THE HAZARDOUS WASTE SYSTEM

U.S. Environmental Protection Agency
Office of Solid Waste and
Emergency Response

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FOREWORD

This report provides an overview of hazardous waste management practices in the United States. The primary focus is on hazardous wastes as defined in the Resource Conservation and Recovery Act (RCRA) and the Superfund program. In addition to a description of the current system, discussions are provided of the potential impacts of current regulatory and other initiatives.

This is a summary report which draws from more detailed, ongoing investigations. It is anticipated that the report will be updated periodically as new information becomes available. It is also possible that the report may be expanded in the future to include more discussion of related statutes and waste systems.

We hope that this report, and its subsequent revisions, will serve as a focal point for discussions of future directions in the hazardous waste management area. Comments on the information presented herein will be very much appreciated.

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TABLE OF CONTENTS

PAGE

EXECUTIVE SUMMARY ES-1

Hazardous Waste Managed ES-1
Treatment and Disposal ES-2
Regulatory and Other Effects ES-4
Implications for the Future ES-7

SECTION 1 *HAZARDOUS WASTE MANAGED* 1-1

Definitions of Hazardous Waste 1-1
Large Quantity Generators 1-3
Small Quantity Generators 1-4
Geographic Implications 1-5

SECTION 2 *TREATMENT AND DISPOSAL* 2-1

Treatment Technologies 2-2
Incineration Technologies 2-4
Land Disposal Technologies 2-5

SECTION 3 *REGULATORY AND OTHER EFFECTS* 3-1

Land Disposal Restrictions and Technology Standards 3-1
Waste Minimization Policy 3-3
Deep-Well Injection Regulation 3-4
Domestic Sewage Sludge Regulation 3-4
Ocean Incineration Regulation 3-6
Corrective Action Policies 3-6
Superfund Off-Site Policy and Clean-Up Standards 3-7
Redefinition of RCRA Hazardous Waste 3-8

SECTION 4 *IMPLICATIONS FOR THE FUTURE* 4-1

More Incinerators Needed 4-1
More Information About On-Site Activities 4-2
Regional and Waste Specific Capacity 4-3
Waste Minimization 4-6
Siting and Permitting Issues 4-6

TABLE OF CONTENTS
(continued)

PAGE

APPENDICES

A. Operating Commercial Incinerator Facilities A–1
B. Operating Commercial Land Disposal Facilities B–1
C. Commercial Deep-Well Injection Systems C–1

BIBLIOGRAPHY

EXHIBITS

		PAGE
Exhibit 1	Simplified Waste System Chart	ES-3
Exhibit 2	Volumes of RCRA Hazardous Waste Treated and Disposed	ES-4
Exhibit 3	Hazardous Waste Managed by Industry	1-4
Exhibit 4	Hazardous Waste TSDRs and Waste Volumes by Geographic Sector	1-5
Exhibit 5	Number of Active Facilities by Type of Technology	2-1
Exhibit 6	Estimate of Physical Characteristics of RCRA Hazardous Wastes	2-3
Exhibit 7	Treatment Technologies	2-3
Exhibit 8	Incinerator Types and Incinerable Waste Descriptions	2-4
Exhibit 9	Number of Land Disposal Facilities by Type of Process	2-6
Exhibit 10	Distribution of Municipal Sludge by Managment Practice	3-5
Exhibit 11	Regulations and Policies and Their Potential Effects on Capacity	3-9
Exhibit 12	Potential Capacity Problem Areas	4-4
Exhibit 13	Land Disposal Facilities by Number, Volume, and Available Capacity	4-5

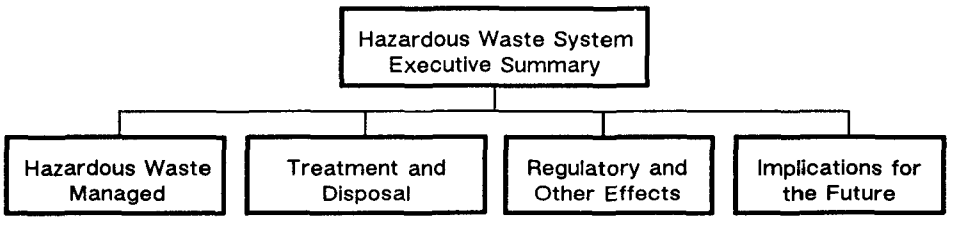
EXECUTIVE SUMMARY

The purpose of this report is to provide an overview of the country's hazardous waste system. Included are discussions of the sources and quantities of hazardous wastes; the system for treatment, storage, and disposal (TSD) of these wastes; and discussions of upcoming regulatory and other impacts on the hazardous waste system.

Rather than looking at hazardous waste issues from a single medium perspective, this report examines hazardous waste issues through an integrated framework for addressing environmental problems. Several functions are to be served by this report.

- First, the report provides an overview of the hazardous waste system. It serves as a point of reference for continuing, more detailed work.
- Second, it serves as a starting point for the 20-year state capacity certification efforts required by the Superfund Amendments and Reauthorization Act of 1986 (SARA).
- Third, the report provides an initial vehicle for discussion of possible impacts of the various EPA regulatory efforts underway with respect to hazardous waste control.
- Finally, the question of whether there is, in fact, a "capacity problem" is addressed in a very preliminary way.

Each section of the report is shown below and briefly summarized in the following paragraphs. More detail is provided in subsequent report sections.



HAZARDOUS WASTE MANAGED

The primary focus of this report is hazardous waste as defined in the Resource Conservation and Recovery Act (RCRA) and by the Superfund program. However, the hazardous waste system does not exist in isolation. Before dealing with the specific subject of hazardous wastes, it is useful to overview several key elements of the overall waste system.

Such an overview is provided in Exhibit 1. The point of this diagram is to illustrate the relationships among such items as hazardous wastes, municipal and industrial wastewaters, and non-hazardous solid wastes. It will be increasingly important to understand "where things go" as we deal with hazardous and solid waste, and wastewaters.

It is also important to note that the overview in Exhibit 1 does not deal with every source or possible exposure route of hazardous wastes or toxic substances. For example, hazardous air emissions, pesticide applications, and many "non-point" waste sources are not included in Exhibit 1. These sources and others such as wastes discharged to surface waters through a National Pollutant Discharge Elimination System (NPDES) permit are not discussed in detail in this report.

Now, let's return to RCRA and Superfund hazardous wastes, which are highlighted in the bold portion of Exhibit 1. The hazardous wastes managed under RCRA totaled about 275 million metric tons (MMT) in 1985. The overwhelming majority of this, well over 99 percent, was managed by "large quantity generators" (over 1,000 kilograms per month).

A number of factors could affect the volumes of wastes generated in the future. Factors such as economic and population growth, regulatory decisions, and waste minimization efforts will influence the amount of waste produced. As industrial production increases the volume of industrial wastes produced could also increase. However, efforts to recycle and reuse wastes, as well as programs to minimize the amount of waste generated are likely to temper increases in waste volumes.

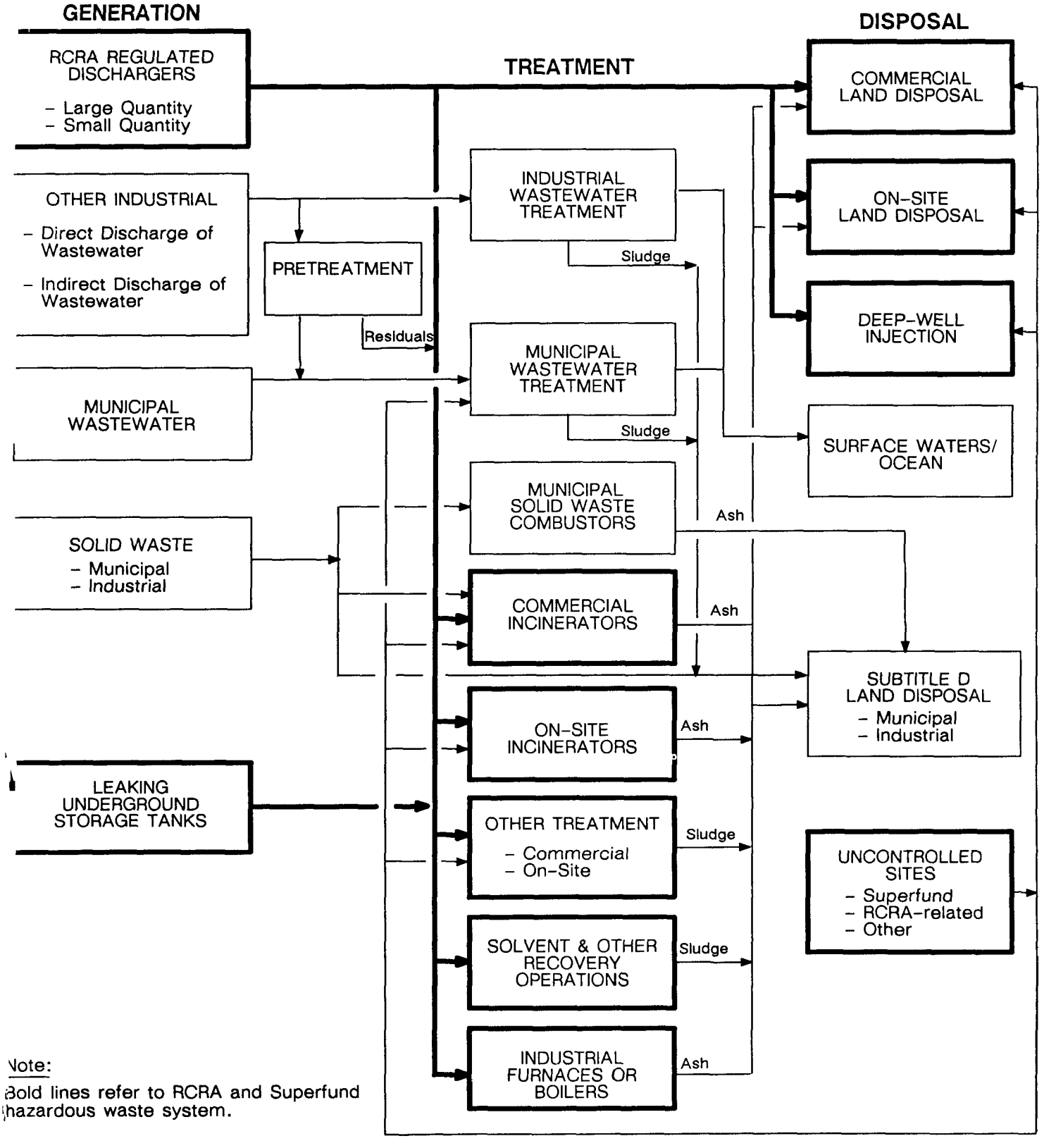
TREATMENT AND DISPOSAL

Referring again to the bold print portion of Exhibit 1, let's now outline the treatment and disposal part of the hazardous waste system.

First, it is important to note that about 96 percent of all RCRA hazardous waste is managed on the sites of private companies, the remaining 4 percent goes to off-site commercial treatment and disposal facilities. An approximate breakdown of the treatment and disposal system follows.

Exhibit 1

Simplified Waste System Chart



Note:
Bold lines refer to RCRA and Superfund hazardous waste system.

Exhibit 2

Volumes of RCRA Hazardous Waste Treated and Disposed

	On-Site at Private Firms (MMT)	Off-Site at Commercial Firms (MMT)	Estimated Total (MMT)
Incineration	1.7	0.4	2.1
Other Treatment	204.0	1.6	205.6
Solvent & Other Recovery	*	*	57.0
Furnaces & Boilers	*	*	0.9
Land Disposal	8.0	5.0	13.0
Deep-Well Injection	*	*	~25.0
Total			303.6**

Source: National Screening Survey, U.S. EPA, Office of Solid Waste (1986).

** Breakdown of on-site versus off-site waste volumes is not currently available.*

*** Total exceeds 275 MMT as deep-well injection, which is covered under the Safe Drinking Water Act, is included.*

MMT=million metric wet tons per year

The above table relates to about 3,000 facilities which treat, store, or dispose of RCRA hazardous waste. There are currently over 175 on-site incinerators and 14 commercial incinerators. A list of commercial incinerators is contained in Appendix A of this report. In addition to incineration, there are many other treatment practices including biological wastewater treatment, solidification, steam stripping, and treatment impoundments. Most current treatment systems consist of on-site impoundments handling relatively dilute wastewaters. There are about 430 operating land disposal facilities, approximately 60 of which are commercial facilities which accept a wide range of wastes. Appendix B of this report contains a list of commercial operating land disposal facilities. Finally, while the majority of deep-well injection systems are located on-site, a few commercial facilities also use deep-well injection systems. These facilities are identified in Appendix C of this report.

REGULATORY AND OTHER EFFECTS

Due to a large number of new statutory and other requirements, hazardous waste management must deal with a series of "moving targets". Some of the more significant ones are briefly outlined below.

Land Disposal Restrictions and Technology Standards

The Hazardous and Solid Waste Amendments of 1984 (HSWA) required that EPA ban the land disposal of over 400 chemicals and waste streams unless the wastes are treated, or it can be demonstrated that there will be "no migration as long as the waste remains hazardous." The solvents and dioxin portion of the rules went into effect in November 1986. Others will be promulgated over the next 2 to 3 years. The major impact of these rules will be to significantly increase treatment required for many hazardous wastes.

Waste Minimization Policy

EPA strongly favors preventing the generation of waste rather than controlling it after it is generated. EPA's waste minimization program focuses on two main goals. First, to foster the use of waste minimization through technology and information exchange, and second, to report to Congress in 1990 on the need for regulations on waste minimization.

According to a recent study conducted by EPA, a 20–30 percent reduction in waste volume should be possible through process changes, product substitution, recycling and "good housekeeping" practices. Concerns over economic and liability issues are already driving firms to reduce the volume and toxicity of the wastes they produce. Finally, a number of states have aggressive waste minimization programs; EPA will attempt to encourage and support such programs.

Deep-Well Injection Regulation

In accordance with the Hazardous and Solid Waste Amendments EPA must also determine whether to further restrict certain hazardous wastes from deep-well injection by August 1988. Currently, information is being collected to support the development of a regulatory decision.

It is important to note that a large amount of dilute hazardous wastes (about 20–35 MMT per year) is disposed of in this manner. Deep-well injection is largely practiced in a few Southwest and Midwest states. Thus, a significant regional impact could be felt if this practice is inhibited.

Domestic Sewage Sludge Regulation

Under the Clean Water Act, municipalities are required to treat wastewater before discharging it to surface waters. This treatment process generates sludge which must be used or disposed of. Very large amounts of non-hazardous sludge are produced each year. The overwhelming majority of this sludge is landfilled and used for land application. A smaller amount (about 20 percent) is incinerated.

RCRA contains an exclusion for hazardous wastes which are mixed with domestic sewage. EPA is developing information on the volume of hazardous waste being discharged to sewers, and is scheduled to propose regulations on domestic sewage sludge by September 1987.

A major environmental issue currently involves whether domestic sewage sludge will be considered hazardous under EPA's new Toxicity Characteristic Leaching Procedure (TCLP). This could potentially bring large volumes of waste into the RCRA system.

Ocean Incineration Regulation

Regulations are currently being developed to provide a framework for possible applications for ocean incineration of hazardous waste. If and when successful applications are made to ocean incinerate these wastes, such operations could provide additional capacity for concentrated, liquid hazardous wastes.

By October 1987, EPA is scheduled to issue final regulations on designating sites for burning hazardous waste at sea. Final regulations on ocean incineration will be promulgated in late 1988. The planned ocean incineration regulations apply exclusively to liquid organic wastes and do not cover solid wastes.

Corrective Action Policies

Corrective action involves cleaning up RCRA facilities which have been contaminated by hazardous wastes releases. This includes instances where past management practices involved the disposal of hazardous wastes in solid waste management units. Leaking underground storage tanks are another potentially large universe for corrective action. Presently, there are about one million underground storage tanks, approximately 5-20 percent of which may be leaking.

The volume of contaminated soils and sludges generated from corrective action cleanups could be large. While most of the waste will likely be treated and disposed of on-site, some concentrated wastes may require off-site handling. These wastes will compete for existing commercial incineration and land disposal capacity.

Superfund Off-Site Policy and Clean-up Standards

Under the Superfund Amendments and Reauthorization Act of 1986 (SARA), EPA is required to establish standards for Superfund clean-up actions and also to identify the conditions for disposing of Superfund wastes off-site. The impact of these provisions could change the proportions of hazardous wastes managed on-site and off-site. For example, the new clean-up standards could increase the use of mobile treatment units and stabilization techniques to manage wastes on-site. Some of the more concentrated wastes will likely shift off-site for treatment and disposal.

Furthermore, the off-site disposal provision of SARA restricts where Superfund wastes can be taken. Only those facilities which are in compliance with RCRA and the Toxic Substances Control Act (TSCA) and applicable state requirements are eligible to accept wastes from Superfund sites. Specifically, the unit receiving Superfund wastes must not be releasing any hazardous wastes and the overall facility must be controlled by a corrective action program. Several Superfund sites have experienced difficulties locating a commercial facility eligible to accept their wastes.

Redefinition of RCRA Hazardous Waste

Currently a waste is defined as hazardous under RCRA if it possesses certain characteristics or is listed in Subpart D, Part 261 of the Code of Federal Regulations (40 CFR). About half of RCRA hazardous waste possesses one of the four characteristic attributes: reactive, ignitable, corrosive, or EP toxic. The other half of the wastes are "listed" hazardous wastes.

Under the current definition, RCRA regulates about 275 MMT of waste and about 3,000 facilities treat, store or dispose of RCRA hazardous waste. EPA is considering the use of such criteria as waste concentration and management practices in potential new definitions of hazardous wastes. Changing such criteria for defining a hazardous waste could significantly affect the volume of waste currently regulated by RCRA and the size of the regulated community.

IMPLICATIONS FOR THE FUTURE

It is highly likely that the hazardous waste system of tomorrow will be different than the one of today. Regulatory impacts, costs of waste disposal, liability considerations, regional capacity constraints, and waste minimization efforts are already affecting waste management practices.

As a result of the regulatory and other factors discussed above, a number of general observations about the waste management system become apparent.

- First, there will be increasing restrictions on land disposal without some type of treatment.
- Second, hazardous waste treatment and disposal will steadily increase in cost.
- Third, it will be important that the impacts of new regulations are carefully examined to ensure that additional problems are not created.

Having made these observations, let's briefly look at the initial implications that can be drawn from information provided in the report. These implications are intended to serve as a starting point in identifying national priorities as well as focusing on issues of concern to regions and states. The initial implications of the report are summarized below.

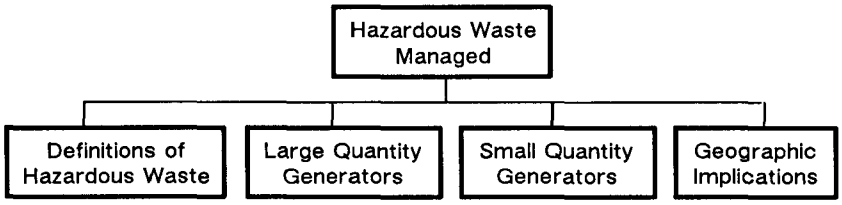
- First, more facilities are needed to incinerate certain hazardous wastes. This need is likely to increase as SARA's remedial action provisions and RCRA's corrective action and land disposal restriction programs are implemented.
- Second, a better understanding of on-site hazardous waste management activities is required. With 96 percent of all RCRA hazardous wastes managed on-site, it is important to understand and deal with likely industry responses to the various regulatory and other impacts.
- Third, waste management capacity is largely a regional and waste specific issue. While there is generally adequate capacity to handle some wastes, such as most liquid organic wastes, there is currently inadequate capacity to treat dioxin and solvent contaminated soils and certain dilute wastewaters. In addition, some states and regions have inadequate capacity and must ship their wastes to other areas of the country. Since wastes can move freely in interstate commerce, it will be difficult to "tie down" specific capacity shortfalls.
- Fourth, EPA fully supports the concept of waste minimization through the use of technology transfer, recovery and recycling operations, waste exchange programs, and source reduction techniques. It is far better to reduce the generation of hazardous waste than manage waste after it is created.
- Finally, there is a recognized need to site and permit new hazardous waste management facilities and to expand existing units. This is an important part of planning for the future. The 20-year state capacity certification requirement in SARA is a major step in encouraging states to develop new capacity.

This report provides a "big picture" look at emerging hazardous waste issues. It offers a framework for strategic planning at the national, regional, and state level. Furthermore, Exhibit 1 provides a conceptual tool for qualitatively evaluating the interrelationships among various parts of the waste system. However, for assessing the needs for regional or waste specific capacity, more detailed information is required than is presented in this report.

The information contained in this report is based on existing EPA surveys and studies as well as in-person interviews with several major hazardous waste generators and treatment and disposal facility operators. Some data are better than others, and not all data are comparable. At the conclusion of several on-going EPA and other studies, more detailed information on hazardous waste generation, treatment, and disposal will be available.

SECTION 1

HAZARDOUS WASTE MANAGED



In 1985, about 275 million metric tons (MMT) of hazardous waste, as the term is currently defined, were managed in RCRA regulated units. In this section, the important issue of hazardous waste definition is addressed. Also included in this section is a breakdown of the sources, locations, and quantities of hazardous waste managed in the RCRA-regulated system.

DEFINITIONS OF HAZARDOUS WASTE

Defining what constitutes a "hazardous waste" requires consideration of both legal and scientific factors. The basic definitions used in this report are derived from: the Resource Conservation and Recovery Act (RCRA) as amended by the Hazardous and Solid Waste Amendments (HSWA), and the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) as amended by the Superfund Amendments and Reauthorization Act (SARA).

- *Hazardous Waste* refers to "...a solid waste, or combination of solid wastes, which because of its quantity, concentration, or physical, chemical, or infectious characteristics may...pose a hazard to human health or the environment..." [RCRA, Section 1004(5)].
- *Solid Waste* means "any garbage, refuse, sludge from a waste treatment plant, water supply treatment plant, or air pollution control facility and other discarded material, including solid, liquid, semisolid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations and from community activities, but does not include solid or dissolved material in domestic sewage..." [RCRA, Section 1004(27)].
- *Hazardous Substance* means "any substances designated in Section 311(b)(2)(A) of the Federal Water Pollution Control Act...any hazardous waste having the characteristics identified in Section 3001 of the Solid Waste Disposal Act...any toxic pollutant listed under Section 307(a) of the Federal Water Pollution Control Act, any hazardous air pollutant listed under Section 112 of the Clean Air Act, and any imminently hazardous chemical substance or mixture...listed in Section 7 of the Toxic Substances Control Act" [CERCLA, Section 101(14)].

Under RCRA, a waste is considered hazardous if it is reactive, ignitable, corrosive or toxic or if the waste is listed as a hazardous waste in Parts 261.31-33 of the Code of Federal Regulations (40CFR). Currently, there are about 400 listed wastes.

In addition to hazardous wastes defined under RCRA, there are "hazardous substances" defined by Superfund. Superfund's definition of a hazardous substance is broad and grows out of the statutory definitions in the Clean Water Act (CWA), the Clean Air Act (CAA), the Toxic Substances Control Act (TSCA), and RCRA. Essentially, Superfund considers a hazardous substance to be any air or water pollutant defined as hazardous in the CAA or the CWA or as a hazardous waste defined in RCRA which exceeds reportable quantity levels. Accordingly, Superfund encompasses numerous wastes and chemical substances:

- 126 "priority pollutants" and 65 "toxic pollutants" (CWA)
- 16 "hazardous air pollutants" and 7 chemicals identified as "criteria pollutants" (CAA)
- 95 chemicals defined as toxic on the basis of production volume, exposure and biological effects (TSCA)
- Substances identified or listed as hazardous waste under §3001 of RCRA
- CERCLA Contract Lab List

Both RCRA and Superfund wastes are discussed in this report. There are, however, other hazardous wastes or toxic substances which are not specifically included. Examples are:

- Wastes from non-point sources (e.g., storm or irrigation run-off)
- Wastes that are exempt from RCRA management, such as wastewaters treated in enclosed tanks and discharged subject to NPDES permits
- Industrial wastewaters discharged to surface waters under NPDES permits or into underground injection systems.
- Agriculture application of pesticides
- PCB wastes that are not contaminated with hazardous waste

Although these wastes are not regulated under RCRA or Superfund, they are covered by other statutory authorities such as the Clean Air Act, the Clean Water Act, the Safe Drinking Water Act, and the Toxic Substances Control Act. The various ways in which these acts interact with RCRA and Superfund are discussed briefly below.

- The **Clean Air Act** (CAA), under Section 112, authorizes EPA to list various hazardous air pollutants. Currently included are asbestos, beryllium, vinyl chloride, benzene, arsenic, radionuclides, mercury, and coke oven emissions. The CAA also sets certain emission standards for many types of air emission sources, including RCRA-regulated incinerators and industrial boilers or furnaces.

- The **Clean Water Act** (CWA) lists 126 priority pollutants to be regulated by effluent limitations over 21 primary industries. The CWA priority pollutants are incorporated into both RCRA and CERCLA. In addition, the CWA regulates discharges from publically owned treatment works (POTWs) to surface waters, and indirect discharges to municipal wastewater treatment systems (through the pretreatment program). Some hazardous wastes which would generally be considered RCRA regulated wastes are covered under the CWA because of the use of treatment tanks and a National Pollutant Discharge Elimination System (NPDES) permit to dispose of the wastewaters.
- The **Safe Drinking Water Act** (SDWA) regulates underground injection systems including deep-well injection systems.
- The **Toxic Substances Control Act** (TSCA) regulates the production and distribution of new chemicals and governs the manufacture, processing, distribution, and use of existing chemicals. Among the chemicals controlled by TSCA regulations are: PCBs, chloroflurocarbons, and asbestos. In specific cases, there is an interface with RCRA regulations. For example, PCB disposal is generally regulated by TSCA. However, hazardous wastes mixed with PCBs are covered under RCRA.

This report focuses primarily on RCRA regulated processes for treating and disposing of hazardous waste (e.g., incineration, impoundments, chemical and biological treatment technologies, and land disposal). The report does not cover various exposure routes of hazardous waste, such as air emissions and discharges to surface waters and POTWs. These are important considerations which may be addressed in subsequent updates of this report.

LARGE QUANTITY GENERATORS

Once a RCRA hazardous waste is generated, it must be managed (i.e., stored, treated or disposed) in accordance with RCRA or CWA requirements. Currently, there are about 3,000 facilities managing 275 MMT of RCRA hazardous waste. Generators also produce over 300 MMT of RCRA exempt waste which is regulated by the CWA.

The overwhelming majority of such hazardous waste is produced by large quantity generators. Large quantity generators are defined as those firms which produce more than 1,000 kilograms of hazardous waste per month. These generators account for 99 percent of the hazardous waste produced and managed under RCRA.

Furthermore, it is possible to look at the industries that produce most of the hazardous waste generated each year. The chemical, petroleum, metals, and transportation industries stand out as major producers of hazardous waste. Exhibit 3 provides information on the number of facilities, the volume of hazardous waste managed, and the nature of waste handled by major industrial categories.

Exhibit 3

Hazardous Waste Managed by Industry

INDUSTRY	NUMBER OF FACILITIES	AMOUNT WASTE MANAGED (MMT)	GENERAL WASTE DESCRIPTION
Chemical	700	218	Contaminated wastewaters, spent solvent residuals, still bottoms, spent catalysts, treatment sludges, and filter cakes.
Fabricated Metals	200	4	Electroplating wastes, sludges contaminated with metals and cyanides, degreasing solvents
Electrical Equipment	240	1	Degreasing solvents
Petroleum Refinery	100	20	Leaded tank bottoms, slop oil emulsion solids, API separator sludge, DAF float.
Primary Metals	150	4	Pickle liquor, sludge with metal contaminates
Transportation Equipment	150	3	Degreasing solvents, metals, sludges
National Security	100	1	All types of wastes
Other	1360	24	All types of wastes
Total	3000	275	

Source: National Screening Survey of Hazardous Waste Treatment, Storage, Disposal and Recycling Facilities, U.S. EPA, Office of Solid Waste, Office of Policy, Planning and Information, 1986.

SMALL QUANTITY GENERATORS

A much smaller amount of waste, about one million tons per year, is generated by small quantity generators. These firms generate between 100–1,000 kilograms of hazardous waste per month. The majority of the 100,000 small quantity generators are automotive repair firms, construction firms, laundromats and dry cleaners, photographic processors, equipment repair shops, laboratories, electroplaters and schools.

Prior to their being regulated in 1984, small quantity generators legally disposed of hazardous waste outside of RCRA regulated facilities. Today, small quantity generators must treat or dispose of their waste in accordance with RCRA's regulations (Subtitle C). Most small quantity generators do not manage their own waste but rely on the services of a commercial facility.

The wastes produced by small quantity generators span the full spectrum of RCRA hazardous wastes. According to EPA's "National Small Quantity Hazardous Waste Generator Survey," over 60 percent of small quantity generator waste is derived from lead acid batteries. The remainder includes acids, solvents, photographic wastes, and dry cleaning residues.

Small quantity generator industries are widely dispersed across the country. Frequently, geographic pockets of small quantity generators representing a collection of industries are concentrated in a few city blocks. While each firm individually generates only a small volume of waste, collectively these firms may constitute "hot spots" of hazardous waste generation. The combined industrial discharge from small firms can potentially upset the chemical or biological treatment processes at publicly owned treatment works (POTWs). While small quantity generators produce only a small volume of waste, their waste is hazardous and must be handled to protect human health and the environment.

GEOGRAPHIC IMPLICATIONS

Next, a look at where hazardous wastes are managed. While most hazardous waste is treated and disposed at the site where it is produced, some hazardous wastes must be transported hundreds of miles to an incinerator or secure landfill. Because waste is shipped interstate, it is important to understand where waste is produced in relation to where it is treated and disposed. For example, some states are net importers of hazardous waste (e.g., Alabama) while other states (e.g., New England states) are net exporters of hazardous waste.

As might be expected, the large majority of hazardous waste is managed in the more highly industrialized areas of the country -- particularly those areas with active chemical and petroleum industries. An approximate geographic breakdown by the number of Treatment, Storage, Disposal and Recycling (TSDR) facilities, and the volumes of waste managed is provided in Exhibit 4.

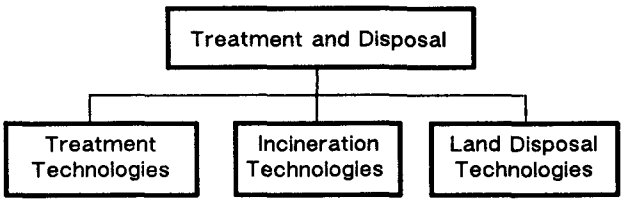
Exhibit 4
Hazardous Waste TSDRs and Waste Volumes by Geographic Sector

GEOGRAPHIC SECTOR	NUMBER OF TSDR FACILITIES	QUANTITY OF RCRA WASTE MANAGED (MMT)
Northeast	830	63
Southeast	440	84
Southwest	390	58
Mid-West	910	64
Rocky Mountains	90	1
Far West	340	5
Total	3,000	275

Source: National Screening Survey, U.S. EPA, Office of Solid Waste, 1986, and EPA's Hazardous Waste Data Management System.

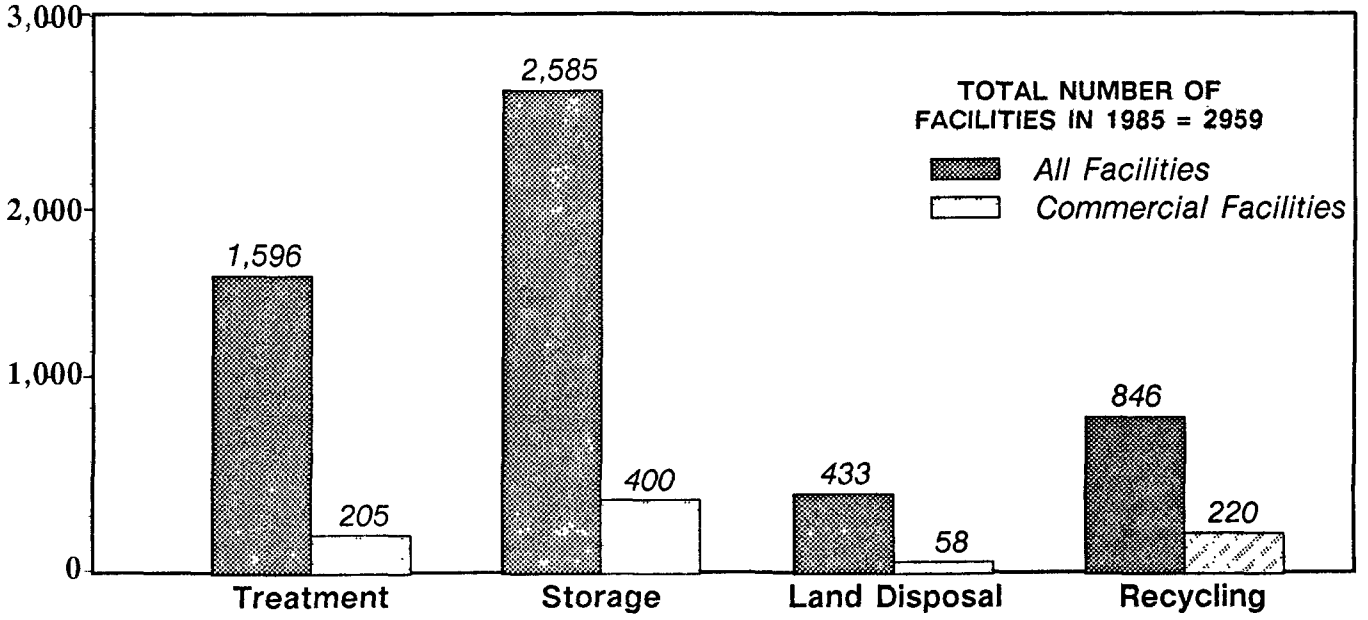
SECTION 2

TREATMENT AND DISPOSAL



The Hazardous Waste System includes about 3,000 facilities that treat, store, or dispose of RCRA hazardous waste (see Exhibit 5). In this section the types of treatment typically used are discussed, with particular emphasis on incineration and land disposal technologies.

Exhibit 5
Number of Active Facilities by Type of Technology



Source: National Screening Survey, U.S. EPA, Office of Solid Waste, 1986.

Note: Some facilities have more than one process.

Because of economic factors and liability concerns, many firms prefer to store, treat, and dispose of hazardous waste on-site. About 96 percent of all RCRA hazardous waste is managed on-site. The remaining waste is taken off-site to commercial facilities, which are in the business of managing other firms' waste. In addition, significant amounts of industrial wastes are exempt from RCRA regulations but covered under the Clean Water Act. These wastes are typically treated and then discharged to surface waters under an NPDES permit. This section is, however, restricted to the treatment and disposal practices used to manage various types of RCRA hazardous waste.

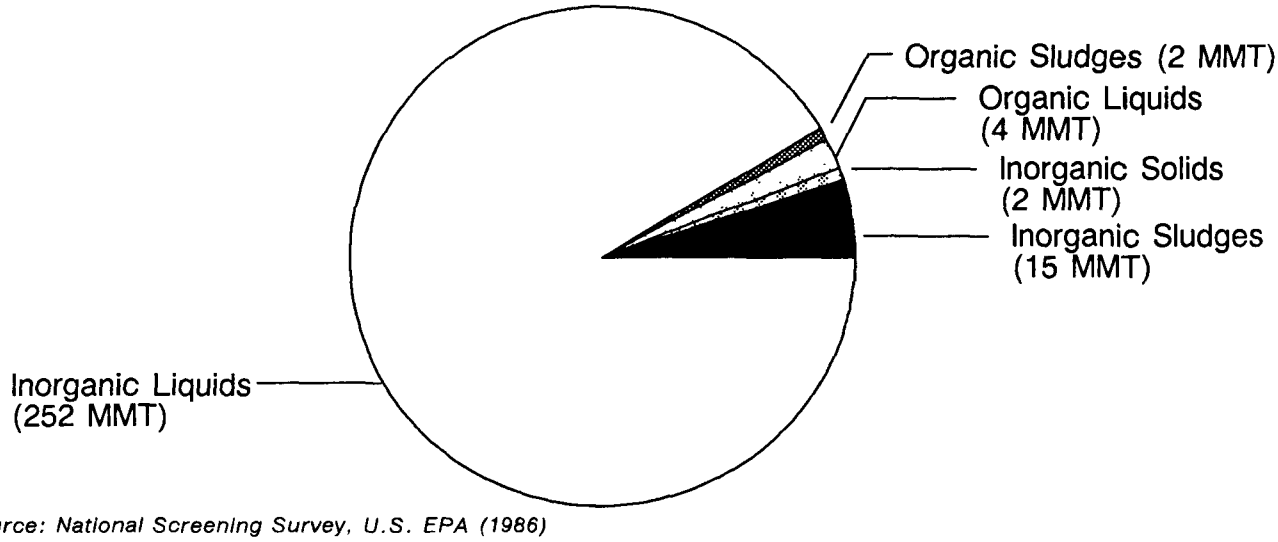
TREATMENT TECHNOLOGIES

In the Hazardous and Solid Waste Amendments of 1984 (HSWA), treatment technologies are favored over disposal of certain wastes. Treatment refers to any process, including neutralization, designed to change the character of hazardous waste in order to render it less hazardous. Typical treatment methods include incineration, biological and chemical wastewater treatment, steam stripping, and solidification.

The vast majority of the 275 MMT of hazardous waste managed annually is treated in impoundments and wastewater treatment plants. A very small amount of waste, about 2 MMT, is presently incinerated. However, the volume of waste incinerated may increase significantly in response to HSWA requirements. Although most treatment processes reduce the volume or toxicity of waste, there is often a residual that must be further treated or disposed. A waste stream may go through more than one treatment process to reduce its toxicity or volume. The most widely used treatment technologies are briefly described below.

- *Incineration* is used to burn primarily liquid organic hazardous waste. In addition, some incinerators are designed to burn solids and sludges as well as liquid wastes. Increasingly, regulatory decisions favor such practices as incineration over land disposal of certain wastes.
- *Biological and Chemical Wastewater Treatment* is the most widely used method of treating aqueous hazardous waste. Wastewaters are rendered less hazardous by biological decomposition, chemical neutralization, or precipitation. Treatment occurs in large settling ponds, covered tanks, or impoundments. Retention time in the treatment units varies from a few hours to several days depending on temperatures and the types of waste streams. A residual sludge is produced in the treatment process which is generally incinerated, treated or land disposed.
- *Steam Stripping* technologies are used in treating aqueous, hazardous wastewaters. Hazardous constituents in the water are converted into gas by means of physical treatment. A non-hazardous gas is then emitted into the air and the hazardous constituents are captured through air pollution control equipment.
- *Solidification* involves mixing a stabilizing agent with hazardous waste to create a solid or impermeable material. The technology requires a large area to combine the stabilizing agent (e.g., Portland cement) with hazardous waste. Solidification is most effectively used on inorganic sludges.

Exhibit 6
Estimate of Physical Characteristics of RCRA Hazardous Wastes



Source: National Screening Survey, U.S. EPA (1986)

An important element in knowing what treatment and disposal practices can be used to manage waste is understanding the physical characteristics of waste. For each type of waste, there are appropriate treatment and disposal technologies. The physical characteristics of the 275 MMT of RCRA hazardous waste managed in 1985 vary from dilute wastewater to metal bearing sludges to PCB contaminated soils. Over 90 percent (by weight) of RCRA hazardous waste is in the form of wastewater. The remaining wastes are organic and inorganic sludges and organic and inorganic solids. Exhibit 6 categorizes hazardous waste by physical characteristics.

As illustrated in Exhibit 7 below, for each type of waste there are one or more appropriate treatment and disposal technologies. The vast majority of hazardous waste is inorganic liquid waste which is generally treated in wastewater treatment plants or treatment impoundments and then discharged to surface waters subject to effluent limitations in NPDES permits. A residual sludge is also produced in the treatment process which is generally treated, stabilized and then land disposed.

Exhibit 7
Treatment Technologies

PHYSICAL CHARACTERISTICS	INCINERATION	WASTEWATER TREATMENT	TREATMENT IMPOUNDMENTS	SOLIDIFICATION	STEAM STRIPPING
Organic Liquids (4 MMT)	●	○	○		
Inorganic Liquids (252 MMT)	○	●	●	○	○
Organic Sludges (2 MMT)	○	○	○	○	
Inorganic Sludges (15 MMT)	○	○	○	●	
Inorganic Solids (2 MMT)	○			○	
● Widely Used ○ Sometimes Used					

Source: EPA, Office of Solid Waste

The volume of incinerated hazardous waste is small and composed mainly of organic liquids and sludges. There is a potential, however, for other types of wastes to require incineration as a result of upcoming regulatory and policy actions. These additional wastes could include more sludges and solids.

Because of the strong interest in the incineration of additional wastes and the restriction on land disposal of certain chemicals, these two technologies are discussed in more detail in the remainder of this section.

INCINERATION TECHNOLOGIES

This section focuses on the growing importance of incineration in treating wastes and the types of incinerators operating today. Incinerable wastes range from highly concentrated, organic liquids to sludges and low concentration, but hazardous, solid wastes. However, wastes with low levels of metals and high organic content burn most efficiently. Incineration will be used for a specific waste if it is the most efficient and economically feasible treatment technology.

Exhibit 6, Estimate of Physical Characteristics of RCRA Hazardous Wastes, serves as a guide for identifying general categories of waste suitable for incineration. Incinerable wastes include the following.

- Organic Sludges 2 MMT
- Organic Liquids 4 MMT
- Inorganic Sludges, Liquids, and Solids Unknown

The above wastes are burned in incinerators specifically designed and permitted to destroy a limited range of wastes. Organic liquid waste, for example, can be burned in liquid injection incinerators, rotary kilns, cement kilns, or used as fuel for industrial boilers and furnaces. Exhibit 8 shows the four major types of incinerators, the number of incinerators in each category and the kinds of waste capable of being incinerated by a specific incinerator design category.

Exhibit 8
Incinerator Types and Incinerable Waste Descriptions

INCINERATOR DESIGN	ESTIMATED NUMBER OF UNITS	WASTE DESCRIPTIONS
Rotary Kiln	40	Liquid sludges, solids, drummed wastes
Liquid Injection	95	Pumpable hazardous wastes, no solids
Fume	25	Liquids
Open Hearth	30	Liquids, sludges, and some solids
Total	190	

Source: EPA, Office of Solid Waste

Most of the RCRA hazardous waste incinerators operating today are located on-site. There are over 175 on-site incinerators that burn 1.7 MMT of hazardous waste. In contrast, the commercial sector has 14 incinerators and burns 0.4 MMT of hazardous waste each year. These units are required to meet air emission and performance standards. An incinerator permit restricts the type of wastes that can be burned in a specific unit. See Appendix A for a list of commercial incinerators.

It appears that commercial incinerators are operating at or near capacity. In response to the potential increase in demand to burn solids and sludges caused by Superfund cleanups and RCRA corrective action, industry is looking into the siting of new incinerators and the expansion of existing incinerator capacity. Section 4 of this report examines incineration capacity in more detail.

LAND DISPOSAL TECHNOLOGIES

Having discussed the major forms of treatment technologies for hazardous waste, let's now turn to land disposal technologies. Historically, many hazardous wastes were land disposed because landfilling was an economical and available means to dispose of wastes. When the land disposal restrictions imposed by HSWA become effective, the land disposal of certain wastes will be prohibited. Only wastes that meet specific standards or are treated to meet these standards will be allowed to be disposed on the land.

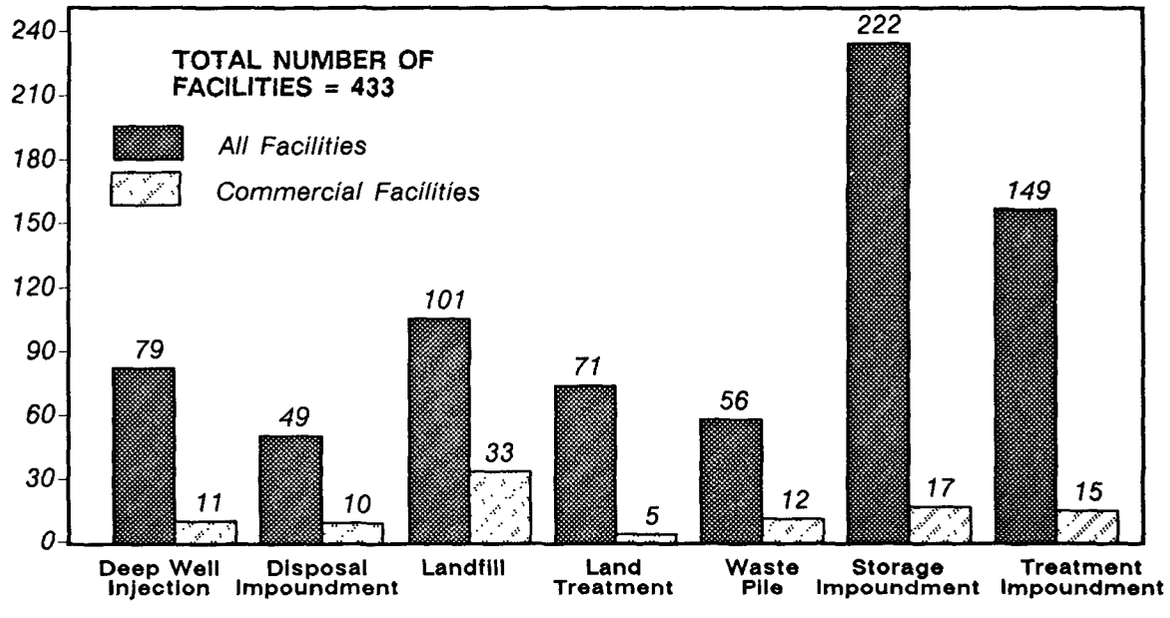
A small percentage of the 275 MMT of hazardous waste generated each year is land disposed in landfills, land farms, or disposal surface impoundments. Land disposal is the depositing or injecting of solid or hazardous wastes on or into the land. Currently, there are about 430 operating land disposal facilities. The various kinds of land disposal facilities are briefly described below:

- *Landfills* are generally below ground, rectangular pits. A permitted hazardous waste landfill must be lined with synthetic materials and have a leachate collection system to prevent groundwater contamination. Most residuals generated in treatment processes, such as incinerator ash or impoundment sludge, are ultimately landfilled. Landfills range in size from a few acres to hundreds of acres. Currently there are about 100 hazardous waste landfills in the country, 33 of which are commercial landfills.
- *Land treatment* involves spreading hazardous waste on the land or placing waste in a shallow pit and using biological decomposition to treat the waste. Land treatment, particularly the form of treatment referred to as land farming, is most often used to dispose organic solids and sludges, such as the waste by-products of the petroleum industry.
- *Deep-Well Injection Systems* are primarily used to dispose of aqueous hazardous waste. Approximately 20-35 MMT of dilute, hazardous waste is disposed annually into deep-well injection systems. This represents about 10 percent (by weight) of all RCRA hazardous waste managed in the country.
- *Surface Impoundments* vary in size from a few hundred square feet to hundreds of acres. They are currently used to treat, store, and dispose of large quantities of aqueous wastes. As much as 100 MMT of RCRA hazardous waste may be treated and disposed of in impoundments. This practice handles a large amount of the wastes currently managed under RCRA.

As shown in Exhibit 9, most land disposal facilities are impoundments located on-site at the plant. In comparison, about 60 commercial facilities have land disposal units and manage 5 MMT of hazardous waste. These units include: landfills, impoundments, land treatment, and waste piles. A list of the commercial land disposal units is provided in Appendix B.

The nature of the wastes managed at commercial facilities may be vastly different from that of on-site wastes. Representatives from the commercial waste management industry indicate that they are now receiving more concentrated wastes than in the past. This is because firms are reusing waste and sending less aqueous waste off-site. This trend is likely to continue in the future as firms minimize the volume of waste they generate.

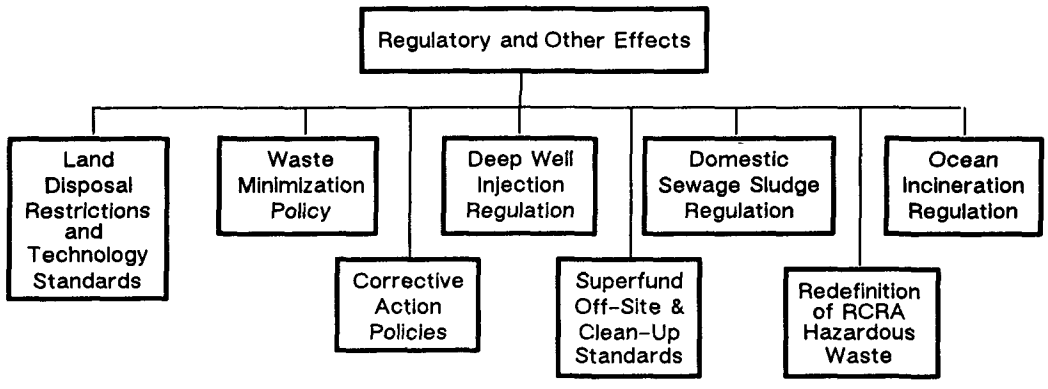
Exhibit 9
Number of Land Disposal Facilities by Type of Process



Note: Some facilities have more than one process.
Source: National Screening Survey, U.S. EPA, Office of Solid Waste (1986).

SECTION 3

REGULATORY AND OTHER EFFECTS



There are a number of on-going regulatory and other activities which will substantially affect the hazardous waste system in the country. Many of these were mandated by the 1984 Hazardous and Solid Waste Amendments (HSWA). Another key factor, of course, is the Superfund cleanups being conducted under the Superfund program.

These regulatory and other activities are in very different stages of development and their potential impacts, therefore, can only be estimated. This section attempts to outline the issues expected to be presented by these activities in order to provide a framework for future planning.

LAND DISPOSAL RESTRICTIONS AND TECHNOLOGY STANDARDS

Since 1984, the number of operating land disposal facilities has decreased from 1500 to less than 500 today. Under the Hazardous and Solid Waste Amendments firms were required to meet certain financial tests, comply with groundwater monitoring and minimum technology standards. Many facilities chose to close rather than meet the above standards. It is believed that many of these facilities were at or near capacity and many others were small units. Consequently, the closing of these facilities is unlikely to significantly decrease land disposal capacity. In 1985, EPA estimated that commercial landfills had about 10-15 years of useful life remaining.

The Hazardous and Solid Waste Amendments prohibit the land disposal of certain hazardous wastes unless the wastes are treated or it can be demonstrated that there will be "no migration as long as the waste remains hazardous." Also prohibited from land disposal are bulk or non-containerized liquid hazardous wastes, certain dioxin-containing hazardous wastes, and some solvent wastes. By 1990, EPA will publish regulations implementing land disposal restrictions for all RCRA wastes. Land disposal of wastes will be prohibited unless the Agency specifies methods that are protective as long as the waste remains hazardous.

Chemicals	Effective Date of Ban
Solvents	November 8, 1986
California List	July 8, 1987
First 1/3	August 8, 1988
Second 1/3	June 8, 1989
Third 1/3	July 8, 1990

On November 7, 1986, EPA promulgated its first regulations implementing the Land Disposal Restrictions for solvent and dioxin bearing wastes. The Agency found there was insufficient capacity nationwide to treat dioxin and solvent contaminated soils and dilute wastewaters contaminated with solvents. Consequently, extensions were granted for these wastes. However, sufficient capacity was found to treat liquid solvent wastes. An exclusion was not granted for these wastes.

HSWA's minimum technology standards also require improving the ways existing and new landfills and surface impoundments are constructed. These standards include: installing two or more liners, a leachate collection system, and a groundwater monitoring system.

As a result of HSWA's requirements, it appears that many surface impoundments may close rather that retrofit existing impoundments. About 100 MMT of hazardous wastewater is managed in surface impoundments. Much of these wastes may shift to treatment tanks. The sludge from the treatment tanks would be subject to RCRA if it is listed as a hazardous waste or exhibits a characteristic. The wastewater treatment tanks would be exempt from RCRA regulations if the treated wastewater were discharged under NPDES permits into surface waters or under the National Pretreatment Program to publicly owned treatment works (POTWs). In either case, the discharge would be subject to the Clean Water Act. These new discharges could have a significant permitting impact on the Clean Water Act permitting and pretreatment programs.

Sludges resulting from the above treatment tanks, and subject to RCRA, would be subject to the HSWA land disposal restrictions. Such sludges could require incineration or other treatment. Currently, there are 14 commercial incinerator facilities, over 175 on-site incinerators, and about 30 new incinerators under consideration.

WASTE MINIMIZATION POLICY

EPA strongly favors preventing the generation of waste rather than controlling waste after it is generated. It is a national policy that the generation of hazardous waste be reduced as expeditiously as possible.

Within the private sector, strong incentives already exist to promote waste minimization. These incentives include:

- Large increases in the price of treating and disposing of hazardous wastes
- Difficulties in siting and permitting new hazardous waste units
- Concern with liability associated with managing hazardous waste
- Public pressure on industry to reduce waste generation

According to a recent EPA study, "Waste Minimization Issues and Options", a 20-30 percent reduction in waste volume may be possible through process changes, product substitution, and "good housekeeping" practices. Many firms have already and are continuing to reduce the amount of hazardous waste produced through a variety of waste minimization techniques including:

- Source Reduction
- Waste Separation and Concentration
- Waste Exchange
- Reuse and Recycling Waste

At present, there are three statutory requirements relating to waste minimization, all of them enacted in the 1984 Hazardous and Solid Waste Amendments. The requirements are summarized below.

- Generators must certify on their manifests that they have a program in place to reduce the volume and toxicity of waste (Section 3002(b)).
- Any new treatment, storage or disposal permit must include a waste minimization certification statement (Section 3005(h)).
- As part of the generator's biennial report, generators must describe the efforts undertaken during the year to reduce the volume and toxicity of waste generated (Section 3002(a)(b)) and document actual reduction achieved.

EPA's waste minimization program has two main objectives. First, to foster the use of waste minimization through technology and information dissemination, and second, to report to Congress by 1990 on the need for regulations on waste minimization.

In conclusion, concern over economic and liability issues are driving generators to reduce the volume and toxicity of hazardous waste produced. Waste minimization can alleviate the capacity problem by reducing the volume of waste requiring treatment and disposal.

DEEP-WELL INJECTION REGULATION

Over 300 MMT of aqueous waste are deep-well injected each year. About 20 to 35 MMT of this waste could be RCRA hazardous wastes.

The majority of deep-wells are located on-site and wastes are disposed of at the plant where they are generated. A small number of commercial firms operate deep-well systems (refer to Appendix C for a list of deep-well injection systems). Most deep-well systems are concentrated along the Gulf Coast of Texas and Louisiana, and in Illinois, Ohio, and Indiana.

The Hazardous and Solid Waste Amendments (HSWA) require that EPA determine by August 8, 1988 whether to further restrict hazardous wastes from deep-well injection. If deep-well injection were prohibited, most of these wastes would probably be redirected to surface waters. Firms could obtain or modify their National Pollutant Discharge Elimination System (NPDES) permit in order to discharge treated wastes from a wastewater treatment plant to surface waters. Some of these wastes may also be sent to publicly owned treatment works (POTWs) and then discharged into surface waters. It is likely that most firms would continue to treat their waste on-site rather than ship large volumes of dilute, aqueous waste to a commercial facility.

The Agency is presently collecting information on the volumes and types of waste disposed of through deep-well injection. It is important to know the amount of waste disposed and where waste will shift if this form of disposal is restricted. Those firms which currently use on-site, deep-well injection systems probably would need to construct wastewater treatment plants to treat their waste.

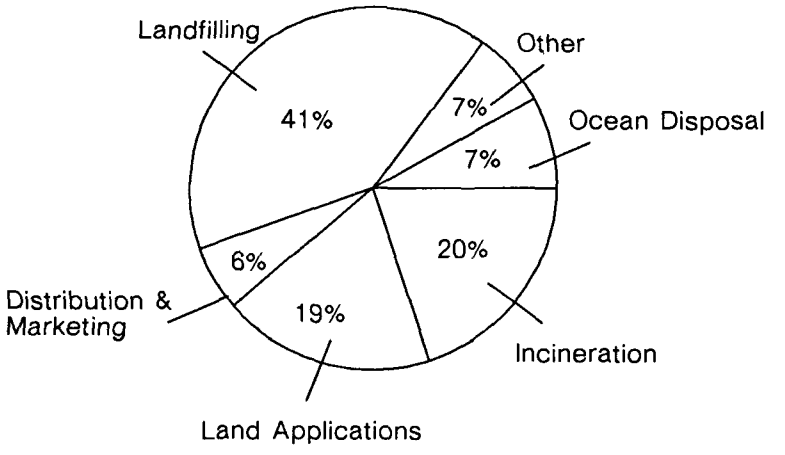
In summary, large volumes of RCRA hazardous and non-hazardous wastewaters are currently discharged into deep-well injection systems. Making deep-well injection regulations more stringent will affect biological and chemical treatment capacity. There is likely to be minimal impact on incineration capacity because it is usually not economically feasible to incinerate dilute, aqueous wastes.

DOMESTIC SEWAGE SLUDGE REGULATION

The Clean Water Act requires municipalities to treat wastewater before discharging it to surface waters. In 1984, approximately 32 billion metric tons of municipal wastewater was discharged to publicly owned treatment works (POTWs). The treatment process generates a sludge which must be used or disposed of.

The quantity of municipal sludge produced annually has almost doubled since 1972. Municipalities now generate about 7.6 million dry metric tons of wastewater sludge a year, the majority of which is landfilled and used for land application. Exhibit 10 illustrates the proportions of sludge managed by type of practice.

Exhibit 10
Distribution of Municipal Sludge by Management Practice



Municipal sludge production is expected to double to 12 million dry metric tons by the year 2000 as the population increases, as more municipalities comply with Clean Water Act requirements, and as more sophisticated wastewater treatment systems are installed.

EPA's technical regulations for reuse and disposal of sewage sludge will set concentration limits for a variety of metals and organics found in municipal sludge. These limits will vary by management practice.

RCRA contains an exclusion for hazardous wastes which are mixed with domestic sewage. The exclusion allows industries connected to POTWs to discharge hazardous wastes to sewers containing domestic sewage without having to comply with RCRA manifest or reporting requirements. These industrial wastewaters would be regulated under the Clean Water Act's pretreatment program. Furthermore, RCRA hazardous wastes brought to wastewater treatment plants directly through a non-domestic sewage pipeline or by rail or truck is not covered by the exclusion and must meet RCRA manifest and reporting requirements. EPA is scheduled to propose regulations on domestic sewage sludge by September 1987.

EPA is developing information on the volume of RCRA hazardous waste being discharged to sewers. When the pretreatment program is implemented fully, the wastewaters discharged into sewers will be cleaner, resulting in a potential increase in industrial sludge that may require additional treatment and disposal.

A major environmental issue involves the application of the Toxicity Concentration Leaching Procedure (TCLP) test to domestic sludges. If the sludges fail the TCLP test, they would be managed as a RCRA hazardous waste. It is uncertain whether most domestic sludges will pass or fail the test. If most municipal sludges fail, large volumes of waste could be brought into the RCRA system.

OCEAN INCINERATION REGULATION

EPA has proposed regulations that would allow certain hazardous wastes to be burned at sea. By October 1987, EPA is scheduled to issue final regulations on designating sites for burning hazardous waste at sea. Final regulations on ocean incineration will be promulgated in late 1988. These ocean incineration regulations will apply exclusively to liquid organic wastes and exclude solid wastes.

About 4 MMT of liquid organic hazardous wastes are managed annually. Approximately 1.7 MMT of these wastes is burned in on-site hazardous waste incinerators and 0.4 MMT is incinerated at commercial hazardous wastes facilities. The remainder is recycled or used as fuel. Demand for hazardous waste incineration capacity could change based on the following circumstances.

- The land disposal restrictions may divert liquid incinerable wastes currently land disposed to incineration.
- A small amount of wastes presently burned in boilers could shift to incineration.
- The Deep-Well Injection regulations now being developed could shift some concentrated wastes currently deep-well injected to incineration.
- Increased Superfund and RCRA cleanup activities could increase the volume of hazardous wastes that require incineration. Most of these wastes are likely to be contaminated soils and sludges. It is difficult to estimate the extent to which the RCRA corrective action program and Superfund's selection of remedy policy will change the demand for incineration capacity.

The extent to which ocean incineration is used will depend upon need, cost and risk considerations. The availability and cost of land based incineration units will affect demand for ocean incineration. Other major factors affecting ocean incineration are the ability to designate sites, to obtain permits for portside support facilities, and to permit ocean incinerator ships. Additionally, the cost of transporting and incinerating wastes in land based versus ocean incinerators would affect utilization rates for each technology. Finally, managing risk to satisfy the public is an issue which affects both land and sea incineration of hazardous wastes.

CORRECTIVE ACTION POLICIES

Corrective action involves cleaning up soils, sludges and groundwater contaminated with hazardous wastes at hundreds of RCRA facilities. Corrective actions may be required where hazardous waste releases have occurred at hazardous waste treatment, storage, and disposal facilities (TSDs) and solid waste management units (SWMUs). Early estimates suggest there are about 7 SWMUs per TSD facility. Corrective action may be required at many of these facilities.

Leaking underground storage tanks represent another potentially large universe for corrective action projects. There are approximately one million underground storage tanks, approximately 5-20 percent may be leaking.

The volume of waste that will be generated from corrective action projects could be large. Although most waste probably will be treated on-site, some concentrated wastes may require off-site treatment. These wastes will likely compete for existing commercial treatment and land disposal capacity.

SUPERFUND OFF-SITE POLICY AND CLEAN-UP STANDARDS

The Superfund Amendments and Reauthorization Act (SARA) establishes standards for Superfund clean-up actions and also stipulates the conditions for disposing of Superfund wastes off-site. These provisions could change the proportions of hazardous waste managed on-site and off-site.

The new clean-up standards provided for in SARA require that Superfund remedies must be protective of human health and the environment, cost-effective, and utilize permanent solutions, alternative treatment technologies and resource recovery to the maximum extent practicable. The on-site remedies must also meet applicable or relevant and appropriate regulations (ARARs) of other federal statutes including: RCRA, TSCA, SDWA, CAA, and CWA. And, where state standards are more stringent than federal standards, state standards must be met. For wastes remaining on-site, the remedial actions are reviewed every 5 years.

The new clean-up standards are expected to increase the use of mobile treatment units and stabilization techniques to manage waste on-site. However, some concentrated hazardous wastes will likely require off-site treatment and disposal. This could increase the demand for commercial capacity.

The off-site disposal provision in SARA restricts disposal of Superfund wastes to those facilities in compliance with RCRA and TSCA and applicable state requirements. Specifically, the unit receiving Superfund wastes must not be releasing any hazardous wastes and releases from other units at the facility must be controlled by a corrective action program. Several Superfund sites have experienced difficulties locating a commercial facility eligible to accept their waste.

Currently, 4 percent of all hazardous waste is managed off-site by commercial facilities. The amount of waste taken off-site could increase substantially in the near-term. This increase is partially attributed to the new clean-up standards and the off-site disposal provision of SARA. This could stress the nation's commercial capacity to handle Superfund contaminated soils and sludges.

REDEFINITION OF RCRA HAZARDOUS WASTE

EPA is considering whether to revise the current defintion of "hazardous" waste. Presently, a waste is defined as hazardous under RCRA if it possesses certain characteristics or is listed in Subpart D , Part 261 of the Code of Federal Regulations (40 CFR). About half of RCRA hazardous waste possesses one of four characteristic attributes: reactivity, ignitability, corrosivity, or EP toxicity. The other half of the wastes are "listed" hazardous wastes. There are now over 400 listed hazardous wastes.

Approximately 275 MMT of RCRA hazardous waste are generated by 40,000 to 60,000 large quantity generators and about 100,000 small quantity generators. Changing the criteria for defining a hazardous waste could significantly affect the volume of waste currently regulated by RCRA as well as the size of the regulated community.

During the next 12 to 14 months, EPA plans to make a series of decisions relative to how wastes are currently defined as hazardous. Issues being considered include using such criteria as waste concentration and management practices in potential new definitions of hazardous wastes.

Each of the above regulatory and policy decisions has the potential to shift waste from one medium to another or one location to another. The various impacts of the regulation discussed in this section are summarized in Exhibit 11.

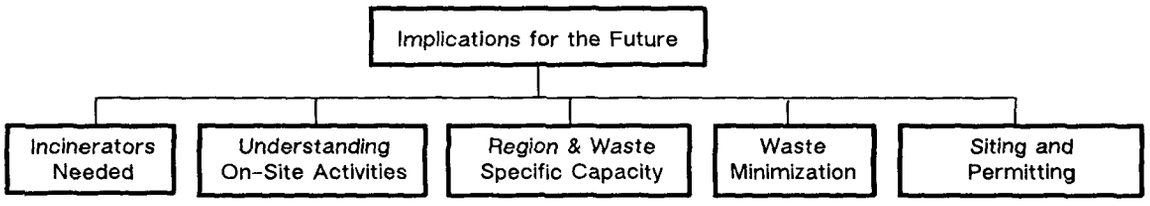
Exhibit 11

Regulations and Policies and Their Potential Effects on Capacity

REGULATION OR POLICY	WASTE TRANSFER DESCRIPTION	AMOUNT OF WASTE	CAPACITY OUTLOOK
Land Disposal Restrictions and Technology Standards	• Shift organic liquids and sludges to incineration. • Solidify inorganic sludges prior to land disposal. • Redirect wastewaters from surface impoundments to treatment tanks and surface waters. Treat and dispose of residual sludge under RCRA.	Moderate Moderate Unknown but potentially large	Constrained Available for short-term May be constrained in short-term
Waste Minimization Policy	• Likely to result in concentration of hazardous wastes prior to treatment and disposal.	Reduce volume 25-35%	Increase the longevity of land disposal units. May increase demand for treatment capacity
Deep-Well Injection Regulation	• Potentially restrict disposal of RCRA hazardous, aqueous wastes from deep-wells; shift wastes to POTWs and industrial wastewater treament plants.	Moderate to Large	Constrained
Domestic Sewage Sludge Regulation	• Large volumes of non-hazardous, municipal sludge are produced annually. RCRA contains an exclusion for hazardous wastes mixed with domestic sewage.	Unknown but may be potentially significant	Sludge currently landfilled, used for land application or incinerated.
Ocean Incineration Regulation	• Permit certain wastes to shift from land based incinerators and industrial boilers and furnaces to incinerator ships.	Small	Constrained for short-term
Corrective Action Policies	• UST and SARA may result in some wastes transferred off-site to RCRA commercial facilities. • Increase the volume of solids and sludges requiring treatment and disposal.	Moderate to significant	Incineration capacity is limited in the short-term. Could improve in long-term given successful siting programs. Land disposal capacity may be constrained in long-term unless successful siting occurs.
Superfund Off-Site Policy and Clean-Up Standards	• Encourages on-site treatment and disposal of Superfund waste. Will minimize the volume of untreated waste transferred to commercial facilities.	Moderate	Could be increased through use of innovative, mobile treatment technology.
Redefinition of RCRA Hazardous Waste	• Potentially change the amount of waste defined as hazardous. It is unknown if specific categories of waste would increase more than others or the impact on particular waste management practices.	Unknown but may be potentially significant	Capacity constrained already for particular wastes such as some solvents and dioxins.

SECTION 4

IMPLICATIONS FOR THE FUTURE



The regulatory actions discussed in the previous section will significantly influence the ways waste is managed in the future. It is difficult to predict the exact interaction among future regulatory actions, generators' response to regulations, and the commercial hazardous waste industry reaction. However, several preliminary conclusions emerge from information provided earlier in this report. These conclusions are:

- More incinerators will likely be needed
- A better understanding of on-site activities is required
- Capacity is generally a regional and waste specific issue
- Waste minimization programs should be strongly encouraged
- Siting new facilities and expanding capacity at existing facilities is a priority

The following provides a brief summary and the rationale supporting each of these conclusions.

MORE INCINERATORS NEEDED

Incineration capacity is already limited for specific types of RCRA hazardous wastes. In addition, some states and regions have inadequate incineration capacity to handle their wastes and must ship waste out of state. Best available data suggest that existing incineration capacity would have been exhausted if an extension had not been granted for solvent wastes when the land ban rule was promulgated in November 1986. While there is adequate national capacity to burn most hazardous wastes, the addition of solvents to the incineration market would have stressed existing capacity.

More incinerators are particularly needed that can burn solids and sludges contaminated by hazardous wastes. More solids and sludges will be added to the hazardous waste system as a result of RCRA corrective actions and Superfund response actions. This will increase the need for incinerators.

According to a recent EPA study, the majority of incinerators are liquid injection incinerators that are operating at about 55 percent capacity. There are about 40 rotary kilns running at approximately 77 percent capacity. As the need to burn solids and sludges increases, the demand for additional rotary kiln capacity will also increase. Recognizing an emerging new demand, several firms are considering building new incinerators. However, the siting and permitting of incinerators are difficult and time consuming. It is not uncommon to take 3 to 5 years to site, permit, and construct an incinerator. This means that significant new capacity is unlikely in the near term.

Because incinerators are designed to burn specific types of waste, EPA is assessing incineration capacity on a waste specific basis (e.g., solvents, PCB, etc.). EPA recently granted a two-year extension for dilute solvent wastes disposed of on the land based on data which indicated that there was insufficient capacity to burn these solvents as well as other wastes currently being incinerated. With respect to PCBs, there are 7 commercial incinerators permitted to burn PCB wastes. (Refer to Appendix A.) The incinerators are located in Deer Park, Texas; Chicago, Illinois; Coffeyville, Kansas; Pittsfield, Massachusetts and El Dorado, Arkansas. Because firms are no longer generating PCB wastes, liquid PCB waste is likely to decrease in the next 2-5 years. On the other hand, more PCB contaminated soils and sludges from RCRA corrective action, Superfund cleanup action, and the PCB phase down requirements are likely to continue demand for PCB incineration. According to EPA's Office of Toxic Substances, demand for PCB treatment and disposal will likely peak between 1987 and 1991. By October 1988, about 1.7 million PCB capacitors will be phased out and 40,000 PCB transformers by October 1990. EPA is currently assessing the capacity to handle the California listed wastes and the first third of the listed wastes for the land disposal ban.

MORE INFORMATION ABOUT ON-SITE ACTIVITIES

Since 96 percent of all RCRA hazardous waste is managed on-site EPA intends to focus on developing a better understanding of on-site activities. Furthermore, due to increased concern about liability and escalating costs of commercial waste disposal, on-site waste management is likely to continue at or near current levels.

Anticipating changes in on-site waste management practices is vital. One area to watch in the near future is what will happen to on-site facilities when surface impoundments are required to meet minimum technology requirements (i.e., liners, leachate collection systems and monitoring systems) and when land disposal restrictions take effect. Will facilities close their surface impoundments, change to treatment tanks, and use an NPDES permit to discharge hazardous wastewaters to surface waters? If so, these would no longer be regulated under RCRA but would be subject to Clean Water Act regulations. This would significantly decrease the volume of RCRA-regulated waste. However, the decrease will represent an "accounting" change rather than a reduction in the amount of waste generated.

Learning more about on-site management is also important for several other reasons. Not only are volumes significantly larger for on-site facilities, but the types of waste managed at on-site facilities generally are different from those managed by commercials. On-site facilities, with the exception of those in the chemical industry, generally handle a smaller range of hazardous wastes. Commercial facilities, on the other hand, handle very dilute to highly concentrated forms of wastes. Also, commercial facilities could probably not absorb large shifts in incineration demand if on-site facilities decided to ship wastes off-site.

REGIONAL AND WASTE SPECIFIC CAPACITY

Numerous examples exist to support the conclusion that regional and waste specific capacity is already a problem. In some states, there are no commercial hazardous waste incinerators or landfills in operation. In these cases, waste must be transported to other states for treatment and disposal. Some firms already transport hazardous waste hundreds of miles for ultimate treatment and disposal. The regional capacity issue has become particularly important due to the new Superfund requirement that requires states to certify long term capacity to manage hazardous waste.

A few states are actively working to site treatment or disposal units to handle hazardous waste. In certifying 20 years of capacity to manage hazardous waste in order to comply with SARA, some states may consider state or state/private arrangements for operating waste management facilities. Potential capacity problem areas are noted in Exhibit 12.

Exhibit 12
Potential Capacity Problem Areas

CAPACITY PROBLEM AREAS	LIKELY CAPACITY PROBLEM AREAS	UNLIKELY TO BE PROBLEM AREAS FOR CAPACITY
Incineration • Limited excess capacity currently exists commercially for certain liquid organic wastes. On-site capacity is uncertain. • Siting and permitting delays slow capacity expansion. • More sludges and solids could be brought into hazardous waste system (e.g., RCRA and Superfund corrective action), some of which will be incinerated • Capacity inadequate for dioxin and solvent contaminated soils. Capacity problem exists.	**Wastewater Treatment in Tanks or Double Lined Surface Impoundments** • Large volumes of RCRA hazardous waste are currently treated and disposed of in surface impoundments. • Some shift from surface impoundments to tanks could occur (exempt from RCRA, but regulated under the Clean Water Act). • Potential increase in demand for tank treatment. • Solvent wastes scheduled for bans have been granted (if they would require tank treatment) a variance (2 years) from ban. Capacity problem will occur if conversion to tanks or retrofit does not take place.	**Solidification** • Many inorganic solids and sludges are potential candidates for solidification. Limiting factor is availability of landfills. • Set up time and costs are low to stabilize wastes. • Technology is not a limiting factor. • Some waste may need to be stabilized in tanks. Capacity should be available. **Recycling, Reuse, Fuel Distillation** • Most wastes currently going to land disposal would not require these technologies. More likely the wastes would require incineration in a hazardous waste incinerator. • Major permit modifications are not necessary (RCRA exempt processes). • Use of these alternatives may be reduced by regulations on waste minimization, fuel specifications, air emissions. Capacity should not be a problem.

Note:

The reader should note that this chart focuses on national, physical capacity. However, economic, transportation, regulatory and legal considerations may constrain the practical availability of capacity. Moreover, regional and state capacity problems may exist.

Based on information currently available, the number and capacity of land disposal facilities was estimated and is provided in Exhibit 13.

Exhibit 13
Land Disposal Facilities by Number, Volume, and Available Capacity

RCRA Hazardous Waste Land Disposal Facilities	Number of Facilities	Volume of Waste Land Disposed 1985	Available Capacity
On-Site Land Disposal	375	8 MMT	unknown
Commercial Land Disposal	60	5 MMT	10–15 years

Source: National Screening Survey, U.S. EPA (1986) and Survey of Selected Firms in the Commercial Hazardous Waste Industry, U.S. EPA (1986).

Assuming current fill rates, it is estimated that 10–15 years of commercial land disposal capacity exists. The life expectancy of on-site land disposal is speculative. However, a number of complex factors could significantly change land disposal capacity in the future:

- The land disposal restrictions will prohibit the disposal of certain wastes. This could extend the useful life of some landfills.
- Waste minimization could potentially reduce the volume of waste generated by 20 to 30 percent. This should result in a small decrease in the volume of waste disposed.
- Stabilization will be used to treat some inorganic solids and sludges prior to land disposal. This involves mixing hazardous waste with a solidifying agent, such as Portland cement. Stabilization could increase the volume of waste by 20–100 percent. This will cause landfill space to be used up at a faster rate.
- Wastes and contaminated soils from Superfund sites, RCRA Corrective Action, and Leaking Underground Storage Tank cleanups may increase the volume of waste requiring land disposal.
- Possible changes in the criteria for listing RCRA waste may change the volume defined as hazardous. The result could change the amount of wastes ultimately managed under RCRA.

Although the Hazardous and Solid Waste Amendments favor treatment over land disposal of waste, landfills will be needed long into the future. Land disposal units will continue to be the ultimate destination for the residuals of various other treatment processes (e.g., incinerator ash, scrubber sludge, etc.).

WASTE MINIMIZATION

In the last few years, the costs of treating and disposing of hazardous wastes have increased significantly. Rising costs and concerns over the liability of managing hazardous wastes have driven firms to look seriously at ways to minimize the amount of wastes they produce. According to a recent study conducted by EPA, it may be possible to achieve a 20 to 30 percent reduction in waste through process changes, product substitution, recycling, and "good housekeeping" practices.

Most importantly, many firms and a number of states are implementing aggressive waste minimization programs. EPA strongly supports and encourages such programs.

SITING AND PERMITTING ISSUES

More effective siting and permitting are among the most important solutions to the capacity problem. Technologies exist to treat and dispose of wastes, but siting and permitting facilities employing these technologies are difficult.

It will be important for federal, state, and local regulators to address these issues. EPA has a number of initiatives underway, including potential state-wide permitting for mobile waste treatment units. Streamlining of the permit modification process is another issue which EPA is addressing. In addition, EPA and the states are working diligently to meet the Hazardous and Solid Waste Amendments (HSWA) permitting deadlines for existing land disposal, incinerator, and storage and treatment facilities.

Finally, with the Superfund Amendments and Reauthorization Act of 1986 (SARA) provision that states certify 20 years of capacity to manage hazardous waste, states will need to focus on alternative treatment technologies and innovative approaches to siting new facilities.

APPENDIX A

Operating Commercial Incinerator Facilities

OWNER	LOCATION	TYPE OF UNIT	TYPE OF WASTES
Environmental Systems Company	El Dorado Arkansas	Rotary Kiln	PCB, Acids, Halogenated & Non-Halogenated Solvents, Halogenated & Non-Halogenated Organics
International Technology Corporation	Martinez California	Liquid Injection	Acids, Non-Halogenated Solvents & Organics, Metallic Inorganics
Chemical Waste Management Inc.	Sauget Illinois	Liquid Injection & Fixed Hearth	Halogenated & Non-Halogenated Solvents, Halogenated & Non-Halogenated Organics
Chemical Services, Inc.	Chicago Illinois	Liquid Injection & Rotary Kiln	PCB, Halogenated & Non-Halogenated Solvents, Halogenated & Non-Halogenated Organics, Non-Metallic Inorganics
LWD, Inc.	Calvert City Kentucky	Liquid Injection	Acids, Halogenated & Non-Halogenated Solvents, Halogenated & Non-Halogenated Organics, Metallic Organics
LWD, Inc.	Clay Kentucky	Rotary Kiln	Acids, Halogenated & Non-Halogenated Solvents, Halogenated & Non-Halogenated Organics, Metallic Organics
Rollins Environmental Services	Baton Rouge Louisiana	Liquid Injection & Rotary Kiln	Acids, Halogenated & Non-Halogenated Solvents, Halogenated & Non-Halogenated Organics, Metallic Organics, Metallic and Non-Metallic Inorganics
Rollins Environmental Services	Bridgeport New Jersey	Liquid Injection & Rotary Kiln	Acids, Halogenated & Non-Halogenated Solvents, Halogenated & Non-Halogenated Organics, Metallic Organics, Metallic and Non-Metallic Inorganics
Rollins Environmental Services	Deer Park Texas	Liquid Incineration & Rotary Kiln	PCB, Acids, Halogenated & Non-Halogenated Solvents, Halogenated & Non-Halogenated Organics, Metallic Organics, Metallic and Non-Metallic Inorganics
Caldwell Systems, Inc.	Lenoir North Carolina	Liquid Injection & Solid Incineration	Halogenated & Non-Halogenated Solvents, Halogenated & Non-Halogenated Organics, Metallic & Non-Metallic Organics
Ross Incineration	Grafton Ohio	Liquid Injection & Rotary Kiln	Acids, Halogenated & Non-Halogenated Solvents, Halogenated & Non-Halogenated Organics,
Stablex South Carolina Inc.	Rock Hill South Carolina	Fixed Hearth	Halogenated & Non-Halogenated Solvents, Halogenated & Non-Halogenated Organics, Metallic Organics
GSX Thermal Oxidation Corp.	Roebuck South Carolina	Liquid Injection	Halogenated & Non-Halogenated Solvents, Halogenated & Non-Halogenated Organics
B.D.T., Inc.	New York	Not Available	Metals

* In addition, there are four TSCA commercial incinerators permitted to burn PCB wastes. They include: Pyrochem (Coffeyville, Kansas), Pyrotech Systems - mobile unit, U.S. EPA incinerator - mobile unit, and General Electric (Pittsfield, Massachusetts).

Source: EPA, Office of Solid Waste and Office of Toxic Substances.

APPENDIX B

Operating Commercial Land Disposal Facilities

OWNER	LOCATION	TYPES OF FACILITIES	WASTE
Chemical Waste Management Inc	Emelle Alabama	Landfill, Storage Impoundments, Treatment Impoundments	Metals,Cyanides, Acidic Corrsives, PCBs, Halogens
Lion Oil Company	El Dorado Arizona	Land Treatment, Storage Impoundments	Metals
IT Corp Benecia	Benecia California	Landfill, Disposal Impoundments, Storage Impoundments,	Metals, Cyanides, Solvents
IT Corp Vine Hill	Martinez California	Treatment Impoundments	Metals
IT Corp Imperial	Westmoreland California	Disposal Impoundments, Treatment Impoundments	Metals, Solvents
Casmalia Resources	*Casmalia* California	Landfill, Disposal Impoundments, Treatment Impoundments	Acidic Corrosives, Metals, Cyanides, Halogens
Chemwest Industries Inc	Fontana California	Storage Impoundments	Acidic Corrosives
AMCE Fill Corporation	Martinez California	Landfill	Other
IT Corp Baker Facility	Martinez California	Disposal Impoundments, Treatment Impoundments	Metals, Acidic Corrosives
Chemical Waste Management Inc	Kettleman City California	Landfill, Treatment Impoundments	Acidic Corrosives, Metals
CECOS International Inc	Bristol Connecticut	Waste Piles	Metals, Cyanides
City of Danbury	Danbury Connecticut	Landfill	Metals
Torrington Landfill	Torrington Connecticut	Landfill	Metals
Salsbury Laboratories	Charles City Iowa	Storage Impoundments, Treatment Impoundments	Metals, Solvents, Halogens
Envirosafe Services of Idaho	Grand View Idaho	Landfill, Waste Piles	Acidic Corrosives, Metals, Cyanides, Solvents, PCBs, Halogens
SCA Chemical Services Inc	Chicago Illinois	Storage Impoundments, Treatment Impoundments	Other
Peoria Disposal Co	Peoria Illinois	Landfill	Metals
CID-Landfill	Calumet City Illinois	Landfill	Acidic Corrosives, Metals, Cyanides, Solvents, Halogens
Kerr-McGee Chemical Corp	Madison Illinois	Storage Impoundments	Other
CECOS International Inc./BFI	Zion Illinois	Landfill	Metals, Solvents, Halogens
Four County Landfill	Rochester Indiana	Landfill	Metals
Adams Center Landfill Inc	Fort Wayne Indiana	Landfill	Acidic Corrosives, Metals, Cyanides, Solvents, Halogens

Operating Commercial Land Disposal Facilities (cont.)

OWNER	LOCATION	TYPES OF FACILITIES	WASTE
CECOS International Inc.	Westlake Louisiana	Storage Impoundments	Acidic Corrosives, Metals, Solvents, Halogens
CECOS International Inc	Livingston Louisiana	Landfill	Acidic Corrosives, Cyanides, Solvents, Halogens
Chemical Waste Management Inc	Carlyss Louisiana	Landfill	Metals, Cyanides, Solvents, Halogens
Rollins Environmental Services	Baton Rouge Louisiana	Landfill, Storage Impoundments Treatment Impoundments	Metals, Solvents, Cyanides, Acidic Corrosives
Wayne Disposal, Inc	Bellerville Michigan	Treatment Impoundments	Acidic Corrosives, Metals
Environmental Waste Control	Inkster Michigan	Treatment Impoundments	Acidic Corrosives, Metals
Chem-Met Services Inc	Wyandotte Michigan	Waste Piles	Acidic Corrosives, Metals, Solvents, Halogens
Federal-Hoffman Inc	Anokia Minnestoa	Landfill	Other
North Star Steel Co	St. Paul Minnesota	Waste Piles	Metals
B. H. S. Inc	Wright City Missouri	Landfill	Metals, Halogens
Rogers Rental Landfill	Centreville Mississippi	Land Treatment	Other
Burlington Northern Somers	Somers Montana	Waste Piles, Storage Impoundments	Acidic Corrosives, Metals, Solvents
US Ecology Inc	Beatty Nevada	Landfill	Metals, Cyanides, Solvents, PCBs, Halogens
Frontier Chemical Waste Process	Niagara Falls New York	Waste Piles	Metals
CECOS International Inc	Niagara Falls New York	Landfill	Acidic Corrosives, Metals, PCBs
F E I Landfarming	Oregon Ohio	Land Treatment	Metals
Ashland Chemical Co	South Point Ohio	Waste Piles	Other
Chemical Waste Management Inc	Vickery Ohio	Storage Impoundments	Acidic Corrosives, Metals
Fondessy Enterprises Inc	Oregon Ohio	Landfill	Metals, Cyanides, Solvents, Halogens
Erieway Pollution Control Inc	Bedford Ohio	Waste Piles	Acidic Corrosives, Metals, Halogens
CECOS International Inc	Williamsburg Ohio	Landfill	Metals, Cyanides, Solvents, PCBs, Halogens
Delhi Industrial Products	McDonald Ohio	Waste Piles	Metals

Operating Commercial Land Disposal Facilities (cont.)

OWNER	LOCATION	TYPES OF FACILITIES	WASTE
Eagle Picher Industries Inc	Quapaw Oklahoma	Disposal Impoundments	Metals, Solvents
USPCI	Waynoka Oklahoma	Landfill, Disposal Impoundment, Waste Piles, Storage Impoundments Treatment Impoundments	Acidic Corrosives, Metals, Cyanides
Chem-Security Systems Inc	Arlington Oregon	Landfill, Storage Impoundments, Treatment Impoundments	Acidic Corrosives, Metals, Solvents, PCBs, Halogens
Mill Service Inc	Yukon Pennsylvania	Disposal Impoundments, Waste Piles	Metals
Mill Service Inc	Bulger Pennsylvania	Disposal Impoundments, Waste Piles	Metals
GSX Services of South Carolina	Pinewood South Carloina	Storage Impoundments	Acidic Corrosives, Metals, Cyanides
Yale Security Inc	Lenoir City Tennessee	Storage Impoundments	Acidic Corrosives, Metals
Gibraltar Chemical Resources	Winona Texas	Treatment Impoundments	Cyanides, Halogens
US DOE K-25 Site	Oakridge Texas	Storage Impoundments	Acidic Corrosives, Metals
Gulf Coast Waste Disposal	Texas City Texas	Landfill, Land Treatment	Metals, Cyanides
Chemical Waste Management Inc	Port Authur Texas	Landfill, Disposal Impoundments, Storage Impoundments, Treatment Impoundments	Acidic Corrosives, Metals, Cyanides, Solvents, Dioxins Halogens
Rollins Environmental Services	Deer Park Texas	Landfill, Storage Impoundments, Treatment Impoundments	Metals, Cyanides, Solvents, Halogens
Olin Corporation	Beaumont Texas	Treatment Impoundments	Acidic Corrosives, Metals, Cyanides, Solvents, Halogens
Malone Service Company	Texas City Texas	Landfill, Storage Impoundments, Treatment Impoundments	Metals, Cyanides, Acidic Corrosives
Texas Ecologists Inc.	Robstown Texas	Landfill	Metals, Cyanides, Solvents, Halogens
USPCI	Knowles Utah	Landfill, Land Treatment, Storage Impoundment	Metals, Acidic Corrosives, Solvents, PCBs, Halogens

Source: EPA, Office of Solid Waste.

APPENDIX C

Commercial Deep-Well Injection Systems

OWNER	LOCATION	WASTE
CECOS International	Lake Charles Louisiana	Acids, Caustics, Cleaning Solutions, Organic and Inorganic Wastewaters, Leachate, Contaminated Soils
CECOS International	Livingston Louisiana	Acids, Chromic Acids, Pickling Acids Caustics, Cyanides, Paints and Inks, Non-Halogenated Solvents, Halogenated Solvents, Waste Oil, Commercial Chemical Products, Contaminated Soil, Asbestos, Spent Catalysts
Chemical Waste Management Inc.	Lake Charles Louisiana	Acids, Chromic Acids, Pickling Acids Caustics, Cyanides, Paints and Inks, Non-Halogenated Solvents, Halogenated Solvents, Waste Oil, Non-metallic Inorganic, Metallic Inorganics, Non-Halogenated Organics, Halogenated Organics, Contaminated Soils
Rollins Environmental Services	Baton Rouge Louisiana	Acids, Chromic Acids, Pickling Acids Caustics, Cyanides, Paints and Inks, Non-Halogenated Solvents, Halogenated Solvents, Waste Oil, Commercial Chemical Products, Non-metallic Inorganics, Metallic Inorganics, Non-Halogenated and Halogenated Organics, Pesticides, PCB Liquids <50ppm, PCB Solids <50ppm, Contaminated Soil, Lab Packs.
Chemical Waste Management Inc.	Vickery Ohio	Acids, Chromic Acids, Pickling Acids Caustics, Waste Oil, Non-metallic Inorganics, Metallic Inorganics, Non-Halogenated Organics.
Chemical Resources, Inc.	Tulsa Oklahoma	Acids, Pickling Acids, Cyanides, Paint and Inks, Non-Halogenated Solvents, Waste Oil, Metallic Inorganics, Metallic Organics, Pesticides.
Disposal Systems, Inc.	Houston Texas	Acids, Chromic Acids, Caustics, Cyanides, Paints and Inks, Non-Halogenated Solvents, Halogenated Solvents, Waste Oil, Commercial Chemical Products, Non-Metallic Inorganics, Metallic Inorganics, Metallic Organics, Non-Halogenated Organics, Halogenated Organics, Pesticides, Contaminated Soil, Texas Class I Hazardous Wastes.

Commercial Deep-Well Injection Systems

OWNER	LOCATION	WASTE
Chemical Waste Management Inc.	Corpus Christi Texas	Acids, Chromic Acids, Pickling Acids Caustics, Cyanides, Paints and Inks, Non-Halogenated Solvents, Halogenated Solvents, Waste Oil, Non-metallic Inorganics, Metallic Inorganics, Non-Halogenated Organics, Halogenated Organics
Malone Service Co.	Texas city Texas	Acids, Chromic Acids, Pickling Acids Caustics, Cyanides, Paints and Inks, Non-Halogenated Solvents, Halogenated Solvents, Waste Oil, Commercial Chemical Products Non-Metallic Inorganics, Metallic Inorganics, Metallic Organics, Non-Halogenated Organics, Pesticides.
EMPAK, Inc.	Deer Park Texas	Acids, Chromic Acids, Pickling Acids Caustics, Cyanides, Paints and Inks, Non-Halogenated Solvents, Halogenated Solvents, Waste Oil, Commercial Chemical Products Non-Metallic Inorganics, Metallic Organics, Non-Halogenated Organics, Pesticides.
Gibraltar Chemical Resources	Winona Texas	Acids, Chromic Acids, Pickling Acids Caustics, Cyanides, Paints and Inks, Non-Halogenated Solvents, Halogenated Solvents, Waste Oil, Texas Class I Waste
Chemical Waste Management	Port Authur Texas	Acids, Chromic Acids, Pickling Acids Caustics, Cyanides, Paints and Inks, Non-Halogenated Solvents, Halogenated Solvents, Waste Oil, Commercial Chemical Products Non-Metallic Inorganics, Metallic Organics, Non-Halogenated and Halogenated Organics, Pesticides, Contaminated Soil.
CECOS International, Inc	Odessa Texas	Acids (pH >5), Chromic Acids, Pickling Acids, Caustics, Metallic Organics Flammable Liquids, Cyanide Waste Stream.

Source: EPA, Office of Solid Waste.

BIBLIOGRAPHY

BIBLIOGRAPHY

Analysis of Capacity Short Falls of Schedules for Implementing the Land Disposal Restriction Program. U.S. EPA, Office of Solid Waste, ICF, Inc., March, 1985. (Report)

Assessment of the Commercial Hazardous Waste Incineration Market. U.S. EPA, OPA, Booz-Allen & Hamilton, Inc., November 30, 1984. (Report)

Capacity Short Falls and the Land Disposal Restriction Program: A Preliminary Assessment. U.S. EPA, Office of Solid Waste, ICF Inc., July, 1985. (Report)

Commercial Hazardous Waste Treatment Capacity: Data Sources, Evaluation and Potential Survey Questionnaire: Final Report (Task 2). U.S. EPA, Waste Treatment Branch, Office of Solid Waste, Booz-Allen Hamilton, GCA, December, 1984. (Report)

Comprehensive Hazardous Waste Management Study. Mississippi Hazardous Waste Council, ERM, Inc., January, 1982. (State Report)

EPA to Issue New Toxic-Waste Rules; Big Rise in Disposal Costs Seen for Firms, Robert E. Taylor, Wall Street Journal, October 23, 1986. (Article)

Estimate of Need. Minnesota Waste Management Board, September, 1985. (State Report) Attachments: Commercial Hazardous Waste Landfill Capacity. Memo, Marcia Williams, U.S. EPA, Office of Solid Waste, November 14, 1985. Recent Data on Out of State Landfill Capacity. Office Memo, December 1985.

Estimating Competition for Commercial Hazardous Waste Treatment Capacity from non-RCRA Wastes: Draft Report (Task 1.3). U.S. EPA, Waste Treatment Branch, Office of Solid Waste, Booz-Allen & Hamilton under contract for GCA, Inc., December, 1984. (Report)

Final Report on Hazardous Waste in North Carolina: Analysis of the Collection Systems, and of the Need for Waste Management Facilities. Battelle Columbus, February 21, 1985. (State Report)

Gulf Coast Disposal of Hazardous Waste: Demand, Capacity, and Pricing - 1980-1990. Gulf Coast Waste Disposal Authority, The Pace Co., September 1981. (State Report)

Hazardous and Solid Waste Amendments of 1984.

Hazardous Waste Facility Needs Assessment. New York State Dept. of Environmental Conservation, Division of Solid and Hazardous Waste, ERM-Northeast, March, 1985. (State Report)

Hazardous Waste Generation and Commercial Hazardous Waste Management Capacity. U.S. EPA, Office of Solid Waste, Booz-Allen & Hamilton, Inc., and Putnam, Hayes & Bartlett, Inc., December, 1980. (Report)

BIBLIOGRAPHY (cont.)

Hazardous Waste Management Plan. Minnesota Waste Management Board, February, 1984. (State Report)

Hazardous Waste Management Report. Minnesota Waste Management Board, December, 1983. (State Report)

Hazardous Waste Management System: Land Disposal Restriction, California List, Office of Solid Waste, November 3, 1986. (Proposed Rule)

Hazardous Waste Management System: Land Disposal Restriction, Solvents and Dioxins, Office of Solid Waste, November 8, 1986. (Final Rule)

Hazardous Waste Management Technology: Draft Report (Task 2.1). U.S. EPA, Waste Treatment Branch, Office of Solid Waste, Booz-Allen Hamilton, GCA, December, 1984. (Report)

Hazardous Waste Treatment and Resource Recovery Facility Feasibility Study. Missouri Environmental Improvement and Energy Resources Authority, ERM, January, 1985. (State Report)

Identification and Evaluation of Sources of Capacity-Related Data for Hazardous Waste Management Technology: Draft Report (Task 2-1). U.S. EPA, Waste Treatment Branch, Office of Solid Waste, Booz-Allen Hamilton, GCA, December 1984.

Improved Hazardous Wastes Management Needs, Chemical Engineering Progress, September 1986. (Article)

Incineration Permitting and Capacity, Office of Emergency and Remedial Response, July 16, 1986. (Briefing)

Incinerator and Cement Kiln Capacity for Hazardous Waste Treatment, G.A. Vogel, A.S. Goldbuk, R.E. Zier, and A. Jewell of Mitre Corporation and I. Licis of U.S. EPA, Cincinnati, Ohio. (Article)

Incinerator and Cement Kiln Capacity for Hazardous Waste Treatment. Vogel, G.A., et al., Mitre Corp., presented at 12th Annual EPA Research Symposium, April 21-23, 1986, Cincinnati, Ohio. (Report)

National Screening Survey of Hazardous Waste Treatment, Storage, Disposal, and Recycling Facilities. 1986 U.S. EPA, Office of Policy, Planning and Information, Research Triangle Institute. (Ongoing Study)

National Small Quantity Hazardous Waste Generator Survey, U.S. EPA, Office of Solid Waste, Abt Associates, February, 1985 (Report).

BIBLIOGRAPHY (cont.)

National Survey of Hazardous Waste Generators and Treatment, Storage and Disposal Facilities Regulated under RCRA in 1981. U.S. EPA, Office of Solid Waste, Westat, Inc., April, 1984. (Report)

1984 Needs Survey Report to Congress Assessment of Needed Publicly Owned Wastewater Treatment Facilities in the United States. U.S. EPA, Office of Municipal Pollution Control, Roy F. Weston, Inc., February 1985. (Report)

New Jersey Hazardous Waste Facilities Plan, NJ Hazardous Waste Facility Siting Commission, ERM, March, 1985. (State Report)

Permitting of Land Treatment Units; EPA Policy, and Guidance Manual on Land Treatment Demonstration,: J. Winston Porter, September 17, 1986. (Memorandum)

Potential for Capacity Creation in the Hazardous Waste Management Service Industry. U.S. EPA, Office of Solid Waste, Foster D. Snell, Inc., August 1976. (Report)

Profile of Existing Hazardous Waste Incineration Facilities and Manufacturers in the United States. Mitre, February, 1984. (Report)

Question of Effect of UST Cleanups on the Capacity Subtitle C Facilities, Richard Valentinetti, Office of Underground Storage Tanks, U.S. EPA, Fall, 1986. (Memorandum)

Re-Analysis of the National Survey of Hazardous Waste Generators and Treatment Storage and Disposal Facilities Regulated under RCRA in 1981. U.S. EPA, Office of Solid Waste, Westat, Inc., April, 1984. (Ongoing Study)

Report on Hazardous Waste Management Needs Assessment, TVA, Battelle Columbus. June, 1984. (Report)

Report to Congress on Injection of Hazardous Waste. U.S. EPA, May, 1985. (Report)

Report to Congress: Waste Minimization,: Office of Solid Waste, U.S. EPA.

Resource Conservation and Recovery Act of 1976.

Review of Activities of Major Firms in the Hazardous Waste Management Industry: 1982 Update. U.S. EPA, OPA, Booz-Allen & Hamilton, Inc., August, 1983. (Report)

Review of Activities of Firms in the Commercial Hazardous Waste Management Industry: 1983 Update. U.S. EPA, OPA, Booz-Allen & Hamilton, Inc., November, 1984. (Report)

Serious Reduction of Hazardous Waste, Office of Technology Assessment, September 1986. (Report)

BIBLIOGRAPHY (cont.)

Statement of J. Winston Porter on Capacity and Waste Minimization before the Subcommittee on Environment, Energy and Natural Resources of the Committee in Government Operations, U.S. House of Representatives, September 24, 1986. (Testimony)

Study to Evaluate Impact of EAF Dust Land Disposal on Human Health and the Environment, prepared for the American Iron and Steel Institute by Baker/TSA, Inc., September 1986. (Report)

Survey of Selected Firms in the Commercial Hazardous Waste Management Industry: 1984 Update. U.S. EPA, OPA, ICF, Inc., September, 1985. (Report)

Survey of Waste as Fuel: Track II. U.S. EPA, Office of Solid Waste, Westat, Inc., November, 1985. (Report)

Survey of Selected Firms in the Commercial Hazardous Waste Management Industry: 1985 Update. U.S. EPA, Office of Policy Analysis, ICF, Inc., September, 1986.

Time Requirements for the Siting, Permitting, and Construction of New Hazardous Waste Treatment Facilities prepared for the Office of Solid Waste by Jacobs Engineering Group, Inc., January 3, 1986. (Final Report)