Seventh, shortages of critical personnel—especially shortages of experienced personnel at the EPA—may affect the pace and efficiency of program activities.

PRELIMINARY ASSESSMENT OF REASONS FOR PROGRAM PERFORMANCE TO DATE

The following conjectures, which attempt to define possible reasons for Superfund's performance to date, are provisional and subject to further examination with more detailed information. In the next section of the report, we recommend research to help resolve some of the uncertainties about the program.

Program Not Pursued Aggressively

It is clear that the EPA administrator at the time the Superfund program went into effect was not disposed to pursue the program goals vigorously.\(^2\) Indeed, the assistant administrator for the Superfund program, Rita Lavelle, resigned under a cloud of controversy surrounding the handling of the program (and served a prison term for perjury in her congressional testimony regarding the program). This atmosphere clearly affected the early operations of the program and may have carried over following the departure of these two key individuals.

Time Needed to Resolve Legal Complexities in the Program

The Superfund program represented a new hybrid from a legal and administrative perspective—melding a common-law notion of tort and nuisance with an administratively initiated strict liability system. Implementation of CERCLA was further complicated because the original legislation was not accompanied by a conference-committee interpretation to facilitate the interpretation of legislative intent. Overlying this legal innovation was substantial technical uncertainty about the nature of the harm posed by the substances and about appropriate remedies for containing or mitigating this harm. Congress deliberately left vague the legal treatment of certain provisions in the act, specifying that the courts were better suited to resolve such issues as whether parties should be jointly and severally responsible for the

mixture of substances in a Superfund site. Thus, considerable time and effort was devoted in the first few years to defining “what was meant by the law,” both in court and in administrative deliberations.

In its early years, there was also considerable uncertainty about how much cleanup was required by the law. For example, was it sufficient to isolate harmful (or corrosive or ignitable, etc.) substances from human contact, or did the substances need to be destroyed or rendered harmless? This general discussion often proceeded under the title “how clean is clean?” It incuded a technical discussion of temporary versus permanent remedies and whether removal of harmful substances to another location constituted a remedy.

The “how clean is clean” discussion also had a legal dimension—one that hinged on how cleanup was to be judged against the standards of various, and possibly inconsistent, standards that have been developed for other environmental problems. For example, would the standards of the Safe Drinking Water Act apply, or would those of the Clean Air Act, the Toxic Substances Control Act, or some combination of these and other standards? Furthermore, what is the role of state environmental standards in determining cleanup? At the time of reauthorization in October 1986, Congress amended CERCLA to introduce the notion of “applicable or relevant and appropriate remedies” and declared that these should be applied to the cleanup of Superfund sites. In the reauthorization, some 30 federal standards were explicitly incorporated by reference as applying to Superfund, and Congress also declared that applicable or relevant and appropriate state standards could apply as well. This legal standard is still being clarified—including the issue of whether a “higher” state standard may take priority over a federal standard in the approval of a Superfund remedy. A related issue of implementation is whether a state may supervise and approve the satisfactory completion of a remedy at a Superfund site.

Time Needed for Sites to Mature

Sites progress through stages of fact finding, proposed remedy, and actual remediation. For many sites, these early stages are less

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3See Grad (1985).
5See, for example, a recent decision in Colorado that allows the state to apply a more stringent standard to the remedy for Rocky Mountain Arsenal than what had been approved by the EPA. Inside EPA’s Superfund Report (1989b).
6See, for example, the Rocky Mountain Arsenal by the U.S. District Court, in which the state sought the right to supervise the contractor at an EPA-approved cleanup. Ibid.
expensive than are the remedial activities. For example, remedial investigation/feasibility studies average about $750,000 each, whereas the projected costs of remedy at sites where a record of decision has been completed averages $9 million over the entire history of the program. This natural maturation of individual sites may account in part for the pace of overall expenditure at Superfund sites. In the last two years, the EPA has obligated more than 60 percent of the cumulative obligation amounts over the life of the program.

Program Rigidities

Rigidity and inflexibility could arise in several aspects of any program, but we will focus on those that may be created through legislative guidelines and schedules. The act references several specific standards that must be observed in taking action. In addition, under SARA Congress created a demanding time schedule for achieving a number of program milestones (e.g., a certain number of RI/FS starts and a certain number of remedial designs; see Sec. III). If the EPA fails to meet these schedules, then even more demanding ones must be met at a later date. As a result, the EPA is denied the flexibility that administrative agencies generally receive when they are called upon to develop technical details and to adjust standards as site-specific conditions vary or as technology develops in a new area. This inflexibility may lead to greater cost or, in some circumstances, to delay. In addition, it may bias the agency in favor of working on “easier” sites, where the arbitrary deadline can be met, rather than on the more difficult sites, which in some cases may represent a greater threat to human health or to the environment.

Those familiar with the program recognize the problems created by such detailed legislative requirements but do not expect them to change in the near term. Congressman James Florio (D-N.J.), one of the early supporters of Superfund legislation and a major contributor to its revision in 1985–1986, wrote a highly informative article about the detailed guidelines that Congress created for the EPA in the Superfund legislation. In it, he points out that many aspects of hazardous waste policy would best be developed through a two-part process—with Congress setting broad policy goals and schedules and leaving the EPA administrator to determine specific technical and administrative details. Instead, in SARA, Congress has prescribed detailed limits and specific

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7 These averages are over the entire program period and are not adjusted for inflation. For example, average current dollar values of remedies in 1987 and 1988 were over $9.7 million per site.
8 See Florio (1986).
procedures and has created self-enforcing standards with rigid schedules to be implemented in the absence of EPA action. Florio concedes that Congress is not well suited to the role of providing detailed regulations and administrative details:  

As a matter of institutional capabilities, administrative agencies are better suited than Congress, both substantively and procedurally, for the implementation of complex statutes. In theory, an administrative agency acts with the expertise, speed, flexibility, proactive perspective, and political insulation needed to ensure that regulatory programs are designed and implemented most effectively. Congress, in comparison, is poorly suited institutionally for the task of detailed rulemaking and program administration.

Nevertheless, Florio does not expect Congress to change its course in the near term—e.g., by delegating a broad degree of discretion to the EPA—because of the perception that the administration deliberately ignored clear congressional intent in the implementation of Superfund and other environmental policy. (This point is related to problems that began with the EPA administrator when Superfund was first implemented, as discussed above.)

Problems Caused by Litigious Atmosphere

Superfund is a liability-based system, that applies a principle of strict, joint-and-several liability to a broad class of generators, haulers, and owners and operators of waste facilities. The legislation enables the EPA to seek reimbursement from parties for investigative, remedial, and oversight costs—and it allows the agency to seek punitive costs from parties that refuse to carry out its orders for information—or program-related actions such as investigation, design, or remedy. Given the leverage effect of a joint-and-several liability scheme, one party may face costs far out of proportion to its notion of a “fair” share and may therefore elect to fight the EPA in court or in an administrative hearing. The result may in some circumstances be significant delay and litigation costs.

In addition to this adversarial relationship between some PRPs and the EPA, there may be dispute among PRPs about the selection of the remedy and the allocation of costs—which can lead to another source of delay and litigation costs. Third, PRPs may find themselves in dispute with their insurance carriers over the applicability of insurance coverage to the activities at a Superfund site. For example, many

\footnote{See Florio (1986). Florio also quotes Senator Lloyd Bentsen (D-Tex.), who expressed similar concern about the limitations that a legislative body has in analyzing and implementing such a technically complex detail.}
insurance carriers contend that the character of damage that is being remedied at Superfund sites is not covered by the applicable insurance policies—whereas many of the potentially responsible parties feel that it is covered. This matter has often been subject of vigorous and extensive litigation.\(^\text{10}\)

The ability-based legal doctrine outlined in CERCLA imposes on the EPA a number of obligations that it might not face under a different approach. For example, at least as the program has been implemented, early investigative activities at a potential Superfund site involve careful and elaborate (and expensive) sampling procedures and chemical analyses to characterize the substances involved. Because the results may later be used as court evidence, extensive chain-of-custody and documentation procedures are employed and substances sent to certified laboratories for analysis.\(^\text{11}\)

Furthermore, the liability-based approach, combined with an interpretation of joint-and-several liability, sets up a tension between the EPA and the parties, as well as among the parties themselves, at a time when the EPA might also prefer to have cooperation and expeditious handling of a site. The parties are essentially told on the one hand that they are being sued and on the other that they are being encouraged to cooperate in providing information, identifying a suitable remedy, and financing that remedy. Since the issue may eventually go to court, parties must observe proper communication and notification procedures to protect their interests. With some sites involving as many as 250 PRPs, the sheer volume of communication and record-keeping can be significant.

\(^\text{10}\)For example, in one closely watched case, a federal court decided in December 1988 that the costs of cleaning up the Rocky Mountain Arsenal should be borne by the U.S. Army (which owned the site at one point) and by the subsequent owner, Shell Oil Company, which manufactured pesticides and other products over a period of several years—and that the insurance carriers at various points in time were not required to reimburse the site owner/operator. See Inside EPA's Superfund Report (1989a). In other cases, courts have determined that ongoing leakage from a waste site constitutes a reimbursable occurrence under general liability insurance policies and ordered the insurance companies to reimburse the costs of remedial activities.

\(^\text{11}\)It is not clear why the EPA needs such elaborate procedures if the legal basis for liability is strict joint and several. Presumably the purpose of such careful segregation and characterization of individual substances is to trace responsibility back to particular parties that may have generated or handled these wastes. But if the EPA can sue such parties individually and severally for the aggregate cost of the remedy, it is in the parties' interest, not the EPA's, to determine the apportionment of contribution and harm.
Uncertainty About Remedy Selection

As noted at the outset, when Love Canal and other closed hazardous waste sites first came to public attention, we had little idea of the nature of the threats posed at Superfund sites or the most suitable response to such threats. Uncertainty continues about the most technically appropriate approach to many sites. In some instances, we simply do not know how to assure ourselves that potentially harmful substances can be successfully contained over a long period. In other instances, we lack the means for permanent destruction of all materials that may be contained in some sites—even if costs were not a constraint. Early remedial approaches to sites on the NPL often involved moving wastes from one land disposal site to another. The 1986 amendments created a presumption against this practice and instructed the EPA to favor permanent remedies (among other considerations) when reaching a ROD. Technical uncertainty about appropriate remedies may lead to delay or increased costs at a site as parties search for more effective, or less costly, means of dealing with the site.

In addition to this technical uncertainty, PRPs sometimes feel that they are exposed to legal uncertainty about their responsibility for future actions and costs. The Superfund program has made it very clear that parties may be held strictly responsible for prior waste-handling practices even if there was no negligence. Indeed, parties may be held responsible for cleanup costs even if they followed practices that were explicitly approved by government authorities at the time. At this point, private parties that agree to clean up a Superfund site have no assurance that the EPA (or other parties) will not come along at a later stage and require a different remedy at a site that was previously cleaned up in compliance with a ROD. The EPA practice is to not grant release from future liability for parties that clean up a site (or agree to the financing of a cleanup). As a consequence, PRPs may be slower to agree to a particular remedy—or to their proposed share of costs—than they might otherwise be.

Shortages of Critical Personnel

In principle, shortages of critical personnel, supplies, materials, or other inputs to Superfund program activities could lead to important slowdowns and increases in costs. Let us concentrate on certain personnel in the present discussion, since these have been identified in other studies as potentially most important in Superfund activities.¹²

¹²See, for example, General Accounting Office (1987), Clean Sites (1989), or Environmental Protection Agency, Superfund Progress Report (1989) for discussions of shortages and turnover among the EPA remedial project managers.
Several types of individuals are involved in site investigation, oversight, enforcement, and implementation on behalf of the EPA. Among the most important are individuals in the EPA regional offices who oversee activities at individual Superfund sites. In some cases, these people approve and monitor the work of contractors who carry out fund-financed activities, and in other cases they approve and monitor the work of private parties that have agreed to take the lead responsibility. According to the General Accounting Office and the EPA reports, many of these individuals have relatively short tenure at the EPA, often have little prior experience with hazardous waste site problems, and they have high job turnover. The average tenure of the EPA remedial project managers is 18 months, and some parties associated with remedial program activities report that they have had to deal with as many as four different EPA representatives over the course of remedy selection. This relative inexperience, combined with high turnover, may contribute to delay and inefficiency in the selection and implementation of activities at Superfund sites.

Furthermore, the General Accounting Office (1987) reports that shortages among remedial project managers may bias these managers in favor of fund-financed activities at particular Superfund sites, since they feel that it requires less effort to supervise an EPA contractor than to supervise a PRP. If, in fact, there is a bias in favor of choosing fund-financed activities as a result of the EPA staff shortages, then a second type of inefficiency may be introduced: since EPA contractors operate on a cost-based reimbursement scheme, they have less incentive to control costs as tightly as would a PRP-supervised activity, where the party bearing the costs is also monitoring the activities. This asymmetry in cost consciousness may be reinforced if the EPA project manager also anticipates that some or all of the costs may be later recovered from PRPs through an enforcement action.

\footnote{See Clean Sites (1989), p. 29.}
VI. CONCLUSION AND NEXT STEPS

In the previous sections, we presented an overview of the workings of the Superfund program and several indicators of its accomplishments. We are especially interested in furthering our understanding of the effects of the program's litigation-based approach on the pace, costs, and effectiveness of dealing with closed and abandoned hazardous wastes and waste sites.

On the basis of data drawn largely from the EPA, we find that the program, as it is currently constituted, has begun activities on a substantial number of sites but that relatively few sites have completed the cleanup process. On average, it takes over eight years from the time a site enters the EPA data system to the time a remedy is identified and approved for detailed development and design. The EPA has placed 1,175 sites on the National Priorities List for investigation, study, and, if appropriate, remedy. At the end of September 1988, remedial action had begun at 177 sites, site work had been completed at 34 sites, and 18 sites had been removed from the NPL. In addition, the EPA had removed hazardous materials from another 963 sites that are not on the NPL.

The EPA's actual expenditures—i.e., outlays of federal dollars—totaled $2.6 billion from December 1980 through September 1988. Approximately 64 percent of these outlays has been for work at specific hazardous waste sites, and the balance has been for non-site-specific activities, including general administration, management, and common laboratory and enforcement expenses.

Cost recoveries have been modest, representing less than 10 percent of the EPA's outlays to date. As of September 1988, the EPA had recovered a total of $230 million of its prior outlays from private parties under enforcement actions. This represents settlements from at least some of the parties at a total of 328 sites. The EPA currently plans no further action at 920 sites, and actions have been filed or planned for filing at the balance of 366 sites.

There are several possible explanations for the pace and accomplishments of the program to date. It may be that a program of this complexity requires considerable time, effort, and judicial consideration to reach maturity and full function. On the other hand, there may be some serious difficulties in the approach selected for dealing with prior hazardous wastes.
The EPA recently announced some significant changes in the Superfund program and staffing. It is an open question whether these changes, along with the continued development of the program, will significantly alter the pattern of accomplishments reviewed in this study.

RECENTLY ANNOUNCED CHANGES IN SUPERFUND

In the first half of 1989, two studies presented a review of many aspects of the Superfund program and made suggestions for change: the Lautenberg/Durenberger Study\(^1\) and the so-called EPA 90-day study.\(^2\) Two common themes run through these studies: the need for better management of the Superfund program—including staff training and retention—and the need for a stepped-up enforcement program.

The Lautenberg/Durenberger report gives voice to an often-expressed concern that SARA provided the EPA with a number of strong enforcement tools, but that the agency had made very little use of these administrative and legal procedures for accomplishing program objectives. It called for greatly expanded use of unilateral administrative orders, judicial orders, and treble-damage penalties for failure to comply by private parties. Their report contains a total of 44 recommendations for improved implementation of the program.

In his report as well as in his testimony before the Lautenberg/Durenberger committee when he presented the 90-day study, EPA Administrator William Reilly promised a more vigorous enforcement program, both to compel private takeover of Superfund activities and to recover EPA outlays. “The essence of this strategy is that Superfund is being redirected to be an “enforcement first” program,” he declared.\(^3\) Reilly stated a number of broad goals and proposed taking $75 million from other Superfund activities in order to hire 500 new enforcement staff personnel.\(^4\)

The benefits that advocates see from an increased enforcement effort are several. First, it will provide increased private funding of

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\(^1\) See Lautenberg and Durenberger (1989). The authors are Chairman and ranking minority member, respectively, of the subcommittee on Superfund, Ocean, and Water Protection.

\(^2\) See Reilly (1989). In his confirmation testimony, William Reilly promised to conduct a review of the Superfund program. In addition, the Clean Sites study (1989) was released in January 1989. This study took on added significance in that Reilly, the new administrator of the EPA, had been a member of the board of directors of Clean Sites.

\(^3\) Prepared testimony before the Committee on Environmental and Public Works, U.S. Senate, June 15, 1989.

Superfund activities rather than requiring federal dollars to accomplish the activities. Second, it will provide a credible threat of expensive litigation or penalties for private parties that fail to cooperate with federally initiated activities, which will speed the settlement process and achieve earlier private funding and takeover of Superfund activities. Third, it will make the program more credible, and the expected costs of noncompliance higher, for future waste-related activities. This is expected to lead to more private, voluntary cleanup activities as well as to more protective waste-handling practices for new wastes. Fourth, it will be fairer to the parties that do cooperate with EPA-initiated actions because it will not be profitable for non-cooperative parties to "lie back in the weeds" expecting that the EPA will not pursue them with enforcement or cost recovery actions.

On the other hand, some observers may wonder if an increased enforcement program will work against some aspects of Superfund's objectives. If the program is already made slower and more expensive by its emphasis on litigation, will an increased enforcement effort exacerbate this problem? If there are already shortages of key personnel, will the EPA be able to carry out an increased effort? If settlements are currently made more difficult by high turnover of the EPA personnel who must be involved in the negotiations will an increased enforcement effort encounter further difficulties in this dimension? If the EPA pattern of recent obligations continues, a large fraction of future outlays will be needed for meeting commitments to investigative and remedial activities. Will there be enough resources to significantly expand an enforcement program? Is Congress likely to increase the EPA appropriations for Superfund in an era of tight fiscal constraints?

NEXT STEPS IN ANALYSIS

The previous sections have helped lay the foundation for examining the effects of the Superfund program to date and for anticipating the effects of recently announced changes. But the picture is yet incomplete—in terms of both the detail and the scope of the available data. In general, we can provide a reasonably good overview of the information that is available to the EPA regarding the numbers of sites, actions taken, and federal costs incurred for sites that come in contact with the federal program in some manner. At present, however, we have relatively little information about the details of differences within the federal program—for example, the effects on cost, pace, and efficacy of taking one administrative or legal approach over another for handling particular sites.
In terms of scope of information, too, we have little information about the sites that are handled exclusively outside the federal Superfund program (such as sites handled exclusively under state supervision or those handled exclusively by private parties without governmental involvement). We do not know if these nonfederal activities are considerably larger than the federal component or if they constitute a relatively modest part of the overall effort. Furthermore, we do not know at present if the nonfederal costs and accomplishments have a similar distribution across activities to the federal effort. For example, are litigation and other transaction costs a similar fraction of dollar outlays to date, or are they notably different from the federal share of costs?

Clearly, we need to expand the scope of future analysis to non-EPA activities and to monitor the effects of the recently announced changes within the EPA.
Appendix A

NUMBERS OF SITES AT MAJOR STAGES OF THE SUPERFUND PROCESS, CUMULATIVE THROUGH MARCH 1989

<table>
<thead>
<tr>
<th>Status of Sites</th>
<th>Number of Sites</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sites in the EPA information system</td>
<td>30,844</td>
</tr>
<tr>
<td>Preliminary assessments completed</td>
<td>28,101</td>
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<tr>
<td>Site inspections completed</td>
<td>9,902</td>
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<tr>
<td>Sites with no further action planned</td>
<td>12,416</td>
</tr>
<tr>
<td>National Priorities List</td>
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<tr>
<td>Final</td>
<td>890</td>
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<tr>
<td>Proposed</td>
<td>273</td>
</tr>
<tr>
<td>Total</td>
<td>1,163</td>
</tr>
<tr>
<td>Removal actions</td>
<td></td>
</tr>
<tr>
<td>NPL</td>
<td>274</td>
</tr>
<tr>
<td>Non-NPL</td>
<td>1,073</td>
</tr>
<tr>
<td>Total</td>
<td>1,347</td>
</tr>
<tr>
<td>Remedial investigation or feasibility</td>
<td></td>
</tr>
<tr>
<td>study, cumulative starts</td>
<td>845</td>
</tr>
<tr>
<td>Remedial design, cumulative starts</td>
<td>300</td>
</tr>
<tr>
<td>Remedial action, cumulative starts</td>
<td>204</td>
</tr>
<tr>
<td>Site work completed</td>
<td>41</td>
</tr>
<tr>
<td>Delisted from NPL</td>
<td>26</td>
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</tbody>
</table>

SOURCE: Environmental Protection Agency.  
Appendix B

DISTRIBUTION OF LEAD RESPONSIBILITY
AT SITES THROUGH MARCH 1989

<table>
<thead>
<tr>
<th>Activity</th>
<th>Cumulative Through 3/31/89</th>
<th>Percentage of Activities</th>
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</thead>
<tbody>
<tr>
<td>Removal actions</td>
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<td></td>
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<tr>
<td>Fund-financed</td>
<td>1,006</td>
<td>75</td>
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<tr>
<td>PRP response</td>
<td>248</td>
<td>18</td>
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<td>Both</td>
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<td>7</td>
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<td>NPL sites</td>
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<td>Non-NPL sites</td>
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<td>80</td>
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<td>Total</td>
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<td>RI/FS</td>
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<tr>
<td>Fund-financed</td>
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<td>56</td>
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<tr>
<td>PRP response</td>
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<tr>
<td>Both</td>
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<tr>
<td>Federal facilities</td>
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<td>3</td>
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<td>Total</td>
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<td>100</td>
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<td>Remedial designs</td>
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<td></td>
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<tr>
<td>Fund-financed</td>
<td>176</td>
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<td>PRP financed only</td>
<td>110</td>
<td>37</td>
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<td>Both</td>
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<td>4</td>
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<tr>
<td>Federal facilities</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>300</td>
<td>100</td>
</tr>
<tr>
<td>Remedial actions</td>
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<td></td>
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<tr>
<td>Fund-financed</td>
<td>114</td>
<td>56</td>
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<tr>
<td>PRP financed only</td>
<td>80</td>
<td>39</td>
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<tr>
<td>Both</td>
<td>6</td>
<td>3</td>
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<tr>
<td>Federal facilities</td>
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<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>204</td>
<td>100</td>
</tr>
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SOURCE: Environmental Protection Agency,
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**Process: Juries**


**Process: Alternative Dispute Resolution**


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A special bibliography (SB 1064) provides a list of other RAND publications in the civil justice area. To request the bibliography or to obtain more information about The Institute for Civil Justice, please write the Institute at this address: The Institute for Civil Justice, The RAND Corporation, 1700 Main Street, P.O. Box 2138, Santa Monica, California 90406-2138, (213) 393-0411.