CHAPTER 4

Data for Hazardous Waste Management

Contents

List of Tables

List of Figures

CHAPTER 4

Data for Hazardous Waste Management

Summary Findings

- Inadequate data conceal the scope and intensity of the national hazardous waste problem. Substantial improvements can be made in all data areas, and are particularly needed for health and environmental effects required for risk assessments.
- Although improved data are being obtained by the Environmental Protection Agency (EPA) and the States, effective implementation of government programs are hindered by major inadequacies and uncertainties concerning the amounts of hazardous waste being generated, the types and capacities of existing waste management facilities, the number of uncontrolled sites and their hazard levels, and the health and environmental effects of releases of hazardous waste constituents.
- Under State and Federal regulations some 255 million to 275 million metric tons (tonnes) of hazardous waste are generated annually, although the Federal program recognizes only about 40 million tonnes. States sometimes define hazardous waste differently than does the Federal program. This leads to differences in the perceived types and quantities of waste that pose hazards, and to confusion as to the degree and focus of efforts required to control hazardous waste. The Federal program exempts many millions of tonnes of waste deemed hazardous to varying degrees.
- The Resource Conservation and Recovery Act's **(RCRA)** permitting efforts for facilities will be based on the current EPA national data base. These data are generally recognized to be incomplete and, in some respects, inaccurate.
- The inventory of uncontrolled sites in the Nation is still incomplete, and the severity of the hazards posed by many of the listed priority and unlisted sites is uncertain.
- There are very limited data concerning the short- and long-term health and environmental effects of exposures to actual hazardous waste. The disease registry and the health survey mandated by the Comprehensive Environmental, Response, Compensation, and Liability Act of 1980 (CERCLA] have not been completed.
- There is a need for a long-term, systematic program in EPA—for which a congressional mandate does not exist—with the goal of obtaining more complete and reliable data on hazardous wastes, facilities, sites, and exposures to and effects from releases,

Introduction

"Hazardous waste management" is defined in the RCRA legislation as (l):

> . . . the systematic control of the collection, source separation, storage, transportation, processing, treatment, recovery and disposal of hazardous wastes.

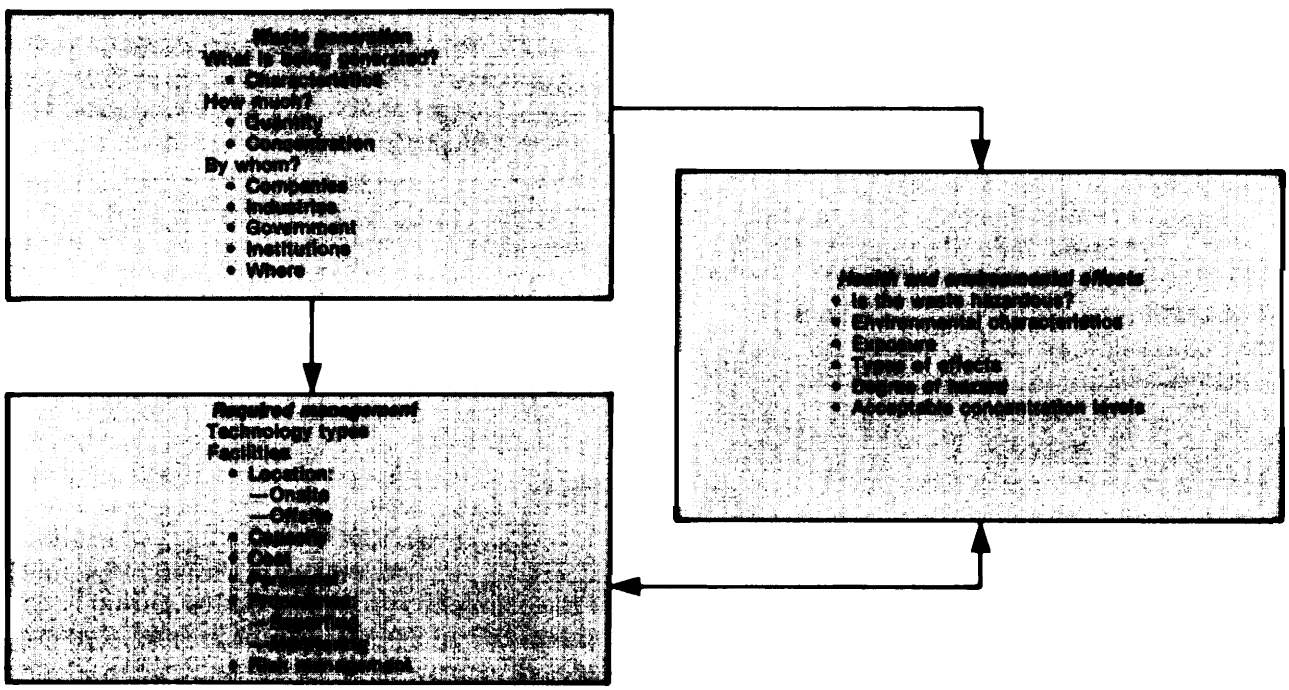
Considerable data are required to determine the technologies and strategies suitable for managing a given hazardous waste. The roles of government, industry, and the public in the protection of health and the environment through hazardous waste management are complementary; however, the data needs of each group differ. It is necessary for government to define siting criteria, to regulate the design or performance of management facilities, to monitor compliance with these regula-

tions, and to enforce the regulations. Industries must identify the nature and hazard of their waste, select existing technologies (or develop new ones) for effective management, and ensure adequate management of their waste. To assist government and industry in maximizing the effectiveness of hazardous waste management efforts, the public should have access to as much information as possible concerning the activities of hazardous waste generators and management facilities (with appropriate consideration of the proprietary nature of some information), and concerning regulations governing these activities.

To provide a framework for discussing these various data needs, the basic issues and information involved in managing a given hazardous waste stream are illustrated in figure 4. Figure 5 illustrates the possible paths that hazardous waste may take during the management process. Both of these models are deliberately simplified; they are intended only to present conceptual frameworks. The various chapters of this study address the components of these figures in detail.

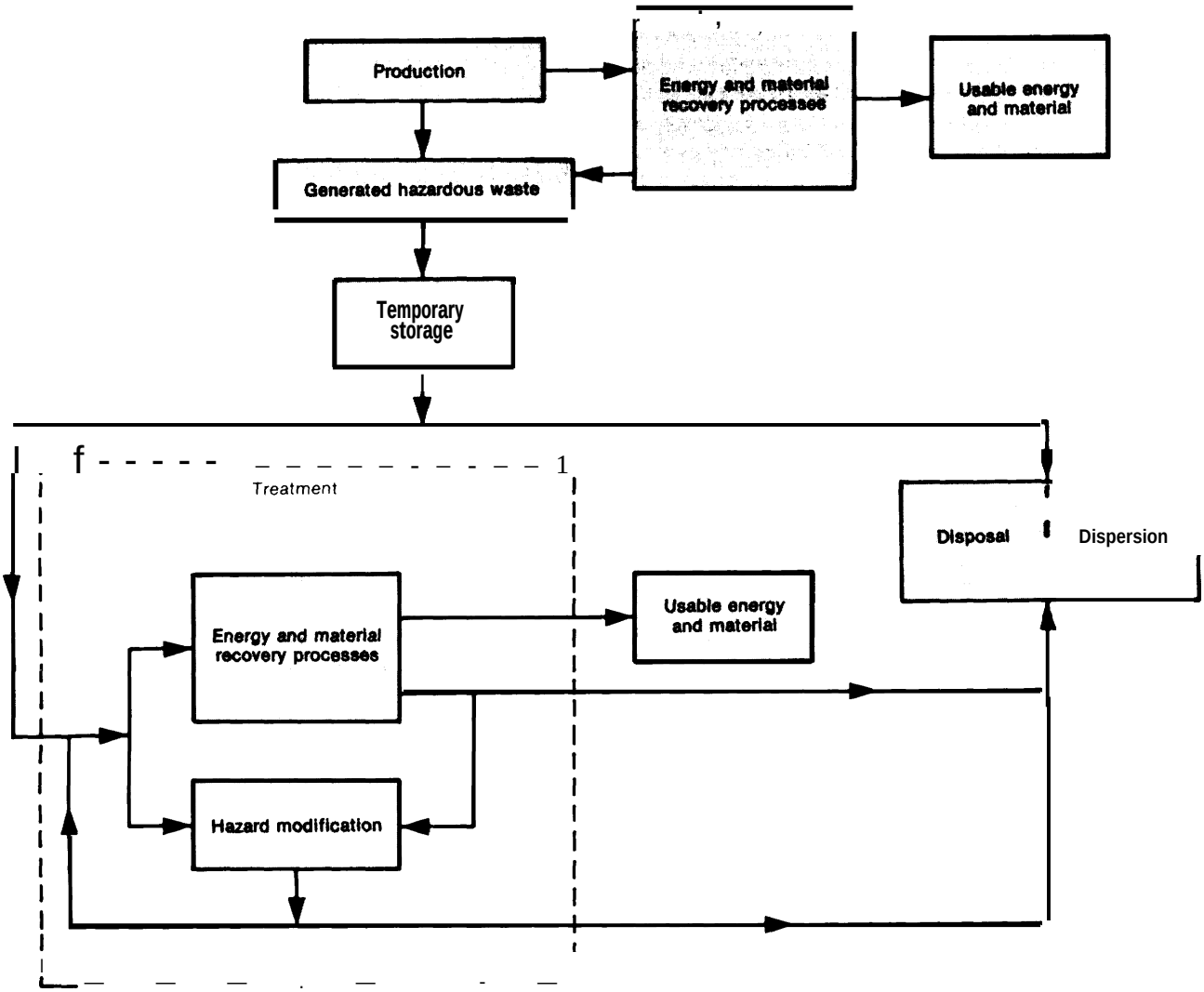
This chapter discusses the need and availability of data for hazardous waste management. First, the roles of government, industry, and the public are described, and a brief overview of relevant statutes and regulations is given. Second, data types discussed are described. Third, the universe of regulated waste is defined. Fourth, current data requirements, resources, and uses are discussed as they relate to generators and generation, health and environmental effects, and management facilities. Finally, some priorities are suggested for development of required data resources for effective hazardous waste management.

Figure 4.—Determination of Hazardous Waste Management Solutions



SOURCE: Office of Technology Assessment.

Figure 5.—Hazardous Waste Management Paths



SOURCE Off Ice of Technology Assessment

Management Roles of Government, Industry, and the Public

Congress enacted RCRA in *1976* to address issues concerning current and future management of hazardous waste and the recovery of energy and materials. RCRA is but one of several Federal statutes concerned with public health and environmental quality through the management of hazardous substances. The relationship of these statutes to RCRA is more fully discussed in chapter 7. As a result of several environmental acts, sources of data have been developed concerning the chemical characteristics and potential impacts of hazardous substances on health and the environment. Information and expertise developed under each

of these sometimes overlapping environmental statutes can contribute to the implementation of RCRA,

The role of the Federal Government as set forth in RCRA includes the establishment of a system that will protect health and environmental quality through proper management of hazardous waste. The responsibilities for implementing hazardous waste management programs are shared by the Federal government and the States. States have the authority to implement programs more stringent than required by the Federal program. RCRA focuses on hazardous waste management and transportation. The regulation of generators is limited to waste analysis and recordkeeping. EPA has promulgated a regulatory program designed to document and constrain the disposition of hazardous waste from point of generation to final disposal (see fig. 5). Table 15 summarizes RCRA and CERCLA mandates for data collection. Many of the required studies and surveys have not yet been completed.

The role of industry in the implementation of RCRA is an important one. Hazardous waste generators, as well as industries involved in hazardous waste storage, recovery, treatment, disposal, and transportation are involved. Industry's role in RCRA implementation is to comply with Federal and State waste management regulations, choosing waste management options that do not threaten health or the environment and balance both immediate costs and long-term financial liabilities, This choice should be based on adequate data resources.

Generators are required to maintain records of waste, reflecting the quantity and nature of the waste generated, and its disposition. Generators who transport their waste to offsite storage, treatment, disposal, or recovery facilities must maintain transport manifests.

The primary role of the public has been in creating a sense of urgency that motivates government to enact and implement hazardous waste management laws. Public participation is an essential ingredient in the development of the States' hazardous waste management programs. The public has another important function–that of visual monitoring and of reporting conditions in and surrounding hazardous waste facilities that may present a threat to health and safety.

Table 15.—RCRA and CERCLA Data Collection Mandates

RCRA data collection	CERCLA data collection
Subtitle C	
• Notifications by TSD[a] facilities [b c]	• List of at least 400 priority sites[b]
. Manifests of transported wastes[b c d]	• Inventory of published health effects[b]
• Site inventory	• National registeries[b]
Subtitle D	—Diseases and illnesses related to exposure to toxics
. Inventory of open dumps[b]	—Persons exposed to toxics
Subtitle E	• Special studies[b]
• Available recovery/recycling technologies	—Waste disposal sites
• Available energy/materials for reuse and conservation	—Screening programs and surveys on health and environmental effects
Subtitle H	• List of areas closed to the public due to presence of toxics[b]
• Special research and development projects[b]	
—waste characteristics	
—effects on health and the environment	
—waste management technologies	

[a]Treatment, storage, and disposal.
[b]Federal responsibility.
[c]Industry responsibility.
[d]State responsibility.

SOURCE" Office of Technology Assessment

Types of Data

In this chapter, the term data refers to both numerical and nonnumerical information. Six data classes, are presented below:

1. Type E: Environmental data characterize the nature of the environment that is exposed to the waste. The data incorporate biological, ecological, geological, meteorological, and chemical characteristics, as well as all relevant transport mechanisms,
2. Type W: Waste data characterize a given waste. It is desirable that these data pertain to individual waste constituents and to the waste as *a* whole. Two types of waste characteristics are recognized:
   a. physical and chemical characteristics: state (solid, liquid, gas, solution or suspension in a liquid such as water], viscosity, density, flashpoint, corrosiveness, organic or inorganic, elements, compounds, mixtures, concentrations, chemical degradability, reactivity in ambient environments, reactivity in waste stream; and
   b. biological characteristics: toxicity (including genetic effects), nature of hazard, hazard level, persistence, degradability, tendency toward bioaccumulation, fate in humans and the environment.
3. Type F: Facility data characterize a single facility involved in the generation, storage, recovery, treatment, or disposal of hazardous waste. These data include location, operating characteristics, input-output waste characteristics, and the nature of environmental and human exposure to hazardous constituents associated with the facility.
4. Type T: Technology data characterize the typical performance of available management technologies (e.g., landfills, injection wells, incinerators).
5. Type S: State data represent the overall activity of all facilities in the State.
6. Type N: National data represent the overall activity of all facilities in the Nation.

Throughout the following discussion, the data type referred to is indicated by E, W, F, T, S, or N, where the type is not otherwise identified. The data needs of government, industry, and the public are summarized in table 16.

Table 16.-Summary of Data Needs

User	Legislation/regulation	Permitting	Monitoring	Enforcement	Planning	Public information
Federal Government	E,W,T	E,F	E,F	F	E,W,F,T	E,W,F,T
State government	E,W,T	E,F	E,F	F	E, W,F,T	E, W,F,T
Generators	W,T[a]				W,F,T	W,T
Management facilities	E,F,T	E,F	E,F	F	E, W, F,T,S	F,S
Public	E,W,T	E,F	E,F	F		

KEY: E—environment data; F—facility data; N—national facilities data; S—State facilities data; T—technology data; W—waste data.
[a]Data required t. participate In the legislative and regulatory processes

SOURCE: Office of Technology Assessment.

The Universe of Regulated Waste

The defined universe of hazardous waste varies among the States and the Federal program. RCRA defines hazardous waste as a subset of solid waste as follows:

The term "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 or solid or dissolved materials in irrigation return flows, or industrial discharges which are point sources subject to permits under section 402 of the Federal Water Pollution Control Act, as amended . . . or source, special nuclear, or by-product material as defined by the Atomic Energy Act of 1954, as amended . . . (z)

The term "hazardous waste" means a solid waste, or combination of solid wastes, which because of its quantity, concentration, or physical, chemical, or infectious characteristics may—

(A) cause, or significantly contribute to an increase in mortality, or an increase in serious irreversible, or incapacitating reversible, illness; or

(B) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of, or otherwise managed (3).

RCRA requires EPA "to develop and promulgate criteria for identifying the characteristics of hazardous waste and for listing hazardous wastes . . . taking into account toxicity, persistence, and degradability in nature, potential for accumulation in tissue, and related factors such as flammability, corrosiveness and other hazardous characteristics" (4).

Chapter 7 describes the EPA process for identifying and listing hazardous waste. In 1978, EPA proposed a definition of hazardous waste which varied somewhat from the RCRA definition and modified that definition in 1980. The EPA definition is discussed in chapter i',

RCRA excludes certain waste from regulation as hazardous; in some cases these exempted wastes are regulated under other environmental acts. For administrative ease in initiating the RCRA regulations, EPA set certain additional exemptions. Examples of RCRA and EPA exemptions are shown in table 17. Some of these exempted wastes pose relatively low hazards, but others are generally understood to pose serious threats. Several hundred million tonnes of wastes are likely now exempted annually, pose significant hazards. Such deregulation activities by EPA are substantial. Some typical examples are: the delisting of spent pickle liquor that is reused or accumulated, and transported for the purpose of reuse, or that is reused in wastewater treatment in a facility holding a National Pollutant Discharge Elimination System (NPDES) permit; regulatory deferral of waste from paint manufacturing and paint waste from the mechanical and electric products industry; and deregulation of stabilized residues where approved technologies are applied.

Some States have elected to broaden the RCRA and EPA definitions of hazardous waste to include various additional chemical compounds, waste produced by small-volume generators, waste specifically excluded by RCRA from regulation as hazardous in the Federal program, various solid wastes, or waste specifically excluded by RCRA from regulation as solid waste.

Data Requirements: Generators and Generation of Waste

Federal and State Governments require waste generation data for legislation, regulation, and public information. The development of legislation requires information concerning the amounts and types of waste generated, feasible regulatory strategies, and costs of regulatory options. For purposes of regulation, and for public information, the universe of hazardous waste requiring management should be defined and generators of such waste must be identified. Methods of waste management, and the amount being generated in each locality, should be determined. Potential health and environmental effects should be identified.

Table 17.—Examples of Exemptions From Federal Regulation as Hazardous Waste

Waste type	Estimated annual generation (million metric tons)	Possible hazard	Determined by
Fly and bottom ash from burning fossil fuels[a]	66	Trace toxic metals	RCRA
Fuels gas emission control waste	Unknown	Toxic organics, and inorganic	RCRA
Mining waste, including radioactive waste[b]	2,100	Toxic metals; acidity; radioactivity	RCRA
Domestic sewage discharged into publicly owned treatment works[b]	5	Uncertain, toxic metals likely	RCRA
Cement kiln dust[a]	12	Alkalinity, toxic metals	RCRA
Gas and oil drilling muds and production waste; geothermal energy waste.	Unknown	Alkalinity, toxic metals, toxic organics, salinity	RCRA
NPDES permitted industrial discharge	Unknown	Toxic organics, heavy metals	RCRA
irrigation return flows	Unknown	Pesticides, fertilizers	RCRA
Waste burned as fuels[c]	19	Unburned toxic organics	EPA
Waste 011	Unknown	Toxic organics, toxic metals	EPA
Infectious waste	Unknown	Infectious materials	EPA
Small volume generators	2,7-4.0	Possibly any hazardous waste	EPA
Agricultural waste	Unknown	Variable	EPA
Wastes exempted under delisting petitions	Unknown	Presumably insignificant	EPA
Deferred regulations	Unknown	Unknown	EPA
EPA deregulation	Unknown	Presumably Insignificant	EPA
Toxicity test exemptions:	Unknown	Organics	EPA
Recycled waste:	Unknown	Improper application of various materials	EPA

†Wastes may be delisted on the basis of a petition that is concerned only with the constituent(s) which have determined the original listing; however, other hazardous constituents may be present which have previously been unrecognized administratively
‡Wastes not identified as toxic by the EPA extraction procedure test and not otherwise listed by EPA
‡Legitimate recycling is exempt from RCRA regulations except for storage However, there have been numerous Incidents (e g the dioxin case in Missouri) involving recycled materials which are still hazardous

SOURCES [a] *Federal Register*, vol 43, No 243 12/18/78
b Technical Environmental Impact of Various Approaches for Regulating Small Volume Hazardous Waste Generators (Washington, D C Environmental Protection Agency contract No 68.02-2613, TRW, December 1979)
c "A Technical Overview of the Concept of Disposing of Hazardous Wastes in industrial Boilers" (Cincinnati Ohio Environmental protection Agency contract No 68-03-2567, Acurex Corp , October 1981)
d "The RCRA Exemption for Small Volume Hazardous Waste Generators, Staff Memorandum" (Washington, D C U S Congress Off Ice of Technology Assessment, July 1982

As for industrial data needs, the generators of hazardous waste require facility data concerning specific waste quantities, constituents, and concentrations if they desire to modify their industrial processes to reduce the quantity and hazard of the waste they generate. The waste management industry requires the same information. And, for the purpose of market surveys, both the generation and management industries require data concerning management technologies appropriate and available to handle generated waste, the location of existing facilities, and the quantity and types of waste these can handle, in addition to their current utilization.

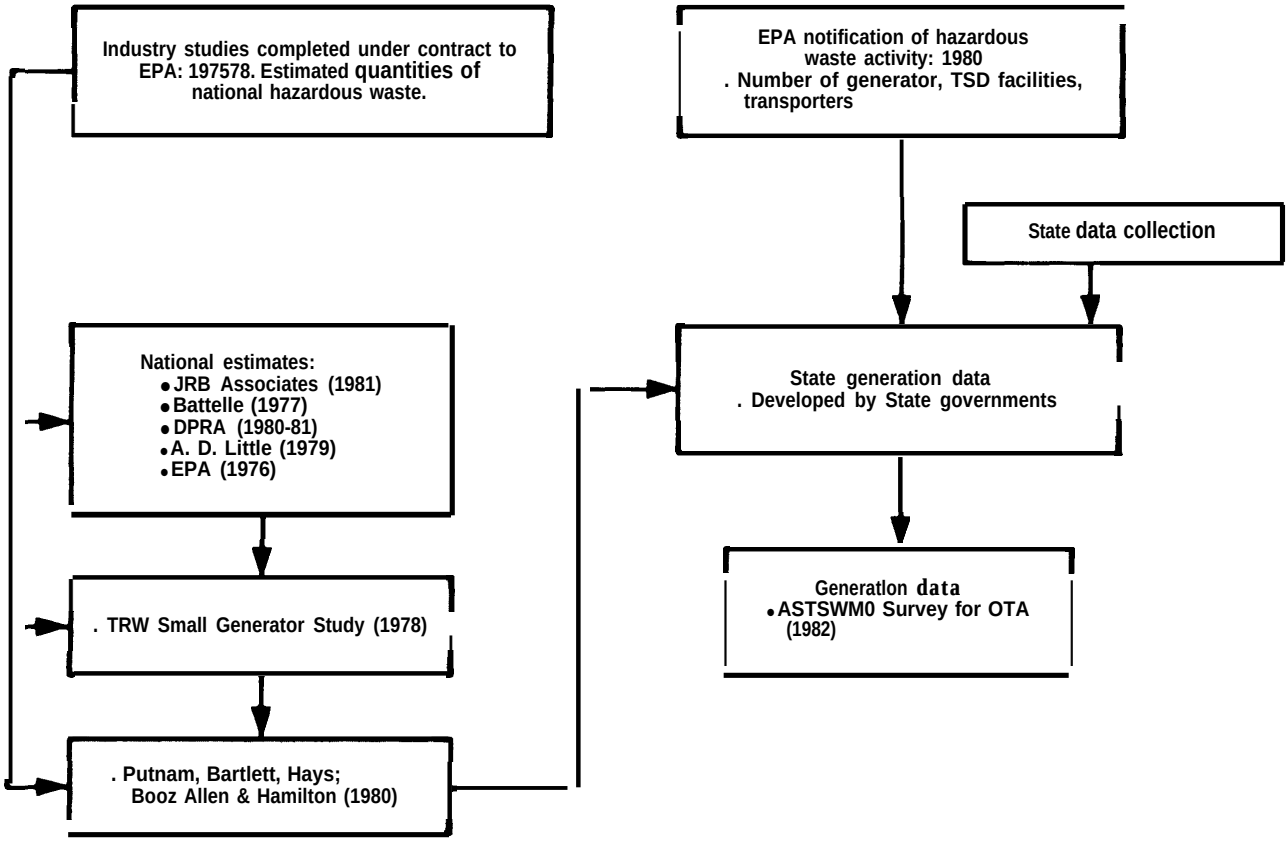
In order to maximize the effectiveness of the public in hazardous waste management, information concerning waste generators, waste generated, and health and environmental effects should be made broadly available.

National Data

Much of the existing data on hazardous waste generation have been developed in a series of studies completed between 1975 and 1982 (5-29). These studies and the relationships among them (the use of one study by another) are shown in figure 6. Also shown is a data set derived from the Federal regulatory requirement that all handlers of potentially hazardous waste notify EPA of their activities.

EPA contracted with several consulting firms during the early 1970's for analyses of waste generated by industrial sectors (mostly manufacturing industries) (5-19). Each contractor developed its own definition of the universe of hazardous waste, The methodology used in each study varied, In general, the contractors calculated aggregate hazardous waste amounts within broad industrial categories by using sev-

Figure 6.— Hazardous Waste Generation Data



SOURCE Office of Technology Assessment.

eral methods. Some studies identified the scope of an industry (e.g., number of plants and location) by using direct industrial information, U.S. Department of Commerce data, or by visiting a small number of "typical" facilities (fewer than 10) and then using the waste generation data for those facilities and data on the number of employees to estimate hazardous waste generation nationwide. * Other contractors identified the numbers of plants nationwide, designed a theoretical model facility, and extrapolated national waste generation using the model. Certain assumptions concerning waste generation and management were applied in these studies. For example, it was assumed that the plants would be in compliance with waste discharge requirements under the Clean Water Act and other environmental legislation; such an assumption would produce a low estimate of total hazardous waste generation. It is unclear whether efforts were made to account for differences in waste generation that would result from variations in manufacturing processes, raw materials, and management practices among individual plants.

The 15 industry studies formed the data base for a number of separate efforts to estimate national hazardous waste generation. Among these are studies by JRB Associates (20), Battelle Columbus Laboratories (21), Development Planning and Research Associates (DPRA)

*A recent study for Virginia indicated that the methodology using employment data can be in substantial disagreement with waste generation data obtained from surveys of generators. For example, liquid wastes were underestimated by about 30 percent, and waste sludges and solids were overestimated by close to 20 times. ("Survey of Hazardous Waste Generators in the Commonwealth of Virginia," Malcolm Pirnie, Inc., October 1982.)

(22-24), and Arthur D. Little (25). EPA also used data from the 15 industry studies in the 1978 draft RCRA Regulatory Impact Analysis (26, 27). Although the same basic data appears to have been used by ail, there were variations in the national hazardous waste estimates produced by these efforts. These variations resulted primarily from differences in the statistical methods employed and the time periods represented in each study.

EPA also contracted with TRW (28) to provide an estimate of waste produced by small-volume waste generators. In the course of this effort, TRW provided a national estimate for hazardous waste generation of 61 million tonnes per year, Information concerning the methods of data collection and the analytical techniques used in this study is incomplete. The TRW estimate of 61 million tonnes appears to be derived from data provided by States, industry, and other unspecified EPA consultant reports, The study involved estimation of waste generation rates from data attributed to individual plants of various sizes, and the application of these rates to the distribution of plants reported by the U.S. Bureau of Census. The TRW definition of hazardous waste included, in addition to wastes covered by the EPA definition proposed in 1978, other wastes having certain constituents which were believed by the contractors to be hazardous in pure chemical forms. How much this latter group broadened the universe of hazardous waste as compared to the original 15 industry studies remains unclear. TRW included small-volume generators in its national estimate of hazardous waste. The contributions of small generators to the estimates in the 15 industry studies is not known.

In 1979, EPA contracted with Putnam, Bartlett and Hays (who subcontracted with Booz Allen and Hamilton) to summarize existing hazardous waste generation data and to undertake a survey of commercial hazardous waste management facilities. The purpose of the study (29) was to determine if sufficient management capacity existed to handle the total hazardous waste for 27 priority manufacturing and nonmanufacturing industry sectors (identified by "standard industrial classes," known as SICs). Booz Allen and Hamilton used the data base from the earlier industry studies. Consequently, all variations and limitations in definitions and methodologies from these studies were incorporated in the Booz Allen and Hamilton study. In addition, the data did not correspond to consistent time frames, or to whole industry sectors. To correct for these discrepancies, three general types of statistical adjustments were made:

1. Estimates were adjusted upward to account for the growth of waste generation since the date represented by the source data. (This adjustment does not reflect the recent downturn in industrial activity.)
2. Estimates were adjusted upward to account for waste generation in at least some industries not included in the original study.
3. When estimates referred to only part of an industry sector, the generation 'rate for the total sector was developed by calculating the ratio of production worker hours to waste generation in the subsector, and applying that ratio to the total industry.

The national quantity of hazardous waste generated annually was estimated by this study to be in the range 28 million to 54 million wet tonnes for the year 1980, EPA commonly reports a figure of 41 million wet tonnes for 1980 and 43 million wet tonnes for 1981. It is acknowledged that these figures do not include data concerning waste not regulated by RCRA

In 1980, EPA required hazardous waste generators, owners and operators of hazardous waste treatment, storage, and disposal facilities (TSDF), and hazardous waste transporters to notify EPA of their activities. Information submitted included identification of facility type (i.e., generator, TSDF, transporter), location of the activity, and the types of waste handled according to EPA-established identification numbers, Notices were sent to 428,522 firms that had been identified by WAPORA (a consulting firm) as possibly being subject to RCRA regulation. EPA received approximately 60,000 notifications.

Also in 1980, EPA established a requirement for annual reporting of waste generated and received. This reporting requirement, effective that year, extended only to generators and waste management facilities in States with unauthorized State programs. (At that time, no States had authorized waste management programs.) In 1981, the Federal annual reporting requirement was suspended, and only a few States had partially authorized waste management programs. In October 1982, when the reporting requirement was reinstated retroactive to 1981, all but 16 States had achieved partial State program authorization. Since EPA still only requires generators and waste management facilities in States with unauthorized programs to report annually to EPA, the data received by EPA will represent activities in only a small number of States. EPA has also proposed a regulatory change to undertake biennial statistical samples from all the States in lieu of more comprehensive annual reporting requirements. Finally, EPA has undertaken a new national survey of hazardous waste generators and management facilities. This survey of approximately 10,700 generators and 2,500 management facilities is scheduled to be completed in 1983 and it will provide background information for the ongoing RCRA Regulatory Impact Analysis.

State Data

A number of States have attempted to estimate hazardous waste generation in their jurisdictions. These estimates were based on:

1. **State** inventories of waste generation by facility (including transport manifest data, State facility inventories, and data from generator notifications to the States);
2. extrapolations of the Booz Allen and Hamilton data using EPA notifications for a particular State;
3. data from State manifests for waste transported offsite.
4. extrapolations of State-derived estimates using methodologies similar to the national studies (20-29).

In addition, to address the need for new hazardous waste management facilities and to provide sources of information to the public, some States have formed regional planning organizations. These regional organizations have published estimates of regional waste generation (30-33) using State-supplied estimates of waste generation, or, in recent publications, by extrapolating regional waste generation from member States' manifest data. State waste generation data are discussed below. Chapter 6 discusses hazardous waste management facility siting.

The Association of State and Territorial Solid Waste Management Officials (ASTSWMO) surveyed State data for OTA (33). The results of that survey are presented in table 18. As part of this work, ASTSWMO requested the States to indicate broad differences between the State and EPA universes of hazardous waste. The States were also requested to indicate how their estimates were derived. The ASTSWMO information was obtained both. by telephone and written response to a survey questionnaire. Forty-two States and five territories responded, but the completeness of their responses varied. As table 18 shows, the ASTSWMO study indicates approximately 250 million tonnes of hazardous waste are being produced annually by 40 States, Guam, and Puerto Rico. * The waste from the States and territories not responding might add another 5 million to 25 million tonnes annually to this figure (for a total likely range of 255 million to 275 million tonnes).

The States' waste generation data were derived by a number of different approaches: 19 States appear to have used State inventories; 5 States appear to have used data on manifested hazardous waste, thus underestimating waste generation unless extrapolation to account for waste managed onsite was done. In

*Hazardous waste quantities reported in units of volume (gallons, cubic feet, cubic yards) were converted to units of weight by ASTSWMO using standard EPA conversion factors, as noted in table 18. However, in those cases where States reported quantities in units of weight, the factors used by the States for original converting volume to reported weight (where this conversion was performed) are unknown to OTA.

Table 18.—Hazardous Waste Generation Estimates by EPA and the States

State[a,b]	Quantity (tonnes) EPA estimate	State estimate	Universe Same as EPA	State additions
Alabama[b]	730,000	265,680		PCBs.
Alaska[b]	130,000	360		PCBs.
Arizona[b]	160,000	4,280,000		PCBs, waste oil.
Arkansas	370,000	No data[d]		PCBs, waste oil.
California[e]	2,630,000	15,000,000		Approximately 4 mmt is oilfield waste; also includes mining waste, small *generators,* PCBs.
Colorado[b]	180,000	775,490		PCBs.
Connecticut[b]	610,000	102,000	x	Extrapolated from 3 months manifest data.
Delaware[a]	300,000	272,000	x	—
Florida	960,000	No data	x	—
Georgia[b]	700,000	38,500,800		Some delisted waste; 99.7°/0 is high volume, aqueous solutions, neutralized on site and discharged to sewers and receiving waters.
Hawaii	30,000	No response		—
Illinois[a]	2,530,000	1,810,000		Manifest data only.
Indiana	1,280,000	94,900,000		Includes 92,3 mmt of steel industry wastes, pending delisting and currently regulated under NPDES permit.
Idaho	80,000	No response		—
Iowa	300,000	No response		—
Kansas[a]	350,000	45,300		Refinery waste, small volume generators.
Kentucky[a]	700,000	415,000	x	—
Louisiana[a]	1,250,000	38,800,000		Fly and bottom ash, small volume generators, substances with LD_{50}.
Maine[b]	130,000	5,290		Mineral spirits, tanning industry waste, small volume generators, infectious waste.
Maryland[a]	590,000	272,100		Waste oil, PCBs, fly ash, and other unspecified waste.
Massachusetts[b]	820,000	172,000		Waste oil.
Michigan[b]	1,990,000	408,000		Extrapolated from manifest data; 280 compounds (including waste oil) not on EPA list.
Minnesota[b]	360,000	181,000		PCBs, crank case oil.
Mississippi[a]	340,000	1,810,000	x	—
Missouri[a]	910,000	658,930		Waste oil,
Montana[a]	50,000	91,200	x	—
Nebraska[b]	120,000	0.5 °/0 of national total)		Special waste including infectious waste.
Nevada	50,000	No response		—
New Hampshire[a]	100;000	9,980		Imported PCBs, waste oil.
New Jersey[a]	3,120,000	855,000		Manifest data only; waste oil, PCBs, some delisted waste, and other unspecified compounds.
New Mexico	60,000	No data		Small volume generators, PCBs, waste oil.
New York[b]	2,320,000	1,270,000		PCBs.
North Carolina	1,330,000	No response		—
North Dakota[a]	30,000	125,000	x	—
Ohio[a]	2,570,000	3,260,000		Solid waste on a case-by-case basis.
Oklahoma[b]	230,000	3,570,000		PCBs.
Oregon[b]	200,000	19,100		PCBs and other unspecified compounds.
Pennsylvania[b]	2,550,000	3,628,000		Other unspecified compounds.
Rhode Island[a]	190,000	1,600		A generally broader definition which includes waste oil, low-level radioactive.
South Carolina[b]	1,140,000	1,587,000		Waste oil, paint waste, unstabilized sewerage sludge.
South Dakota[b]	10,000	1,590		Waste oil,
Tennessee[a]	1,820,000	4,300,000	x	- -
Texas[a]	3,010,000	29,146,960		Generally different definition which includes sludge, fly and bottom ash, water soluble oils, boiler sludges, PCBs, and other solid waste.

Table 18.—Hazardous Waste Generation Estimates by EPA and the States—Continued

State[a b]	Quantity (metric tons)		Universe	
	EPA estimate	State estimate	Same as EPA	State additions
Utah[a]	110,000	558,000	x	—
Vermont[b]	30,000	9,070		Waste oils, infectious waste, PCBs, industrial laundries, some waste delisted by EPA, and other unspecified compounds.
Virginia[b]	1,220,000	181,000		PCBs.
Washington[b]	380,000	616,000		Additional unspecified waste.
West Virginia	790,000	No response		—
Wisconsin[a]	630,000	81,600		—
Wyoming	40,000	No response		—
Guam[b]	n/a	1,450	x	—
Puerto Rico[b]	560,000	417,000	x	—
North Mariana Island	n/a	No response		—
American Samoa	**n/a**	**0**		**—**
District of Columbia	**140,000**	**No data**	**x**	**—**
Virgin Islands	**n/a**	**No response**		**—**
Total	**41,200,000 (excl. 2 terr.)**	**250,000,000 (excl. 10 states, 3 terr.)**		

[a] State data based on Inventory.
[b] State data bawd on consultant and/or State agency estimates.
[c] PCBs are currently regulated under TSCA. EPA is considering transferring regulation of this substance to RCRA jurisdiction
[d] A few States did not supply information to this survey.
[e] The State figure of 15 million tonnes is from the testimony of S. Kent Stoddard, Office of Appropriate Technology, House Subcommittee on Natural Resources, Agriculture Research and the Environment, Dec. 8, 1982, It is based on a recent State study.

Conversions: gallons x 0.00378 - metric tons
tons x 0.907 = metric tons
cubic feet x 0.02828 = metric tons
cubic yards x 0.78441 - metric tons

SOURCE: State estimates and associated Information by ASTSWMO unless noted otherwise; EPA estimates by Office of Solid Waste for 1980.

the **case** of New Jersey, a recent study has indicated that in addition to the wastes reported in the survey results, as much as 3 million tonnes of hazardous wastes annually may be dumped into the ocean. * Data from the remaining responses were derived through use of EPA notifications and estimates of waste generated by industrial sectors represented by the notifications. Only 9 States, Guam, Puerto Rico, and the District of Columbia use definitions of hazardous waste that are reportedly the same as that used by EPA. Thirty-two States have adopted definitions that include RCRA exempted waste (e.g., mining waste, waste from energy production, or waste resulting from the application of environmental controls) or EPA-exempted waste (such as PCBs, or those produced by small-volume generators).

Some **States** have included materials, including hazardous waste and contaminated soil, requiring management under RCRA which have resulted from cleanup actions at uncontrolled sites. Nationally, these cleanup efforts are just beginning. However, very large amounts of hazardous materials will be generated in the future as CERCLA activities increase. It appears that EPA estimates of hazardous waste generation do not include materials resulting from cleanup actions. Nonetheless, the magnitude of this source of "cleanup wastes" to be managed under RCRA is great. In the past, most hazardous wastes have been land disposed (as much as 80 percent) and, according to EPA estimates, 90 percent of these were probably mismanaged. Therefore, several hundred million tonnes of wastes themselves, plus large amounts of contaminated materials (e.g., soil) resulting from leakage, may require management in the future. Estimates for California are that about 100,000 tonnes of hazardous materials will be produced annually from cleanup actions during the next 10 years. Ex-

● This figure for ocean dumping was based on data from EPA permits for five waste generators; other data for 1978 indicated a total of about 2.5 million tonnes. It is quite possible that current tonnages may be less; however, the wastes may still be generated in New Jersey, (Environmental Resources Management, Inc., "Hazardous Waste Management Facility Study for the Delaware River Basin and New Jersey, " May, 1982.)

trapolating to the national level, it is likely that several million tonnes of "cleanup wastes" may be produced annually during the coming decade.

In table 18, five States (California, Georgia, Indiana, Louisiana, and Texas) reported very large volumes of waste which they define as hazardous, totaling about 85 percent of the 250 million tonnes reported. These States define hazardous waste differently from either the EPA universe or other respondents in the survey. For instance, 99,7 percent of the waste reported by Georgia represents dilute aqueous solutions, which are neutralized onsite prior to discharge to sewers and receiving waters, but which, nonetheless, are hazardous waste. In Louisiana, the estimate includes waste from energy production, waste from environmental control activities, and fly and bottom ash. In Texas, the estimate includes large-volume waste from energy production, fly and bottom ash, environmental control activities, mining waste, and waste from the demolition of old highways, bridges, and buildings. Indiana's total of 94.9 million tonnes includes 92.3 million tonnes of spent pickle liquor generated by the steel industry. A request by this industry for deregulation under RCRA has been made to EPA,

Several other points should be noted about the figures in table 18. Many of the federally exempted wastes indicated in table 17 are not now regulated by a significant number of States. Many States have recently conducted, or are now conducting, studies on waste generation to obtain more accurate data on waste generation than previously available from EPA. Moreover, much of the data obtained from the ASTSWMO survey and the data becoming available from individual State studies, cover waste generation within the past 2 years (1981 to 1982), This period is one of a depressed economy and lower levels of industrial operation as compared to the pre-1980 period from which the EPA waste generation data were obtained, On the other hand, there is considerably more effective reporting of waste generation figures now than in earlier years, tending to increase recent estimates relative to older ones, Because of the lack of consistent data from the ASTSWMO survey on amounts of waste generated (corresponding to the federally defined sphere of regulated waste v. State-defined waste) and because of the effect of national economic cycles, direct comparisons with EPA data for the States, also given in table 18 are not completely appropriate.

In addition to the information about waste generation, ASTSWMO asked the States for information about the number of hazardous waste generators in their jurisdictions. Forty-three States and four territories reported approximately 55,000 hazardous waste generators, including in some instances an unspecified number of generators exempted under the EPA program. This figure is substantially lower, and the distribution among States may be substantially different, than the figure of 428,522 currently used by EPA in its formula for allocation of funds to the States. However, the figure of 55,000 generators is in agreement with the 60,000 notification responses which were received by EPA in 1980 (as previously discussed), and with the less than 8,000 waste management facilities verified for 1981 (discussed below).

The foregoing existing data correspond to items discussed under Federal and State Government data needs in the previous section. These data may also be of use in formulating strategies and regulations for hazardous waste, Industry's need for data concerning generators and generation does not appear to be substantial. The public's data needs concerning generators and generation will be met progressively as data collected by Federal and State authorities become more reliable.

Uses of Existing Data

The previous discussion of existing data identified various studies that have attempted to quantify both the number of waste generators throughout the Nation and the amount of waste produced annually, These studies have often lacked adequate definitions of hazardous waste, and there have been variations in definitions among the studies. Also, indirect meth-

ods of waste measurement were used in these studies, and direct generation data were sometimes lacking. These problems have led to a discrepancy between the actual quantity of hazardous waste generated annually in the Nation and the quantity perceived in any one study. There are variations among the various studies in perceived quantities of hazardous waste generated.

The reason for seeking waste generation data is to determine means for managing (storing, recovering, treating, transporting, and disposing of) actual—as opposed to perceived—generated waste, in a manner commensurate with the protection of health and the environment. Therefore, the following questions must be addressed:

1. Are the existing generation data useful for the task of actual hazardous waste management?
2. How are these data currently being used for this task?
3. What are the limitations of these data for this task?

Existing National and State generation data represent at best a limited characterization of actual generated waste. These data indicate to some extent the type of waste being generated, relative quantities, and fractional distribution by State. The data cannot be used as a measure of actual waste (by type or in total) being generated in any one State or in the Nation, except to infer that a large quantity of hazardous waste is in fact being produced annually, and that this waste must be managed quickly and effectively.

EPA has found only one administrative use for the existing generation data—in the allocation of Federal funds to State waste management programs, as described below. Faced with the uncertainties implicit in the generation data, and with the need to begin a hazardous waste management program, EPA made two strategic decisions. It was decided that the most pressing problem was industrial hazardous waste from certain priority industries, and that these **wastes** were adequately characterized with regard to waste type and distribution (for preliminary purposes) by the industry reports (5-19) and the derivative study by Booz Allen and Hamilton (29). Furthermore, the decision was made to allocate Federal funds to States using a formula whereby 40 percent of the amount for a State was determined by its fraction of the national waste stream (28.7 million tonnes), 40 percent by its fraction of the Nation's population, 15 percent by its fraction of the Nation's hazardous waste generators (428,522 was used even though only 60,000 responses were received by EPA from those receiving notification forms), and 5 percent by its fraction of the Nation's land area.

It is EPA's intention to progressively modify the values used in the fund allocation formula (and perhaps the formula itself) to reflect improved waste generation and population data, and changing definitions of hazardous waste, for fiscal year 1983 and beyond. The allocation formula was developed some 3 years before completion of the Booz Allen and Hamilton study and has been incorporated in EPA regulations up to the end of fiscal year 1982. It was "unanimously approved by more than 20 State representatives of the National Governors Association" (34). However, this was before there were indications that the data used by EPA might be seriously in error, as more recent State data suggest.

EPA's use of existing data for Federal fund allocation was probably necessary, given its need to act. EPA is certainly aware of the need to improve its generation / generator data base. Further, OTA has been unable to identify any additional administrative use for the existing data, However, as indicated earlier, public sense of hazardous waste problems provides an important influence on public, political, and regulatory activities. On the basis of the EPA estimates for hazardous waste generation and past practices, information concerning the national problem can be communicated to the public. For example, the accumulation of hazardous waste in the environment from past decades of industrial activity is currently equivalent to at least 1 tonne of hazardous waste for every person in the Nation and another tonne is added every 7 years, at cur-

rent rates. These estimates may even be too low. If ASTSWMO waste generation data are more indicative of the national problem, then more than a tonne of hazardous waste may be placed into the environment every year for every person in the Nation.

Data Requirements: Health and Environmental Effects

For effective hazardous waste management, the effects of hazardous waste on health and the environment must be known to government, industry, and the public. Determination of the effects of a particular waste on a particular population can involve some very complex issues (see ch. 6 for a detailed discussion of hazards of waste and problems and data needs associated with determining hazard levels). In order to address the effects of waste comprehensively, data are required concerning:

1. the characteristics of waste: constituents, chemical, and physical data;
2. environmental characteristics: pathways, physical characteristics of the environment (air, water, soil), and distribution and characteristics of the population;
3. toxicological data: dose response and exposure factors; and
4. environmental fate and distribution: persistence, bioaccumulation, and media distribution.

Existing Data

It is generally understood that the number of chemical compounds currently recognized in the United States exceeds 3 million and approximately 3,000 new ones are being added each year. The physical and chemical characteristics of these substances can be obtained. There is a subset of these known chemicals for which health and environmental effects data have been collected, and about 500 chemicals are being tested under the Toxic Substances Control Act (TSCA) jurisdiction each year to broaden the scope of these data. In addition, TSCA requires industry to characterize all new chemicals, and chemicals for which they plan new uses, with respect to health and environmental effects that may occur through commercial use and disposal. It is not known whether the subset of chemicals for which detailed and reliable information is available represents a significant portion of all existing substances that pose a threat to health and the environment.

The known hazardous effects of the various chemicals can be classified into three groups:

1. physical harm—burns, or other effects due to exposure to acids, caustics and the like;
2. toxic effects—acute and chronic damage; and
3. genetic impairments—a variety of effects directed to genetic components of cells.

Much of the available data is derived from animal studies. The problems that result from extrapolating these data to humans are discussed in chapter 6. Information about chemical characteristics and known effects is reported in a variety of data bases illustrated in table 19. In principle, all of these data are available to the public, but few mechanisms are in place (within Federal and State programs) to facilitate public access or public understanding. The data are being developed by various groups including universities, the National Institute of Environmental Health Science, the National Institute of Health, the Centers for Disease Control (CDC), and the National Institute for Occupational Safety and Health. CDC maintains a large quantity of epidemiological data. As required by TSCA, industry supplies EPA with data on each new substance developed, including its chemical and physical properties, its health and environmental effects, and some limited information on waste management. All of these data are developed under statutes other than RCRA and may not specifically address RCRA concerns.

Table 19.—Health and Environmental Effects Data

Source	Subject	Where maintained
MEDLINE	Recent articles on research; articles on diseases and chemicals,	National Library of Medicine
TOXLINE	Toxicological information from human and animal toxicology studies; the effects of chemical on the environment; adverse drug reactions; analytical methodologies.	National Library of Medicine
EPA-NIH Chemical Information System	Physical, chemical, and regulatory information about chemical substances.	National Institutes of Health
International Register of Potentially Toxic Chemicals	17 profiles on chemicals: essential physical and chemical properties; toxicity; reported effects on humans and laboratory organisms, and the environment; safe and effective use of chemicals.	UN Environment Program
Toxicology Data Bank	Literature on general toxicology which has been subjected to peer review.	Library of Medicine
Registry of Toxic Effects of Chemical Substances	Toxic effects of chemicals, including aquatic toxicity rating, cancer reviews.	NIOSH, CDC, Public Health Service
Chemical Activity Status Report	Lists chemicals research, authority for research, purpose, and information contact.	EPA

SOURCE: Office of Technology Assessment,

The threat that a hazardous substance poses to health and the environment can take many forms and vary significantly in degree (see discussion of hazard in ch. 6). Although a variety of tests are available to generate data concerning health effects, there has been little effort made to standardize protocols for interlaboratory comparisons of a single compound, or to standardize methodologies that facilitate comparisons among compounds for a variety of species.

Little data are available regarding the fate of any given waste constituent once it enters the environment. There are virtually no data concerning the interactions among various compounds in a waste, and there exist virtually no data on, or experience with, testing mixtures of chemicals for potential health and environmental effects. In some cases, data on individual compounds can be used for prediction.

The existing data on health and environmental effects of hazardous waste constituents only begin to address the various data needs concerning these issues that were listed in the previous section. The lack of progress in this area is becoming a major issue. For example, with regard to the CERCLA requirement for the formation of the Agency for Toxic Substances and Disease Registry in the Department of Health and Human Services, one of the originators of CERCLA has noted:

> Two years have passed since the law was enacted and virtually nothing which HHS was instructed to do has been done. As a result, the General Accounting Office is now investigating the Department's conduct (35).

A concern for the health and the safety of the environment is the driving force of hazardous waste management efforts. Unfortunately, the available information concerning the effects of hazardous substances on health and the environment is far from complete, and many of the issues involved are poorly understood. Hazardous waste management efforts-including regulation, the design and operation of facilities, siting, permitting, monitoring, and enforcement—are proceeding, even though they are sometimes based on perceptions rather than on sound data. The process of integrating health and environmental effects data into the design of management facilities, and using these data to control the operation of such facilities, is in its infancy. However, these efforts do not currently give sufficient consideration to health and the environment (see ch. 6 for greater detail regarding this issue).

Data Requirements: Management Facilities

Data related to management facilities are needed by government and industry, In many cases, the same data are used for different purposes.

Government needs data on facilities for effective regulation of them, for monitoring compliance with the regulations, for selecting fruitful areas for research and development (R&D), for actions required under CERCLA, and for providing information to the public. Government must respect the proprietary nature of much of this information.

In order to write regulations, data are required on available management technologies—their types and performance—and whether or not these technologies, in managing existing waste, can reduce exposure of people and the environment. This information, may lead to restricting certain types of waste to specific management technology design and performance standards (W, T).

In order to implement hazardous waste management regulations, data are required for the siting, permitting, and monitoring of facilities, and for monitoring the transportation of hazardous waste, Siting of facilities may be done by zoning certain land areas as appropriate to specific types of management technologies, or by selecting individual sites. Both environmental data and technology performance data are needed for zoning (T). In addition, the siting of an individual facility may require degree-of-risk data for the proposed facility (T, F).

The permitting process is the key to effective hazardous waste management and requires detailed facility data. These include the identification of management facilities, the nature and volume of the waste being managed, health and environmental impact data, the degree of risk offered by the proposed facility, and the financial capabilities of the facility operator to maintain the facility in the event of its closure, and for liability contingencies (F).

Monitoring the performance of waste management facilities requires data concerning both the facility itself and the surrounding environment, Data on the facility itself include visual inspection data (e. g., the detection of leaks or ruptures); process data (e.g., temperatures, flow rates, chemical concentration levels); and data concerning the nature of the release of substances from the facility to the environment—the characteristics of the substances released, the quantities released, and where, when, and in what manner environmental systems were exposed to these substances. Data on the ambient environment of the facility are required to track the long-term response to the released substances. The performance of the facility may have to be modified if these data show an unacceptable response (E, F).

To establish R&D priorities, technology data are required concerning the performance of available management technologies, and the level of performance improvement necessary to remove continuing threats to environmental and human safety.

For monitoring the transportation of hazardous waste from generators to offsite management facilities, various facility data are required (F), The characteristics of waste transported, along with the source and destination of transported waste should be determined, Data regarding transport vehicles (required to ensure that accidental releases of hazardous substances are minimized), dates of transportation and receipt, and the safety measures required in case of accidental release should be adequately defined.

Facility data will be needed to identify waste management facilities that may require cleanup action under CERCLA. These facility data may overlap somewhat with the data on hazardous waste management facilities regulated under RCRA

Industrial data needs on facilities must be satisfied if industry is to play an effective role

in hazardous waste management. Various types of data are required for the design of new management facilities and for decisions regarding the use of existing facilities for handling new waste. These data needs include:

- input waste characteristics and volume (F);
- design specifications—design standards and performance standards, both regulated and unregulated (T);
- potential of release of hazardous constituents into the environment and degree-of-risk data (F);
- health and environmental effects data (E, W);
- economic analysis of specific technologies (T);
- ability to reduce hazard level of waste or to adequately contain waste for a specified time period (F); and
- manpower required to operate the facility (F).

In the operation of management facilities, industry requires data in the following categories:

- input-output waste characteristics (F);
- day-by-day performance characteristics (F);
- ambient environment monitoring data (E);
- characteristics and quantity of waste in storage, and available storage capacities (F); and
- worker and environmental exposure to hazardous substances (F).

Facility data are also required to indicate areas and priorities for R&D. This need is similar to that described in government data needs, above. In planning for expansion, industry requires data including:

- amount of waste generated in a State or region of concern (W, S);
- existing management facilities, their capacity, and volume of waste throughput (F);
- available management alternatives for prospective generated wastes—e.g., material/energy recovery, incineration, storage (T);
- transportation needs (F); and
- availability of suitable sites (T, F).

The public needs data to understand what is proper waste management, The public should have easy access to nonproprietary data of the above types. In addition, information on monitoring and enforcement programs should be made available to the public,

RCRA mandated collection of information on waste management facilities in operation prior to RCRA permitting. Initially, these data were compiled from industry applications for hazardous waste permits, known as part A applications. Two subsequent surveys were conducted by EPA to determine the validity of these data. A number of additional efforts within the EPA Office of Solid Waste have attempted to identify hazardous waste management facilities. The best known of these efforts is a 1980 report (29), which was updated in 1982 (36]. An ongoing survey effort, due in 1983, may provide additional detailed information on 2,500 hazardous waste management facilities. "The latter data will be used as background information for the RCRA Regulatory Impact Analysis.

Facility information has also been gathered under other environmental laws. For instance, surface impoundment and open dump inventories have been conducted under the Safe Drinking Water Act and the solid waste provisions of RCRA respectively. CERCLA requires the annual listing of at least 400 hazardous waste management facilities requiring priority remedial action. Facilities that discharge treated wastewater into the Nation's waters must obtain NPDES permits under the Clean Water Act, Inventories conducted under the authority of other environmental acts may provide qualitative measures of the accuracy of the part A submissions.

The part A data were compiled from industry information submitted in 1980, when EPA required all operating hazardous waste management facilities to submit an application for an interim status permit (37). The facilities that submitted applications were to be subjected to additional State and Federal reviews prior to receiving full permit status. Information from

this data base has been used to formulate continuing surveys of facilities.

Problems inherent in this data base stem from confusion about the type of information requested. Information required included:

1. location and ownership of the facility;
2. function–storage, treatment, disposal;
3. types of technologies employed—e.g., landfill, surface impoundment, incinerator;
4. capacity of the facility;
5. types and quantities of waste throughput; and
6. whether and to what extent the facility was subject to regulation under other environmental acts.

Standardized measures (e. g., measures of capacity] and specified criteria were not required. Furthermore, definitions given in the application were poorly stated and space for responses was often inadequate. Approximately 10,200 responses were received by EPA, of which only some 60 percent included capacity data. Also, discussions with EPA personnel suggest that, in particular, responses to items 4 and 5 are unreliable. The completeness and accuracy of the information are, therefore, questionable. However, it may be necessary to use this information, since it is the best available.

The applications have been subjected to two telephone validation surveys (38). The first of these, covering approximately 700 facilities, indicated that the original part A data represented an overstatement of available hazardous waste management services. The results of the second survey, which reached about 85 percent of the facilities in the part A data base, are shown in tables 20 and 21. EPA's estimates of nationwide numbers of facilities, and waste throughput or technology capacity were derived with a methodology that allows for the fact that not all part A respondents were reached. Table 20 shows that an estimated total of 7,785 hazardous waste management facilities in nine technology classes were operating in the Nation in 1981. Waste throughput estimates were provided for seven of the nine technology types and facility capacity estimates were provided for two technology types (storage and treatment tanks]. Due to incomplete data for both waste throughput and capacity, and because figures for all are given in inconsistent units of measure, no meaningful total national capacity or waste throughput estimates can be made for the hazardous waste management industry.

Table 21, derived from the part A data and its second validation, shows the estimated number of commercial offsite hazardous waste management facilities in the Nation during 1981, the estimated waste throughput for the first seven technology types, the estimated facility capacity for the last two technology types, and the estimated proportion of total na-

Table 20.—Hazardous Waste Management Facilities During 1981 (regulated under RCRA

Technology type	**Original** Part A data	**Estimated** number of sites	Estimated total
			Waste throughput
Injection wells	159	114	3.5 billion gal
Landfills	545	270	8.3 million tons
Land treatment	222	148	8,600 acres[a]
Surface impoundments	1,754	1,096	**28.8** million square yards[a]
Waste piles	585	312	13.2 million cubic yards[a]
Incinerators	608	317	272 million gal
Storage containers	7,551	5,652	57 million gal
			Estimated capacity
Storage tanks	4,230	2,280	303 million gal
Treatment tanks	3,013	1,951	3.1 billion gal
Total	10,247	7,785	n/a

[a]Westat's questionnaire requested throughput data, the figures given In units of area do not represent either throughput or capacity

SOURCE Westat and EPA, 1982.

Table 21.—Number and Size of Commercial Offsite Facilities During 1981 (regulated under RCRA

Technology	Estimated total number	Estimated total during 1981	Percent of national facilities
		Waste throughput	
Injection wells	4	n/a	n/a
Landfills	54	2.1 million tons	25.0
Land treatment	11	276.1 acres[a]	3.2
Surface impoundments	29	1.1 million square yards[a]	**3.8**
Waste piles	**5**	n/a	n/a
Incinerators	**43**	n/a	n/a
Storage containers	**49**	860,000 gal	1.5
		Estimated capacity	
Storage tanks	47	*15* million gal	4.9
Treatment tanks	22	7.1 million gal	0.2
Total	**125**	n/a	n/a

[a]Westat's questionnaire requested throughput data; the figures given in units of area cannot represent either throughput or capacity and therefore appear to be meaningless.

SOURCE: Westat and EPA, 1982.

tional waste throughput or waste management capacity at these facilities. An estimated total for 125 such facilities is given. Commercial offsite facilities represented in table 21 are defined as "those facilities that reported generating a low percentage (10 percent or less) of the hazardous waste they handled in 1981 and indicated that commercial waste management was the primary activity at the site" (37).

In 1980, EPA released a report that estimated the availability of offsite commercial hazardous waste management services, which constitute a small subset of total hazardous waste management capacity. In the context of the EPA report, the term "commercial facilities" includes facilities engaged in treatment and disposal for fee, but excludes waste oil refiners, resource recovery facilities, storage and transfer stations, waste brokers, conventional sanitary landfills, and publicly owned wastewater treatment works" (29). The report was intended to enable EPA to evaluate various regulatory alternatives that influence demand for offsite waste management services. The report provides estimates for the number and capacity of existing commercial hazardous waste management in the Nation, and for needed additional national and regional hazardous waste management capacity by technology type.

The report provides only general indications of its sources of information-–EPA files, industry service directories, and telephone surveys. The capacities of facilities failing to respond were computed using data from similar facilities. The report considers '127 commercial facilities, roughly 50 percent of the commercial facilities submitting part A applications, but all of the commercial facilities according to the recent validation study noted above. It does not contain data on any onsite management facilities, or generator-owned offsite facilities. The report estimated that the commercial facilities (about 2 percent of total hazardous waste management facilities) represented about 20 percent of available national hazardous waste management capacity. This is consistent with the generally accepted view that usually about 15 to 30 percent of hazardous waste in a State are managed offsite.

Total national and regional management facility capacity needs for the early 1980's are also estimated by technology type. The report indicates that, while adequate hazardous waste management capacity currently exists in the Nation, it maybe poorly distributed relative to generation.

In 1982, Booz Allen and Hamilton (36) updated their previous report (29). This update

considered the activities of only nine firms operating 46 commercial facilities. This updated report discusses the activities of these facilities during 1981, and the effect of EPA regulations on those activities, but gives no further insight into the national or regional character of the overall hazardous waste management industry, It does indicate, however, that capacity utilizations in 1981 were relatively low, which is consistent with lowered rates of waste generation in recent years resulting from lowered levels of industrial activity.

Management facility data have also been collected in studies performed for the States, However, only a fraction of the States appear to have collected such data: California, Louisiana, Michigan, New Jersey, North Carolina, and Texas. While currently limited, State data will be improved progressively through the permitting process. Presently, few States have received EPA authorization to implement permitting programs. These States that have received this authority (by October 1982) are Arkansas, Georgia, Mississippi, North Carolina, South Carolina, and Texas, Oklahoma's authorization is due in late 1982. Extant State data on management facilities have not been analyzed by OTA.

CERCLA Sites.–National estimates of the number of sites that contain hazardous waste and that may require cleanup, have been provided by two studies: an EPA consultant report by Fred C. Hart Associates (39) and a report by the Chemical Manufacturers Association (CMA) [40). Their estimates of the number of sites range from 4,800 (the CMA study) to 30,000 to 50,000 sites (the EPA consultant estimate). The CMA estimate was based on a telephone survey of the States, but does not say how many States provided data, or how the States that did respond derived their figures. The EPA consultant report was derived from compilations of data provided by EPA Regional Offices, but no consistent methodology appears to have been employed by these offices. Few of the sites were visited during the course of the EPA consultant study. In February 1983, EPA had about 15,000 uncontrolled sites in its national inventory, According to EPA data, preliminary assessments had been carried out for only 14 percent of the sites, and site inventories had been completed for 2 percent of the sites in the inventory as of December 1982.

In 1982, EPA published a list of 115 hazardous waste disposal sites as the interim national priority CERCLA sites, This list was later extended by 45 additional priority sites that were judged also to pose substantial threats to health and the environment. EPA's methodology for ranking uncontrolled sites is discussed in some detail in chapter 6. In December 1982, EPA released the first complete National Priority List of 418 sites, and intends to periodically update this list.

Summary .—The existing facilities data described above do little to satisfy the data needs of government, industry, and the public concerning management facilities. The only need that these existing data do satisfy (and then only marginally) is that of identification of management facilities and the technologies they employ,

A significant quantity of required technology level data (T) are available to industry, government, and the public. These data are discussed in chapter 5.

The required facility level data (F) that currently exist are largely in the hands of industry. Much of these data will progressively pass to government, and some in turn to the public, as a result of the permitting process,

Existing EPA facilities data is being used as a source, for the States and EPA, of names and addresses of facilities that may require permitting by the States. The determination of a given facility's need for a permit, the process of issuing the permit, and the monitoring of the facility's compliance to the requirements of the permit all require data beyond the scope of the validated part A data.

The data are also used as a source by the public, of facilities that have reported to EPA an involvement in hazardous waste management. This information provides communities with a primary focus for local concerns about the management of hazardous waste. It also en-

ables communities, concerned about the presence and operation of a given waste management facility, to determine whether EPA or the State currently recognizes that facility as handling hazardous waste–facilities not so recognized will not be permitted and regulated.

These EPA data resources are also used to identify those management facilities that are offsite or commercial facilities, and are therefore receiving transported hazardous waste. This information might be useful to the transportation industry in its market surveys. It might be useful to the public because it defines where hazardous waste is going. In addition, such information should prove useful to the States in their efforts to establish manifest systems to regulate the transportation of hazardous waste.

The waste throughput and capacity estimates included in the EPA data appear to have little practical use. These data are incomplete. They appear to represent capacity for managing both hazardous waste (as defined by EPA) and other solid waste, as well as hazardous waste defined differently by States, or to represent total waste throughput while not distinguishing hazardous waste from other waste. Moreover, even though the data are for facility and technology type, they do not indicate what waste constituents can be managed in each facility. Consequently, it is not possible to compare the quantity of a given type of waste generated in the Nation, or in any State, with the capacity available to manage it. In some cases, the units of measurement for throughput reported in the national data are simply inappropriate. For example, surface impoundment "waste throughput" is reported in units of area (square yards). The appropriate measure of the quantity of waste that might be treated in such a way would be volume per year (gallons per year), Since evaporation—and perhaps drainage and leaching— continually decreases the volume of waste in a surface impoundment, an appropriate and useful measure of surface impoundment throughput would be the waste input volume per year that the impoundment could handle, or the waste input weight per year. Similar attention to appropriate units must be given to capacity data whenever these are collected.

If both management capacity data (in the appropriate units) and waste throughput data (in the same units) were available at a facility and technology level for the Nation, and if these data indicated the waste constituents to which the capacity and waste throughput figures applied, then such data could serve several purposes. Both government and industry could determine the distribution of hazardous waste among management technology settings. This data, in concert with other information, would provide a basis for assessing the impact of regulations on a given technology class. However, EPA does not dispute the generally held view, based on its early and more recent data, that as much as 80 percent of hazardous wastes continue to be disposed or dispersed in or on the land. * Also, both government and industry could ascertain those management facilities that were operating near maximum capacity. This would indicate management facilities requiring expansion, and the level of expansion required by an increase in production of waste of the type handled by those facilities, or by the closing of management facilities handling similar waste. Government and industry could also gauge the expansion of the various waste generating industries that could occur without a

*For example, 83 percent of the hazardous waste generated by 14 industries were placed in or on the land, based on 1975-78 data. ("Subtitle C - RCRA Draft Final Environmental Impact Statement–Part I," EPA, April 1980) This figure appears consistent with EPA's statements concerning the fraction of hazardous waste properly managed: "Less than 10 percent of these hazardous manufacturing wastes are estimated to have been treated/disposed in an environmentally adequate manner. " RCRA Subtitle C–Hazardous Waste Management: Regulatory Analysis," EPA, Apr. 30, 1980.) The recent validation survey of management facilities indicated that in 1981 about 20 million tonnes of hazardous waste were disposed in injection wells and landfills, but no data were available for other forms of land disposal such as land treatment and surface impoundments or for ocean disposal; therefore, there is confirmation that more than half of currently generated waste are placed into the environment. The ASTSWMO survey also provided some data on land disposal. For example, 1981 data for Louisiana indicates that 97 percent of waste managed offsite are land disposed, and that about 50 percent of the waste managed onsite (99 percent of total) are land disposed. Recent data for Texas indicates that 95 percent of their hazardous waste enter the land, but in Missouri and Massachusetts only 40 and 7 percent, respectively, is land disposed.

need for expansion of corresponding waste management industries and could determine fruitful areas for R&D. Such R&D could lead to modifications of industrial processes that generate waste in a manner that would reduce the quantities of certain types of generated waste, thereby reducing loads on the management facilities that handle that waste. Such modifications could be based on both waste generation and management data of the facility type. Research and development could also lead to new management technologies to handle types of generated waste not adequately handled in existing facilities. This requires detailed generation data, management technology data, and health and environmental effects data.

Another benefit of R&D would be the conservation of national resources. The national view of management facility activities may well identify substantial quantities of energy and materials that could be recovered in a cost-effective manner, rather than being lost in the process of treatment and disposal. The data necessary for these purposes could be collected by EPA through national surveys or could be obtained through the States by means of State surveys and the facility permitting process. Clearly, the uses noted for such data could also be made of any set of State data of the facility and technology types.

It is clear that the information concerning sites containing hazardous waste that may pose a threat to health and the environment is inadequate both from the standpoints of validity and immediate usefulness. Information previously collected by EPA, the States, and industry (39,40) serves as a starting point for investigations preliminary to cleanup, This is, in fact, how the data are being used. However, little information appears to be available about the specific waste contained in these sites, the technologies employed in the facilities, or the risk to health and the environment posed by waste management practices. Such data are fundamental to evaluations preliminary to cleanup activities.

Priorities for Data Acquisition

The foregoing discussion has indicated that a large discrepancy exists between the data required for effective hazardous waste management and that existing at various levels. Considerable effort is required if this discrepancy is to be removed, and the task must be appreached with urgency if damage to health and the environment is to be minimized.

The following data are considered to have the highest priority in this data acquisition effort.

. Health and environmental effects data.—A sound understanding of the effects of hazardous waste on human health and the environment is essential for effective hazardous waste management. It enables the identification of hazardous substances and their relative hazards, assists in setting design and performance standards for management facilities, provides meaningful-reference data with which to evaluate monitoring data, and provides the assurance that management measures adopted are indeed sufficient (see ch. 6).
- Facility data concerning hazardous waste generators and management facilities.–Identification by government of all hazardous waste generators and the volume and nature of their waste is crucial if the problem of hazardous waste is to be fully addressed. Control of management facilities is crucial–this will be possible through the permitting of such facilities.
- Current data for each available hazardous waste management technology.—This data on technologies would include information concerning, primarily, performance and degree of risk. The relationships between input waste characteristics

and output residual waste and effluent characteristics. These data may be used to emphasize the capabilities and limitations of certain technologies to handle particular types of waste, as well as areas that require further R&D (see ch. 5). Though of less importance than performance data in the short term, degree of risk data that addresses site-specific factors are desirable in the long term for effective and reliable management (see ch. 6).

- Data suitable for establishing facility design and performance standards.—These standards must be periodically updated to reflect growing knowledge of health and environmental effects, and to take advantage of evolving management technologies (see ch. 5).
- Data concerning alternative industrial processes (in waste generation industries) that reduce the volume and hazard of waste (see ch. 5).
- Data concerning the costs, to industry and government, of implementing regulations governing hazardous waste management.–(unit **cost** data for management options are discussed in ch. 5, and national industry and government costs are discussed in ch. 7.)
- Data concerning CERCLA sites.—Data are needed on the wastes deposited in the sites, the technologies employed, the risks associated with the continued residence of waste in these sites, and the risks associated with remedial activities at the sites. A systematic investigation of sites is needed and will require extensive financial and manpower resources (see ch. 5). *

*Congress recognized this problem **and** appropriated $10 million from CERCLA funds for sec. 3012 of RCRA for fiscal year 1983. States will receive these funds to develop inventories of hazardous waste sites that may require CERCLA attention. However, the implementation plan by EPA is not focused on discovering new sites, but on gathering more information on known uncontrolled sites.

Chapter 4 References

1. The Resource Conservation and Recovery Act, Public Law 94-580, sec. 1004 (7).
2. Ibid., sec. 1004 (27).
3. Ibid., sec. 1004 (5).
4. Ibid., sec. 3001 (a).
5. “Assessment of Industrial Hazardous Waste Practices—Leather Tanning and Finishing Industry” (NTIS order #PB 261-018).
6. “Assessment of Industrial Hazardous Waste Practices—Inorganic Chemicals Industry” (NTIS order #PB-244-832/2WK).
7. “Assessment of Industrial Hazardous Waste Practices—Paint and Allied Products Industry, Contract Solvent Reclaiming Operations, and Factory Application of Coatings” (NTIS order #PB-251-669).
8. “Assessment of Industrial Hazardous Waste Practices—Storage and Primary Batteries Industries” (NTIS order #PB-241-204/7WP).
9. “A Study of Waste Generation, Treatment and Disposal in the Metals Mining Industry” (NTIS order #PB 261-052).
10. “Assessment of Industrial Hazardous Waste Practices—Organic Chemicals, Pesticides, and Explosives Industries” (NTIS order # PB-251-307).
11. “Assessment of Industrial Hazardous Waste Practices—Textiles Industry” (NTIS order # PB-258-953).
12. “Assessment of Hazardous Waste Practices in the Petroleum Refining Industry” (NTIS order #PB-259-097).
13. “Pharmaceutical Industry Hazardous Waste Generation, Treatment, and Disposal” (NTIS order #PB-258-800/2WK).
14. “Assessment of Industrial Hazardous Waste Practices—Special Machinery Manufacturing Industries” (NTIS order #J? B-265-981).
15. “Assessment of Industrial Hazardous Waste Practices—Electronic Components Manufacturing Industry” (NTIS order #PB-265-532).
16. “Assessment of Industrial Hazardous Waste Practices—Electroplating and Metal Finishing Industries—Job Shops” (NTIS order # PB-264-349).
17. “Assessment of Industrial Hazardous Waste Management—Petroleum Re-Refining Industry” (NTIS order #PB-272-267/6WK).

18. "Assessment of Industrial Hazardous Waste Practices in the Metal Smelting and Refining Industries" vol. 1 (NTIS order #pi)-276-169); vol. 2 (NTIS order #PB-276-l70]; vol. 3 (NTIS order #PB-276-171); vol. 4 (NTIS order #PB-276-172).
19. "Assessment of Industrial Hazardous Waste Practices–Rubber and Plastics Industry" (NTIS order #PB-282-069).
20. Environmental Protection Agency, *A Compilation of Statistics on Solid Waste Management Within the United States* (Washington, D. C.: JRB Associates, contract No. 68-01-6000, 1981].
21. Environmental Protection Agency, *Final Report on Cost of Compliance With Hazardous Waste Management Regulations* (Washington, D. C.: Battelle Columbus Laboratories, contract No. 68-01-4360, 1977).
22. Environmental Protection Agency, *Summary Data for Selected Hazardous Waste Generator Industries, Volume I, Economic and Technical Profiles (working document)* [Washington, D. C.: Development Planning and Research Associates, contract No. 68-01-6322, October 1981).
23, Environmental Protection Agency, *Impact Analysis of Proposed RCRA-FSS Regulation, 1980-1990, Volume I, Draft Technical Document* (Washington, D. C.: Development Planning and Research Associates, November 1980).
24. Ibid., vol. 11, November 1980.
25. Environmental Protection Agency, "Draft Economic impact Analysis of Subtitle C Resource Conservation and Recovery Act of 1976 (Regulatory Analysis Supplement)" (Washington, D. C.: Arthur D. Little, January 1979).
26 Environmental Protection Agency, *Preliminary Working Draft in Preparation of an Environmental Impact Statement for Subtitle C, Re source Conservation and Recovery Act of 1976 (RCRA) Volume II, Appendices A-J* (Washington, D. C.: EPA, undated).
27. Environmental Protection Agency, internal document, Office of Solid Waste, undated.
28. Environmental Protection Agency, *Technical Environmental Impacts of Various Approaches for Regulating Small Volume Hazardous Waste Generators* (Washington, D, C.: TRW, contract **Nos. 68-02-2613** and 68-03-2560, December 1978).
29. Environmental Protection Agency, *Hazardous Waste Generation and Commercial Hazardous Waste Management Capacity* (Washington, D. C.: Putnam, Bartlett and Hays, and Booz Allen and Hamilton, GPO SW894, 1980).
30. A. D. Little, "Hazardous Waste Generation in New England, " memorandum to the New England Council, August 1982.
31. A. D, Little, "A Plan for Development of Hazardous Waste Management Facilities in the New England Region, " report for the New England Regional Commission, September 1979.
32. Great Lakes Basin Commission, "Hazardous Waste Management in the Great Lakes Region," Technical Report IV, Ann Arbor, Mich., August 1980.
33. Association of State and Territorial Solid Waste Management Officials, survey conducted for OTA, 1982.
34. Federal Register, vol. 43, No. 186, Sept. 25, 1978,
35, Sen. Robert T. Stafford, "Hazardous Waste and Superfund, " speech at meeting of National Conference of State Legislatures, Washington, D. C., Dec. 8, 1982.
36. Booz Allen and Hamilton, "Review of Activities of Major Firms in the Commercial Hazardous Waste Management Industry: 1981 Update, " May 7, 1982.
37. Environmental Protection Agency, "Application for a Hazardous Waste Permit: Consolidated Permits Program" (EPA forms 3510-1 and 3510-3), June 1980.
38. Environmental Protection Agency, "Report on the Telephone Verification Survey of Hazardous Waste Treatment, Storage and Disposal Facilities Regulated under RCRA in 1981, " Westat, Inc., November 1982.
39, Environmental Protection Agency, "Preliminary Assessment of Clean-up Costs for National Hazardous Waste Problems, " Fred C. Hart Association, 1979.
40. *Environmental Reporter,* vol. 10, **1980,** p. **2159.**