

**National Survey of Hazardous Waste
Generators and Treatment, Storage,
and Disposal Facilities Regulated
under RCRA in 1981**

PRELIMINARY

HIGHLIGHTS

OF FINDINGS

August 27, 1983

SUMMARY

Preliminary estimates resulting from a two year study to be completed in November by the U.S. Environmental Protection Agency (EPA) indicate that nearly four times as much hazardous waste is generated annually in the U.S. than the Agency had previously estimated. Furthermore, the study indicates that of the 60,000 firms that have identified themselves to the Agency as hazardous waste generators, less than one fourth of these firms generated regulated quantities of hazardous waste during 1981, the selected study year.

The study is based upon a statistical survey of hazardous waste generators and treatment, storage, and disposal facilities regulated by EPA under the Resource Conservation and Recovery Act of 1976 (RCRA). The preliminary projections are derived from information provided by those surveyed regarding their hazardous waste generation and management activities during calendar year 1981, the first complete year following implementation of the RCRA regulatory program.

The initial estimates are preliminary in nature and are subject to statistical uncertainties. Nonetheless, the study suggests that 150 million metric tonnes of hazardous waste were generated across the U.S. and its territories during 1981, in contrast to previous estimates of 40 million metric tonnes per year. (One metric tonne equals approximately 1.1 english (short) tons.)

The larger quantities of hazardous waste appear to have been generated by only a small portion of the generators that have listed themselves with the Agency. EPA required all generators and potential generators of hazardous waste to file notification forms with the Agency in 1980. Nearly 60,000 firms filed generator notification forms. The survey, however, estimates that only 14,100 of those who notified actually generated regulated quantities of hazardous waste during 1981. Many of the notifiers not generating regulated quantities may be RCRA-exempt small generators (less than 1,000 kg. generated per month) or may have notified for protective reasons: EPA encouraged firms to notify even if they were in doubt about their status as hazardous waste generators.

The preliminary estimates also indicate that less than 60% of the treatment, storage, and disposal facilities listed with the Agency managed hazardous waste in regulated processes during 1981. Currently, more than 8,500 Part A permit applications are on record at EPA. Part A applications were submitted by facilities in 1980 to indicate that they managed or intended to manage hazardous waste. Preliminary results of the survey, however, indicate that only 4,800 of these RCRA-regulated facilities managed hazardous wastes in regulated processes during 1981.

EPA's Office of Solid Waste commissioned the survey. A final report on the study will be completed in November and made available to the public. In addition, a number of reports targetted to specific regulatory issues will be produced over the next six to twelve months, drawing upon the more than 6,000 statistical data elements collected from the 12,500 respondents to the survey.

INTRODUCTION

The information presented in this package summarizes the preliminary findings of an extensive national survey of hazardous waste handlers regulated under Subtitle C of the Resource Conservation and Recovery Act of 1976, as amended (RCRA).

The survey, conducted by mail during the fall of 1982 and the spring of 1983, was sponsored and directed by the U.S. Environmental Protection Agency's Office of Solid Waste (OSW). Westat Research, Inc., a national survey research and statistical analysis firm based in Rockville, Maryland, under contract to OSW, provided technical assistance in the survey design and in its implementation and analysis.

This package provides only a summary of certain portions of the obtained data, primarily focused on the number and types of hazardous waste facilities and the quantities of waste handled. An extensive report on the survey and its findings will be developed for public release this fall.

1. PURPOSE OF SURVEY

OSW's purpose in conducting a national mail survey of RCRA-regulated hazardous waste handlers was essentially three-fold:

- The primary purpose of the survey was to characterize the populations of hazardous waste generators and treatment, storage, and disposal (TSD) facilities regulated under Subtitle C of RCRA. The RCRA regulations apply to nearly every segment of American industry and to a wide variety of waste management processes. Due to the lack of available data, the survey was conducted to identify and assess the attributes and characteristics of these industries and processes.
- A second purpose of the survey was to develop a national data base on hazardous waste management practices for use by OSW and others in the continuing development of the RCRA regulatory program and assessing its impact on the regulated community. OSW was required under Executive Order 12291 to conduct regulatory impact analyses of its major hazardous waste regulations. The development of a national statistical data base on hazardous waste management practices is integral to the completion of these required analyses.

The final purpose of the survey was to estimate the magnitude and scope of hazardous waste generation and its treatment, storage, and disposal in the United States. Previous estimates of the total quantity of hazardous waste generated annually have varied substantially. This survey was intended to provide a baseline estimate of hazardous waste generation and treatment, storage, and disposal quantities in 1981.

Figure 1
PURPOSE OF SURVEY

- **Characterize Hazardous Waste Handlers Regulated by RCRA:**
 - Generators
 - Treatment, Storage, and Disposal Facilities

- **Develop Data Base to Support:**
 - Regulatory Development
 - Regulatory Impact Analyses
 - Regulatory Review

- **Estimate 1981 Hazardous Waste Quantities:**
 - Generated
 - Treated
 - Stored
 - Disposed

2. SCOPE OF SURVEY

This survey of hazardous waste handlers was conducted by Westat, Inc. for the Environmental Protection Agency's Office of Solid Waste (OSW) in the fall of 1982. It is the most extensive data collection effort on hazardous waste to date. The survey was national in scope covering the 50 states as well as U.S. Territories. To date, estimates on hazardous waste generation and processing in the United States have generally been based on the many facilities that notified EPA of their intent to generate hazardous waste (about 50,000) or that applied for permits to treat, store, or dispose of hazardous waste (about 10,000). However, the Westat survey was based on facilities that subsequently reported that they actually generated or managed hazardous waste in calendar year 1981. The scope of this survey is restricted to waste management operations regulated under Subtitle C of RCRA. As a result, the survey design excluded certain types of handlers and processes due to RCRA exemptions (e.g., small generators, wastewater treatment in tanks, etc.). Finally, the survey did not include any hazardous waste generator or TSD facilities that failed to register with EPA and thus are in violation of the law.

Figure 2

SURVEY SCOPE

- **National Survey of Hazardous Waste Handlers**
- **1981 Hazardous Waste activities only**
- **Only those who registered with EPA (Notifiers & Part A permit)**
- **Only RCRA covered hazardous waste management:**

Therefore design excludes:

- **Small generators**
- **90-day Accumulators**
- **Wastewater treatment in tanks**
- **Delisted wastes**
- **Other Exempted Handlers and Waste Streams**

3. SURVEY METHODOLOGY

DESIGN

In preparation for the extensive mail survey, Westat conducted telephone interviews with approximately 9,000 treatment, storage and disposal facilities that filed RCRA Part A Applications stating that they intended to manage hazardous waste. These telephone interviews were conducted in two phases during the spring and summer of 1982 in an attempt to verify the processes used by the facilities to manage hazardous waste in 1981. The results provided a sampling frame for the selection of facilities to receive the RIA mail survey questionnaire, and are summarized in the "Report on the Telephone Verification Survey of Hazardous Waste Treatment, Storage, and Disposal Facilities Regulated Under RCRA in 1981," produced by Westat in November, 1982.

Since TSD facilities were to be sampled based upon the technology (or process) used to manage hazardous waste (e.g., landfill, surface impoundment, land treatment, waste pile, incinerator, storage or treatment in tanks or containers, and underground injection), the telephone interview attempted to verify that this technology was used by the facility to manage hazardous waste in 1981. Hazardous waste generators that do not treat, store for more than 90 days, nor dispose of hazardous waste on site, were not required to file Part A applications and, therefore are not listed on the "Part A" file. A sample of these off site generators was selected from EPA's hazardous waste "Notifier file" for the mail survey.

Separate questionnaires were developed for each of the nine technologies and for generation. In addition, a "general" questionnaire was developed for all TSD facilities.

Figure 3

SURVEY METHODOLOGY

Pre Survey Screening:

- TSD process type in 1981 verified
- Proportion of generators not producing hazardous waste in 1981 estimated

Sample Design:

- For national projections
- Stratified (region, SIC, hazardous waste quantity)
- Separate samples for generators & 9 different TSD process types

Data Collection Method:

- Mail Survey in fall 1982
- Extensive telephone call backs

Quality Control Efforts:

- Computer Edit
- Telephone data gap/correction
- Largest handlers rechecked
- Internal consistency checks
- Units of measure standardized

SURVEY OPERATIONS: MAIL OUT, FOLLOWUP, RESPONSE AND
DATA CODING AND EDITING

Each TSD facility received a TSD general questionnaire and one or more questionnaires specific to the technology type(s) for which it was sampled. Most generators received only the generator questionnaire. The questionnaires were developed by Westat in conjunction with EPA staff analysts. They were pre-tested in June of 1982 and received approval from OMB.

The questionnaire package included instructions and lists of hazardous waste codes for use in the questionnaire. Packages were sent by registered mail in September of 1981. By RCRA regulations, facilities had 45 days to respond. Both Westat data collection specialists and the RCRA Hotline at EPA provided technical assistance via telephone to the respondents throughout the response period. Many respondents were granted time extensions to dates up to February 1, 1983. All TSD facilities that did not respond in 45 days were sent followup letters, and, later, were contacted by telephone. Nonresponding generators were mailed followup reminder letters in January, 1982.

Statistical tabulations were run on edited data to minimize errors that might have been caused by respondents, coders or key entry operators. The editing process included: manual editing and visual examination of the coding work; computerized edit to check all data items for legitimate range of values; computerized "logic edits" to check for consistency between many (but not all) questions; and visual examination of frequency distributions to identify any suspect cases. In addition, a major effort was made to resolve questionable responses to important variables. This was done by a "data retrieval" effort that involved telephone call-backs to approximately 30 percent of the respondents.

In spite of this substantial editing effort, it is inevitable that some errors might remain in such a large national data base representing a wide diversity of industries reporting detailed technical data on complex waste handling operations. Even the telephone call-back efforts intended to resolve apparent conflicts were not always successful in obtaining the requested data on selected items. Nevertheless, we believe that the many stages of data editing and cleaning, together with the carefully worded questions, have produced an edited data base, substantially free of processing, coding and entry errors.

4. SAMPLE SIZES AND RESPONSE RATES

Figure 4 shows the number of questionnaires mailed out and the number of responses received (both completed questionnaires for eligible respondents, and statements that no hazardous waste was generated/managed for ineligible respondents. The ratio of column 2 to column 1 in Figure 4 is the response rate shown in Figure 4a. The sample sizes shown in Figure 4a are the number of completed questionnaires received. These sample sizes along with the estimated universe size can be used to determine the statistical reliability or confidence intervals on estimates from the sample (see Section 5).

The response rates achieved in the hazardous waste surveys were high, falling in the vicinity of 90 percent for most process types as shown in Figure 4a. With response rates this high there is little concern about non-response bias. Response rate is defined as percentage of completed questionnaires among eligible facilities that were contacted. Since eligibility of non-respondents was unknown, it was estimated using the same eligibility rate as found among respondents. This is generally a conservative approach since the nonrespondents are often ineligible. Thus the true response rates are likely to be somewhat higher than shown in Figure 4a. This is especially true of generators, which had particularly high ineligibility rates (i.e., a high percent of installations that previously notified EPA of their intent to generate hazardous waste were not actually generating in 1981).

Figure 4 (Preliminary Data)

RESPONSE TO RCRA SURVEY

	<u>Questionnaires mailed out</u>	<u>Responses</u>		
		<u>Total received</u>	# Eligible	# Ineligible
Generators	11220	9877	2016	7864
TSD's (General questionnaire)	2599	2348	1462	884
<u>TSD Components</u>				
Injection Well	115	103	73	30
Landfill	202	172	79	93
Land Treatment	122	99	37	62
Surface Impoundment	327	298	146	152
Waste Pile	243	215	73	142
Incinerator	265	239	125	114
Storage Container	423	389	191	198
Storage Tank Treatment Tank }	847	772	290	482

Figure 4a (Preliminary Data)

SAMPLE SIZES & RESPONSE RATES

	<u>Response Rate</u>	<u>Sample Size</u>
Generators	88 %	2016
TSD's (General questionnaire)	90 %	1462
<u>TSD Components</u>		
Injection Well	90 %	73
Landfill	85 %	79
Land Treatment	81 %	37
Surface Impoundment	91 %	146
Waste Pile	88 %	73
Incinerator	90 %	125
Storage Container	92 %	191
Storage Tank	91 %	235
Treatment Tank		123

5. STATISTICAL RELIABILITY

The statistical accuracy achieved in the survey of hazardous waste facilities varies among the process types which were sampled separately. For a number of facilities or, proportion or percentage type measure (e.g. the proportion of landfills that are lined), the accuracy at the 95 percent confidence level was good for all TSD facilities combined ($\pm 5\%$). For generators it was even better ($\pm 2\%$).

Although highly accurate estimates of numbers of facilities and proportions of facilities with various characteristics was achieved, it was not possible to achieve similar accuracy for quantities of waste. The reason quantity estimates are subject to so much more estimation error is that: (a) quantities of hazardous waste vary dramatically among facilities and (b) the sample design was optimized for facility characteristics rather than quantities. The reason for (b) was partly due to importance of determining facility characteristics (e.g. what proportion of landfills are lined) and partly due to the absence of reliable facility size information at the time that the sample was drawn, which prevented effective probability proportional to size sampling.

An extremely large variation was found in facility size (where "size" is measured by the quantity of hazardous waste generated in 1981.) Figure 5 shows that the size distribution is very skewed due to some very large generators. This also results in a mean value which is 350 times the median. Figure 5a is an alternative way of looking at the same data. If all hazardous waste generators were ranked from the largest to the smallest, then only 1% of the generators would account for nearly 90% of the hazardous waste, as shown in Figure 5a (i.e.,

Figure 5 (Preliminary Data)

DISTRIBUTION OF GENERATOR SIZE (quantity generated)

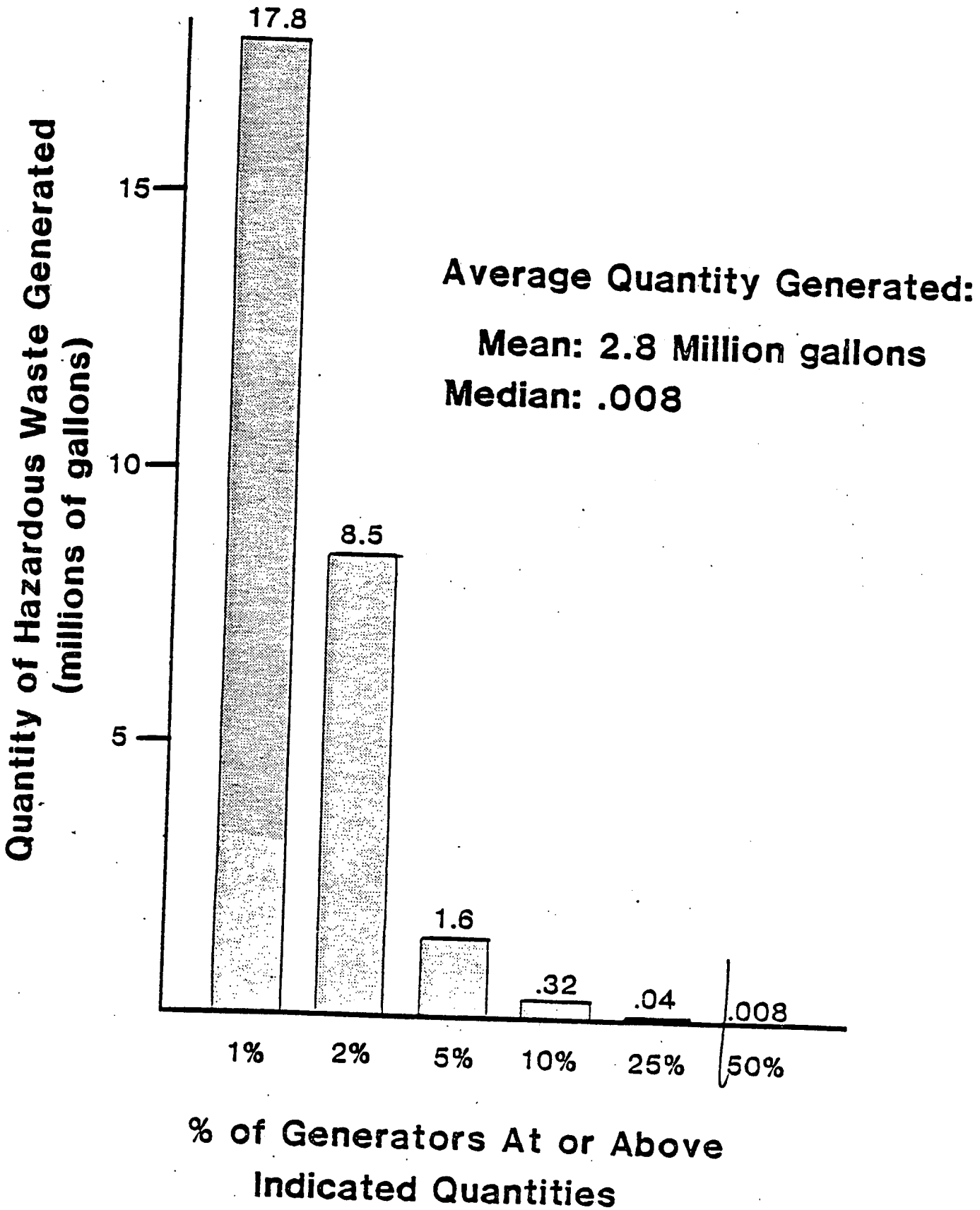
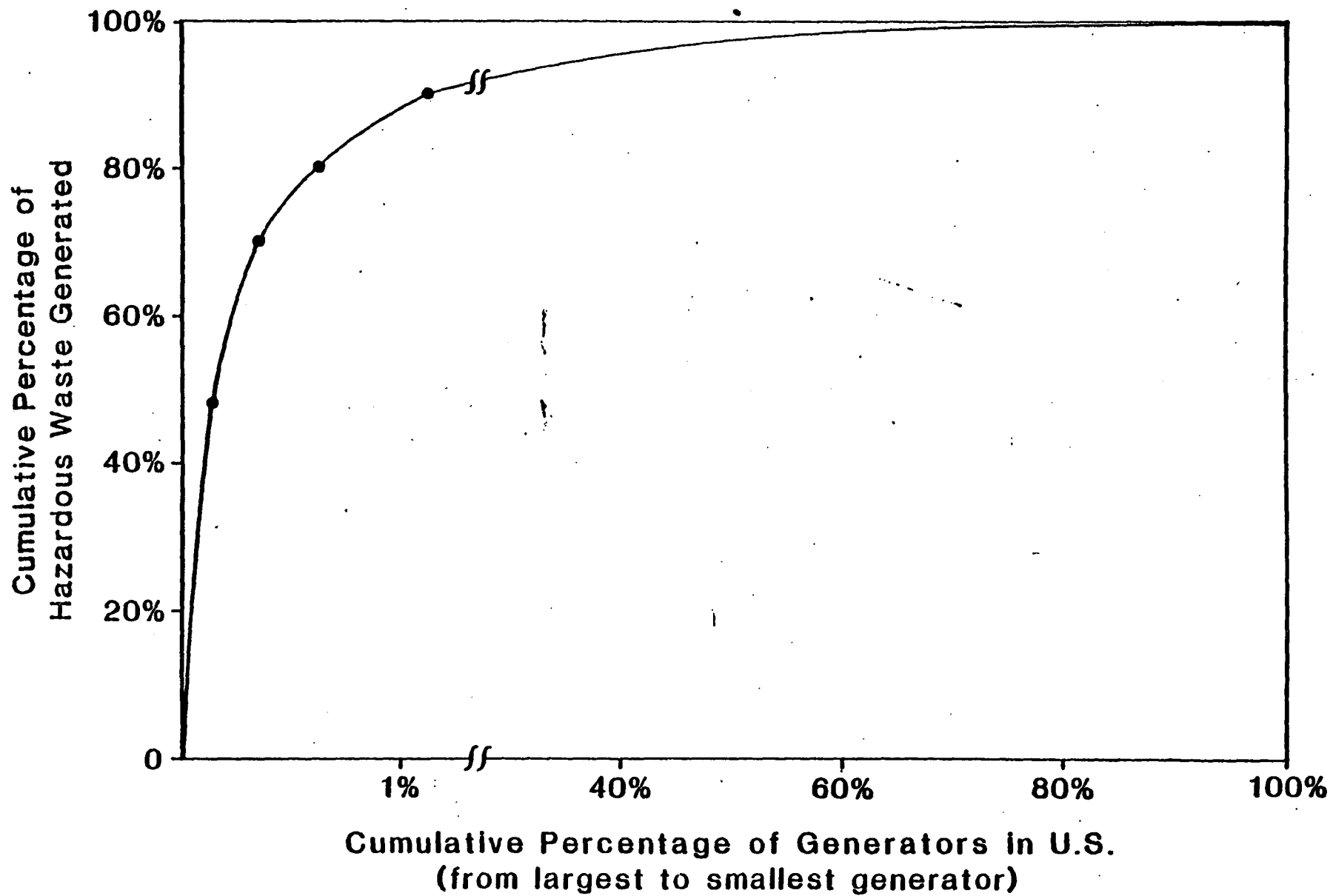


Figure 5a (Preliminary Data)

CUMULATIVE HAZARDOUS WASTE GENERATED in 1981



the largest 140 generators produced about 35 billion gallons, while all 14,100 generators produced only 40 billion gallons).

Similar skewed distributions were found for TSD facilities. For TSD facilities the mean quantity of hazardous waste managed per year was about 200 times the median.

To confirm the quantities reported by the largest facilities, EPA made independent verification phone calls to the largest cases and also determined through in-depth discussions that the wastes and processes reported were indeed RCRA regulated hazardous wastes.

Because the statistical reliability of quantities of waste is much lower than the accuracy for proportion or number of facilities, we have chosen to use the 67% confidence interval (i.e., ± 1 standard deviation) when discussing quantities, which is only half as wide as the 95% confidence interval would be.

Figure 5b shows the large amount of variability found in two measures: the total quantity of hazardous waste generated in the U.S. during 1981 and the total quantity of waste that was managed as hazardous waste in the U.S. during 1981. To interpret the plus or minus factor indicated in the table for generators, the true value of the total quantity of hazardous waste generated is covered with 67 percent confidence by an interval centered at the estimated value and extending on either side of the estimated value by as much as 40 percent of the estimated value. For example, if the estimated value is 100 million gallons, the corresponding 67 percent confidence interval would be from 60 million gallons to 140 million gallons. Clearly, the confidence interval is quite wide and the estimated quantity of total hazardous waste generated is not very precise. A similar interpretation holds for the $\pm 25\%$ factor for TSD facilities.

Figure 5b (Preliminary Data)

**Statistical Reliability of Estimates
from the Generator and
TSD General Questionnaire**

Statistical Reliability of Estimates

Questionnaire	95% Confidence Interval on a Proportion or Number of Facilities	67% Confidence Interval on Quantity of Hazardous Waste Handled
Generator	± 2%	± 40% of the total
TSD General	± 5%	± 25% of the total

Various other quantity estimates from the generator sample and TSD sample show similar sampling error, but usually somewhat better than the ± 40 percent confidence interval for hazardous waste generated. For example, the estimate for hazardous waste generated and shipped off site has a ± 20 percent confidence interval at the 67 percent level.

For individual components or process types the accuracy on numbers of facilities or proportions of facilities with same characteristics ranged from 6 to 11 percent as shown in Figure 5c, but was better than 10 percent for all components except Land Treatment.

The 95 percent confidence intervals presented in Figure 5b and 5c are based on all respondents to the questionnaire. If it is desired to obtain 95 percent confidence intervals for subsets of the respondents, the "plus or minus" term shown for the 95 percent confidence interval should be multiplied by the factor, K, shown below:

<u>Subpopulation as a fraction of the population</u>	<u>Factor, K, to multiply \pm Term in Figure 4</u>
.80	1.1
.60	1.3
.40	1.6
.20	2.2
.10	3.2

This is a reasonable approximation as long as the subsample size is fairly large, say 30 or more.

Statistical Reliability of Estimated Proportions by Process Type

<u>Process Type</u>	<u>Number of Respondents</u>	<u>Statistical Reliability of Proportions at the 95% Confidence Level</u>
Injection Wells	73	± 5%
Landfills	79	± 9%
Land Treatment	34	± 11%
Surface Impoundment	146	± 7%
Waste Piles	73	± 9%
Incinerators	125	± 6%
Storage Containers	191	± 7%
Storage Tanks	235	± 7%
Treatment Tanks	123	± 9%

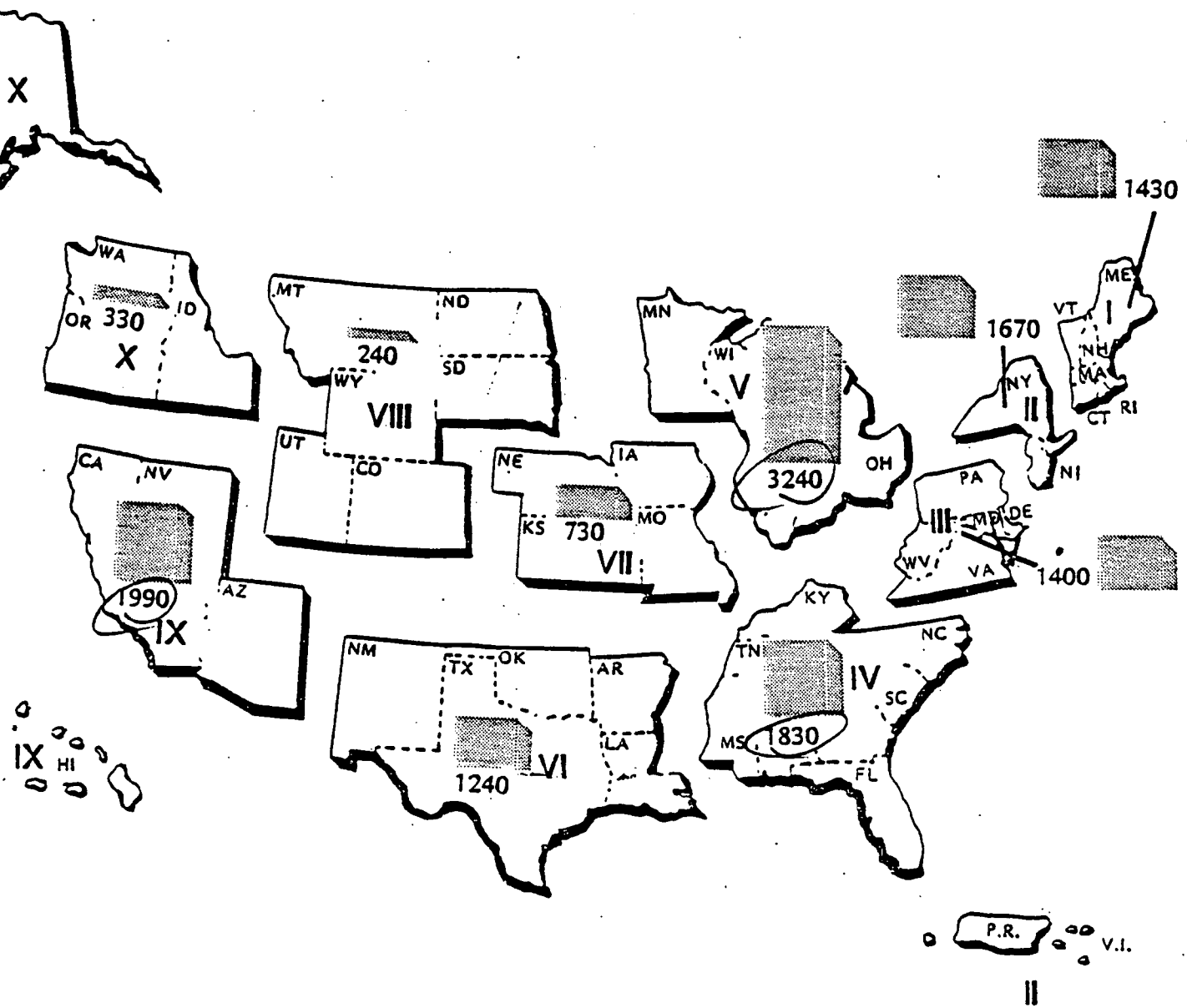
PRELIMINARY

HIGHLIGHTS

OF FINDINGS

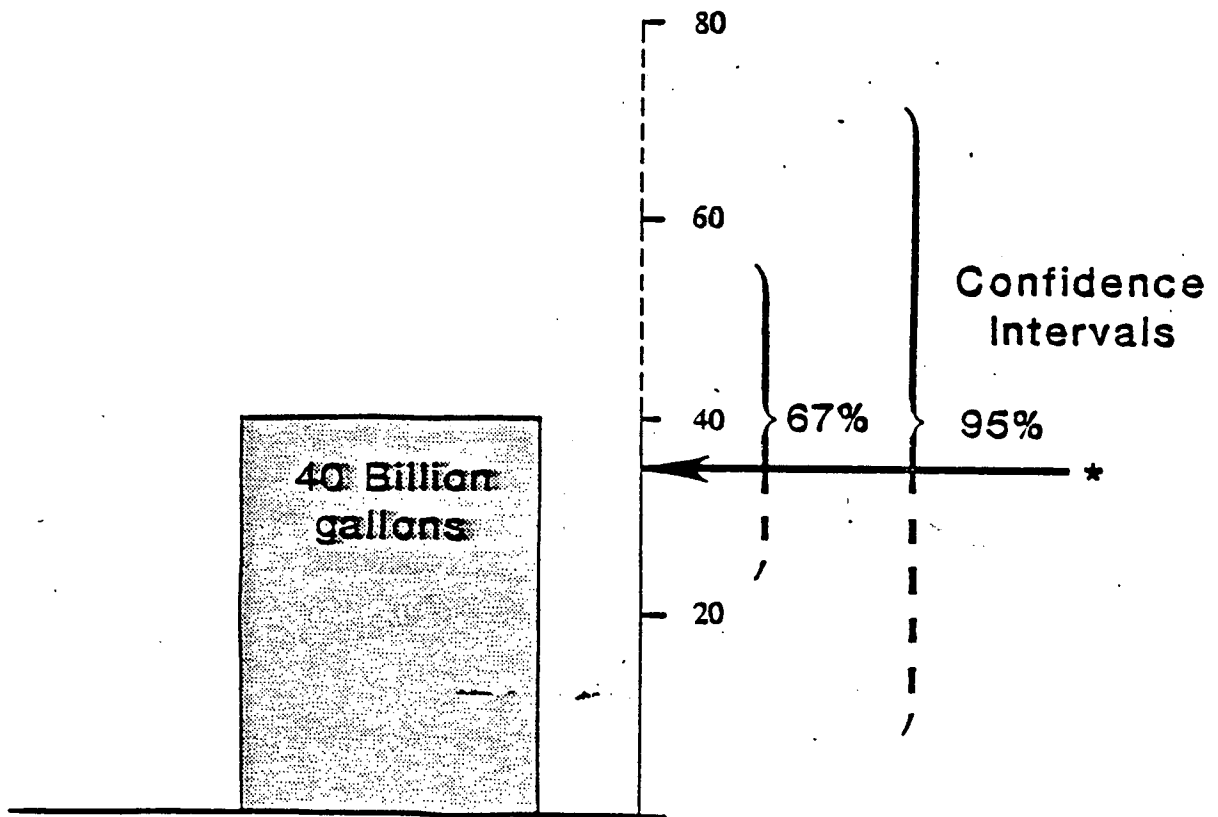
Figure 6 (Preliminary Data)

REGIONAL DISTRIBUTION OF HAZARDOUS WASTE GENERATORS IN 1981



ESTIMATED TOTAL NUMBER OF GENERATORS ACTIVE IN 1981: 14,100

Figure 7 (Preliminary Data)
QUANTITY OF HAZARDOUS WASTE GENERATED
IN 1981



40 Billion gallons = 150 Million metric tonnes

* Known lower limit on quantity generated.

Figure 7a (Preliminary Data)

QUANTITIES OF HAZARDOUS WASTE GENERATED BY TYPE OF WASTE

TYPE OF WASTE	BILLION GALLONS	% OF ALL GENERATION
ent Solvents & Processed Sludges, Listed Industry Waste ("F" or "K" prefix)	25.9	65%
Reactive (D003)	15.6	39%
Corrosive (D002)	13.5	34%
EP Toxic (D004-D017)	3.7	9%
Disposed Toxic Products, off-spec. Products, Chem. Intermediates ("U" prefix)	2.3	6%
Listed by State	1.9	5%
Acute Hazardous Wastes ("P" prefix)	0.3	1%
Ignitable (D001)	0.3	1%
Self-defined as Hazardous	0.1	less than .5%

TOTAL QUANTITY GENERATED = 40 BILLION GALLONS

Figure 7b (Preliminary Data)

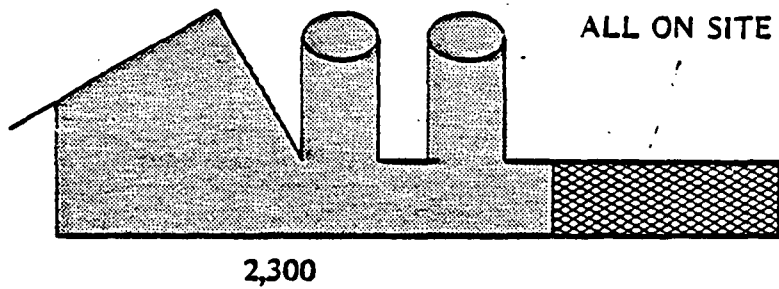
NUMBERS OF GENERATORS AND
QUANTITIES GENERATED BY INDUSTRY

<u>Industry (SIC code)</u>	<u>Number of Generators</u>	<u>Quantity Generated</u>	
		<u>Bill. Gal.</u>	<u>Pct.</u>
Chemicals (28)	2,440	28.4	71%
Machinery (35)	700	2.3	6%
Transportation Equipment (37)	680	2.3	6%
Motor Freight Transport (42)	80	1.7	4%
Petroleum Refining (29)	370	1.3	3%
Primary Metals (33)	850	1.0	3%
Fabricated Metal (34)	2,640	.8	2%
Electrical Machinery (36)	1,510	.7	1%
Electric, Gas, and Sanitary Services (49)	250	.5	1%
Other	4,580	1.0	3%
<hr/>	<hr/>	<hr/>	<hr/>
All Industries	14,100	40.0	100%

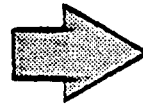
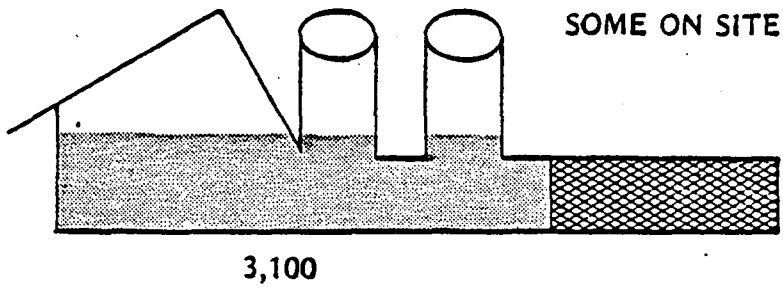
Figure 8 (Preliminary Data)

ON SITE VS. OFF SITE
MANAGEMENT OF GENERATED HAZARDOUS WASTES
IN 1981

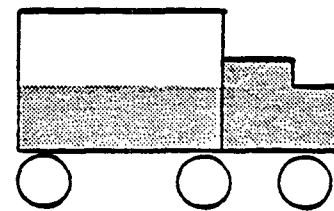
NUMBER OF GENERATORS



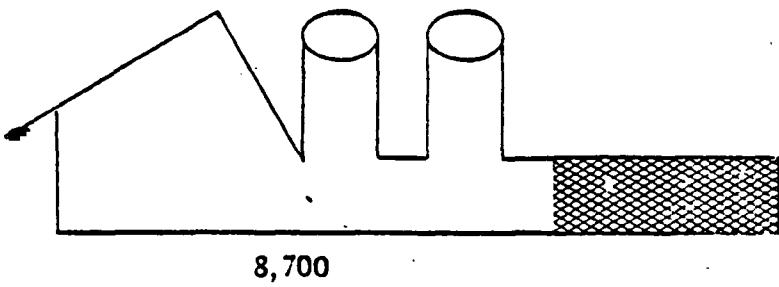
16%



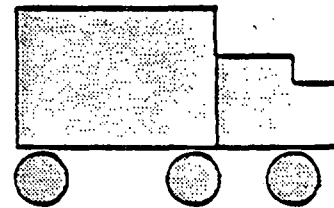
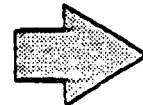
SOME OFF SITE



22%



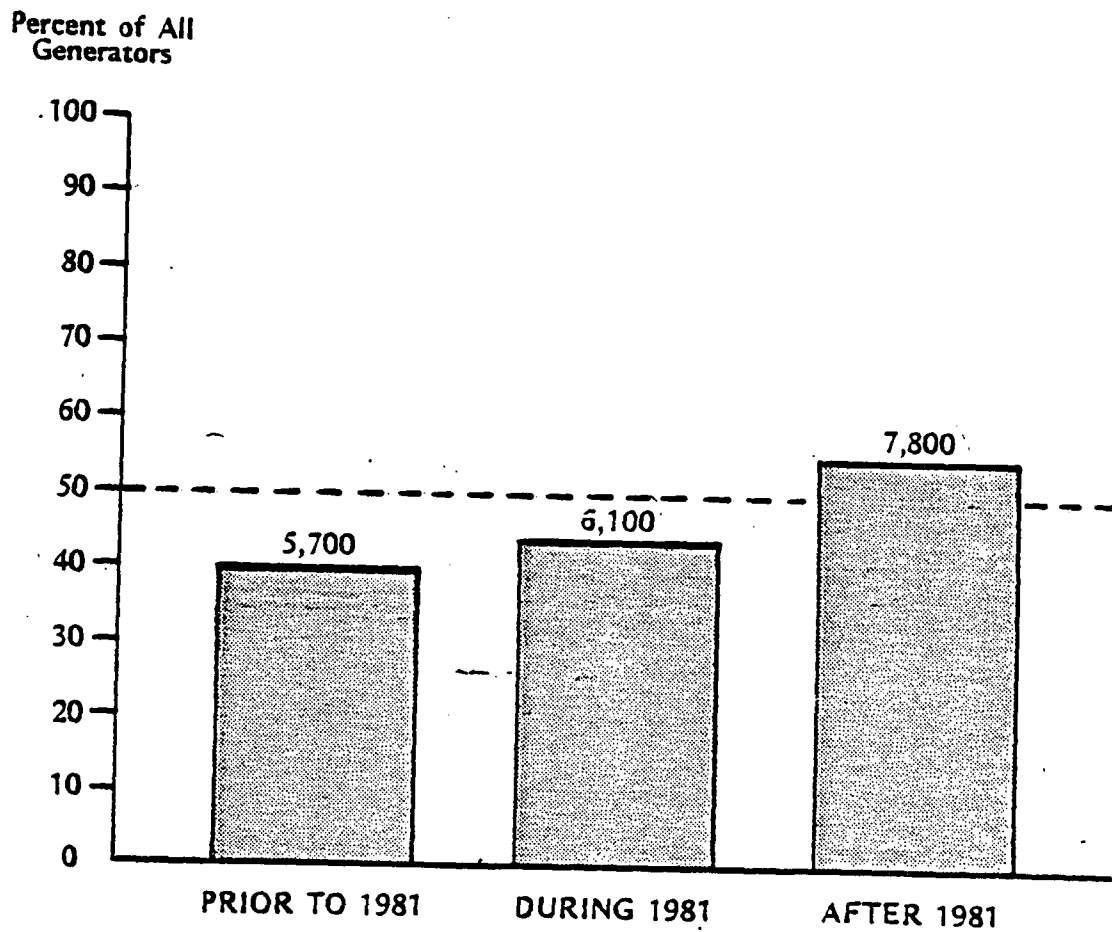
ALL OFF SITE



62%

TOTAL = 14,100 Generators

Figure 9 (Preliminary Data)
NUMBER OF GENERATORS RECYCLING
HAZARDOUS WASTES



Total Generators: 14,100

Figure 10 (Preliminary Data)

HAZARDOUS WASTES RECYCLED IN 1981

(% on site vs. off site)

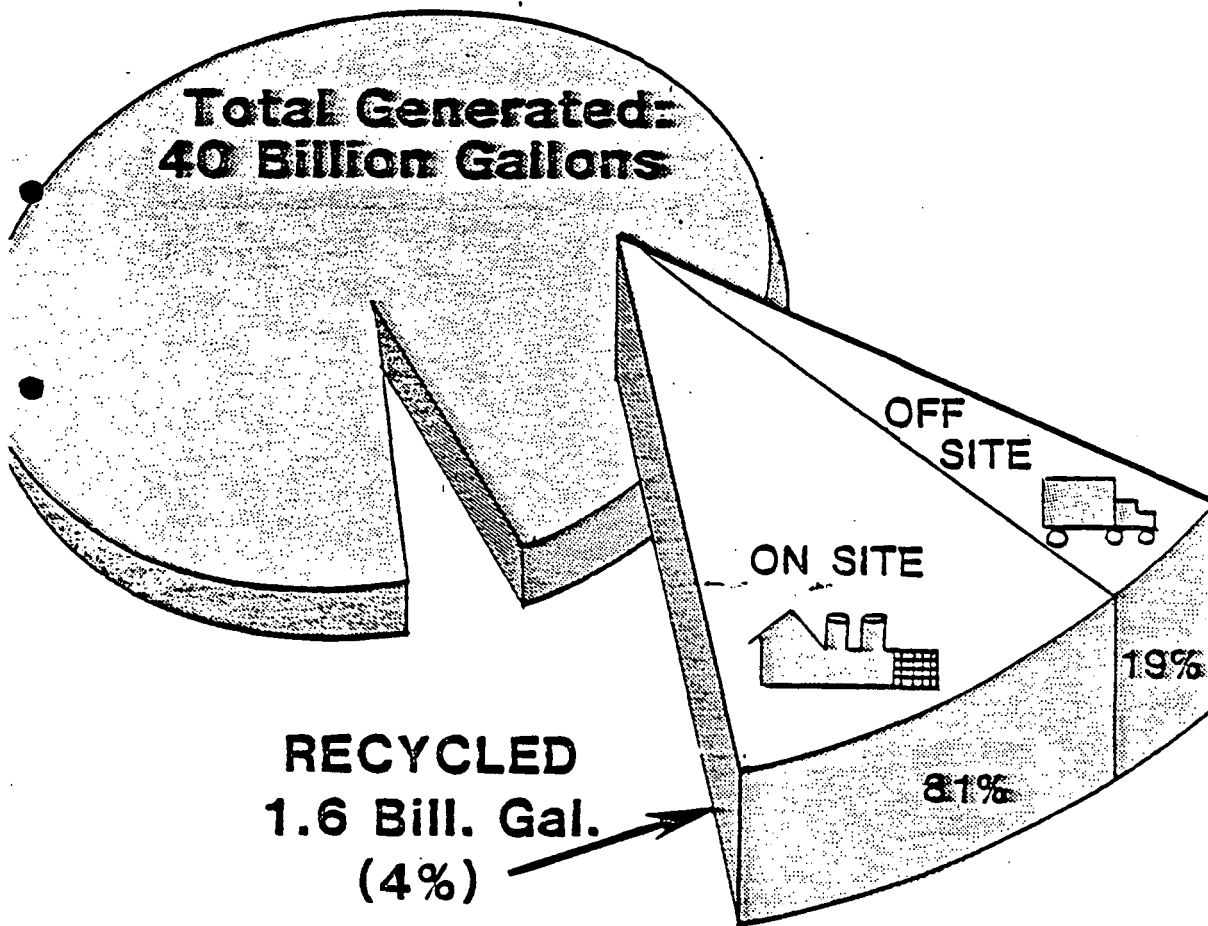
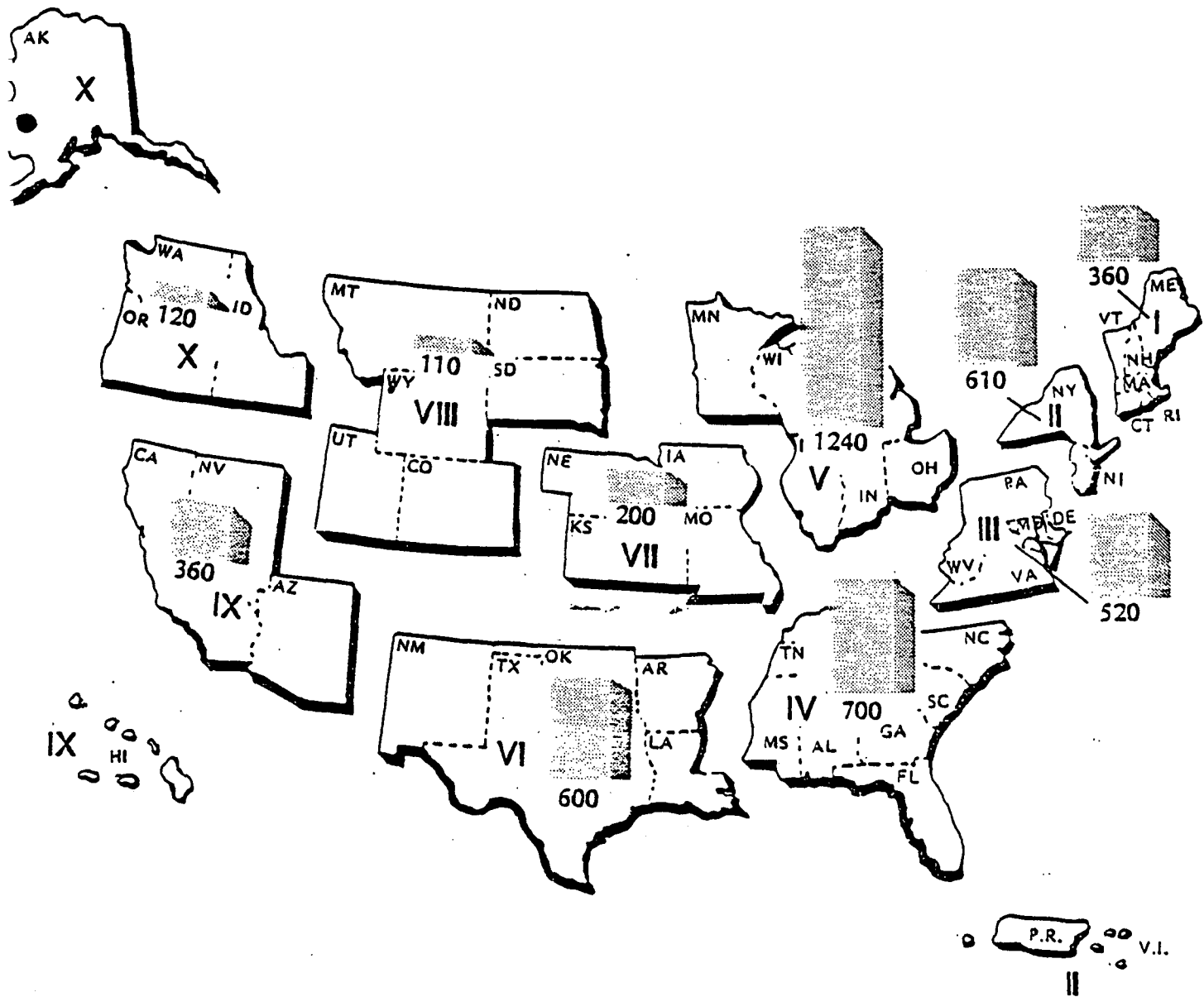


Figure 11 (Preliminary Data)

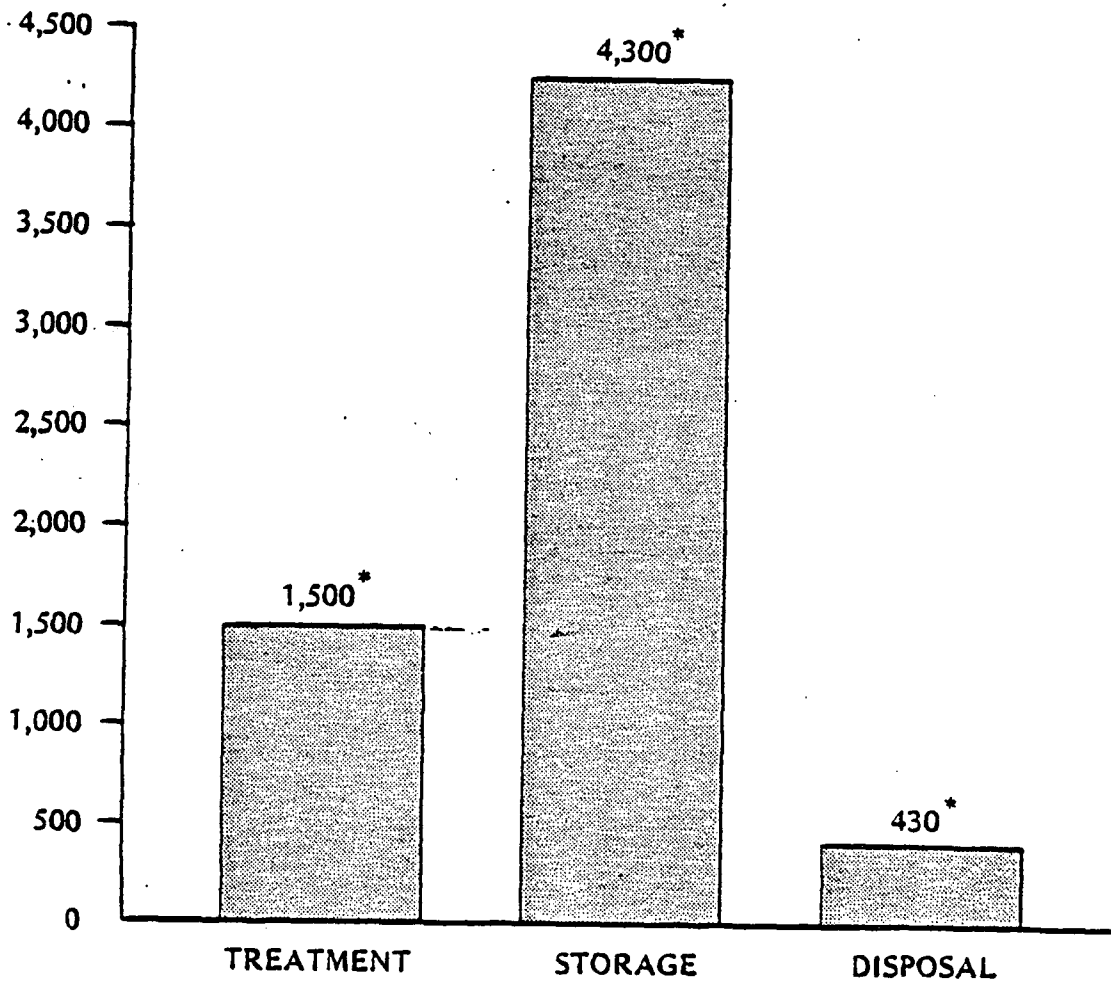
REGIONAL DISTRIBUTION OF TREATMENT, STORAGE,
DISPOSAL FACILITIES IN 1981



ESTIMATED TOTAL NUMBER
OF ACTIVE TSD'S IN 1981: 4820

Figure 12 (Preliminary Data)
NUMBER OF FACILITIES WITH TREATMENT, STORAGE,
AND/ OR DISPOSAL IN 1981

Total TSD Facilities = 4820



* T+S+D exceeds 4820 due to multiple processing at facilities

Figure 13 (Preliminary Data)

**NUMBER OF FACILITIES USING
SELECTED TREATMENT , STORAGE,
AND DISPOSAL PROCESSES**

PROCESS TYPE	NUMBER OF FACILITIES IN 1981*
Storage Container	3,580
Storage Tank	1,430
Surface Impoundment	770
Treatment Tank	610
Incinerator	240
Landfill	200
Waste Pile	170
Injection Wells	90
Land Treatment	70
Other Processes	320

Total TSD's: 4820*

*Sum of process types exceeds 4820 due to multiple processing at facilities

Figure 14. (Preliminary Data)

NUMBER OF COMMERCIAL VERSUS OTHER TSD FACILITIES

Total TSD's - 4820

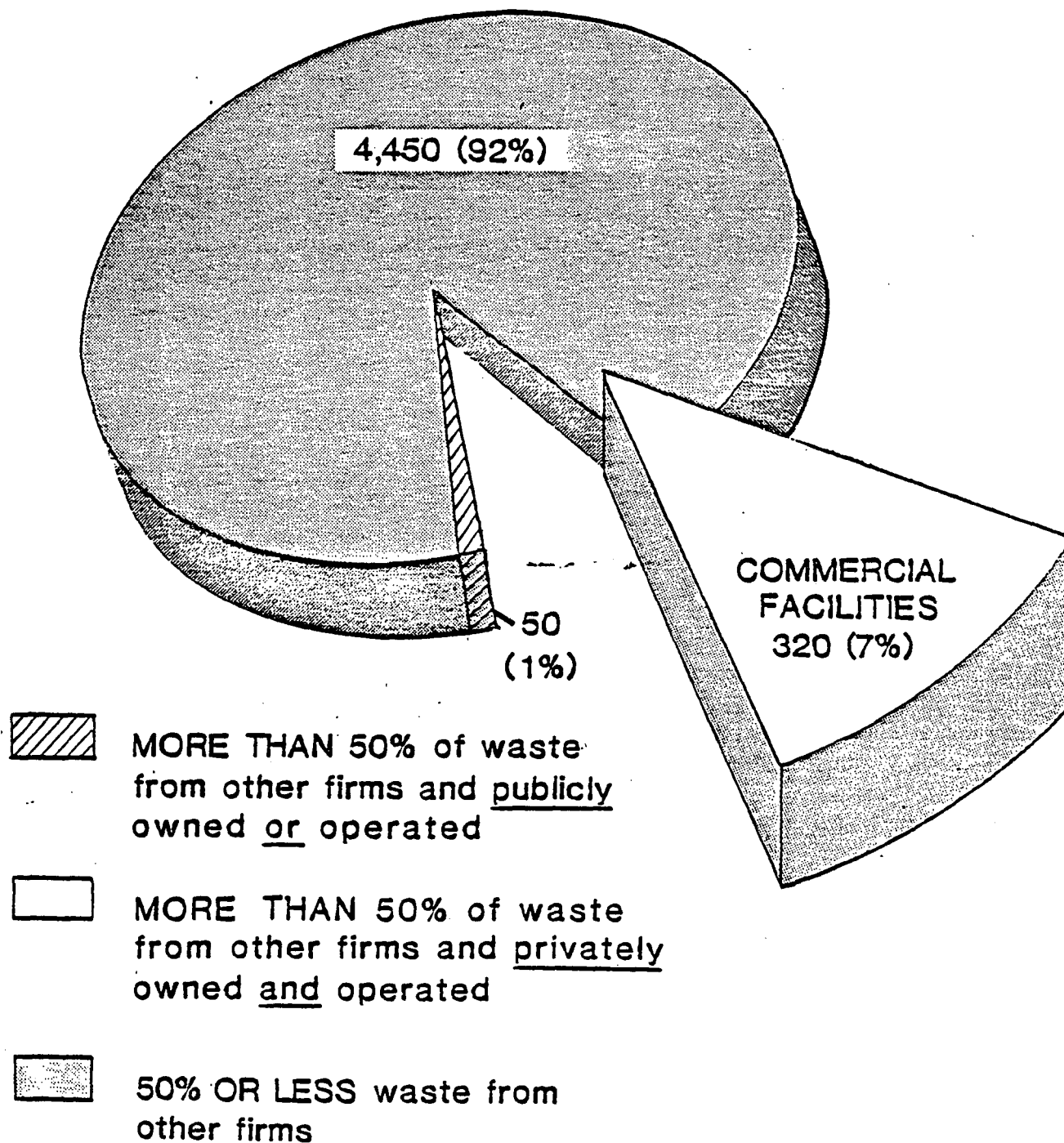
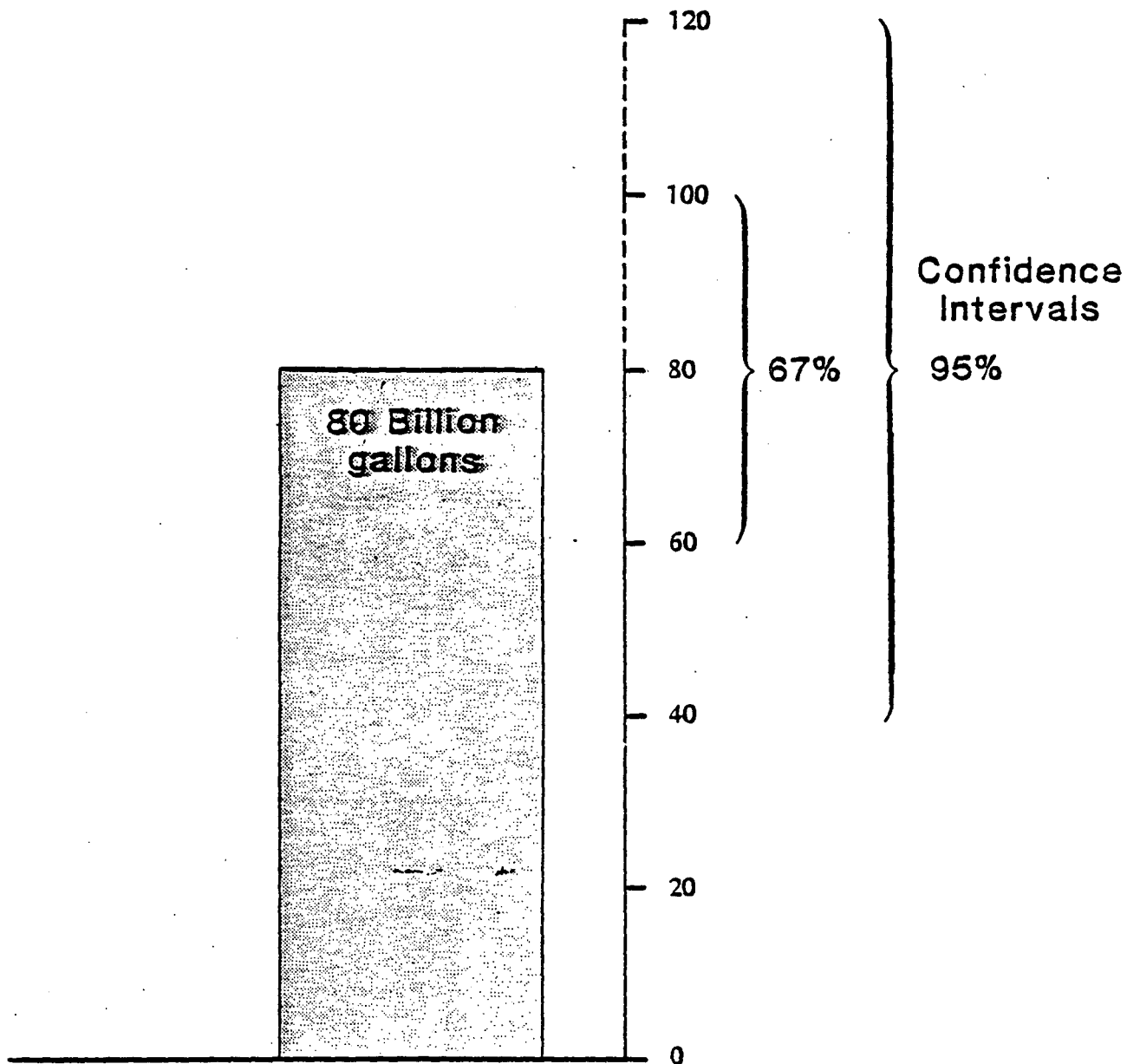
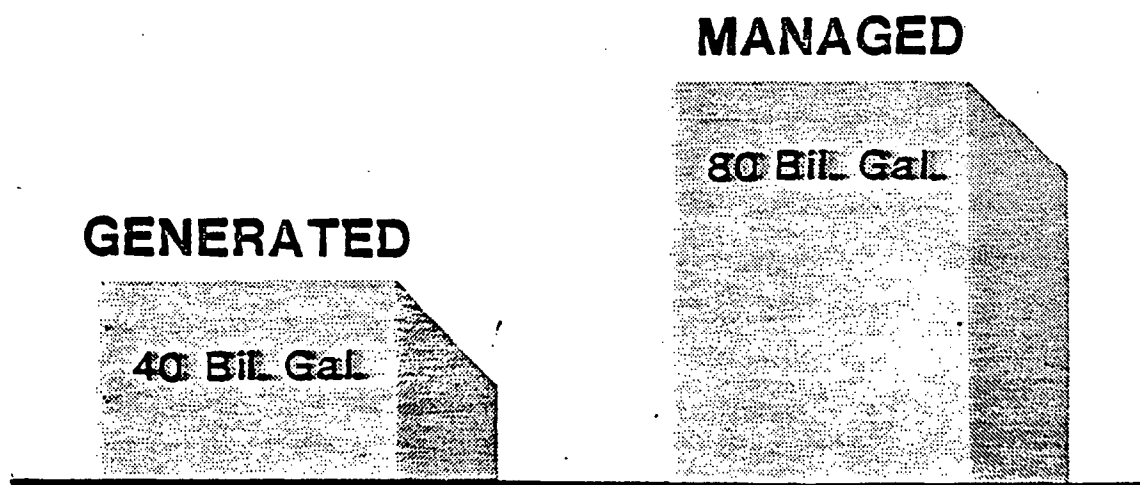


Figure 15 (Preliminary Data)
QUANTITY OF WASTE MANAGED AS
HAZARDOUS WASTES BY TSD FACILITIES IN 1981



80 Billion gallons = 300 Million metric tonnes

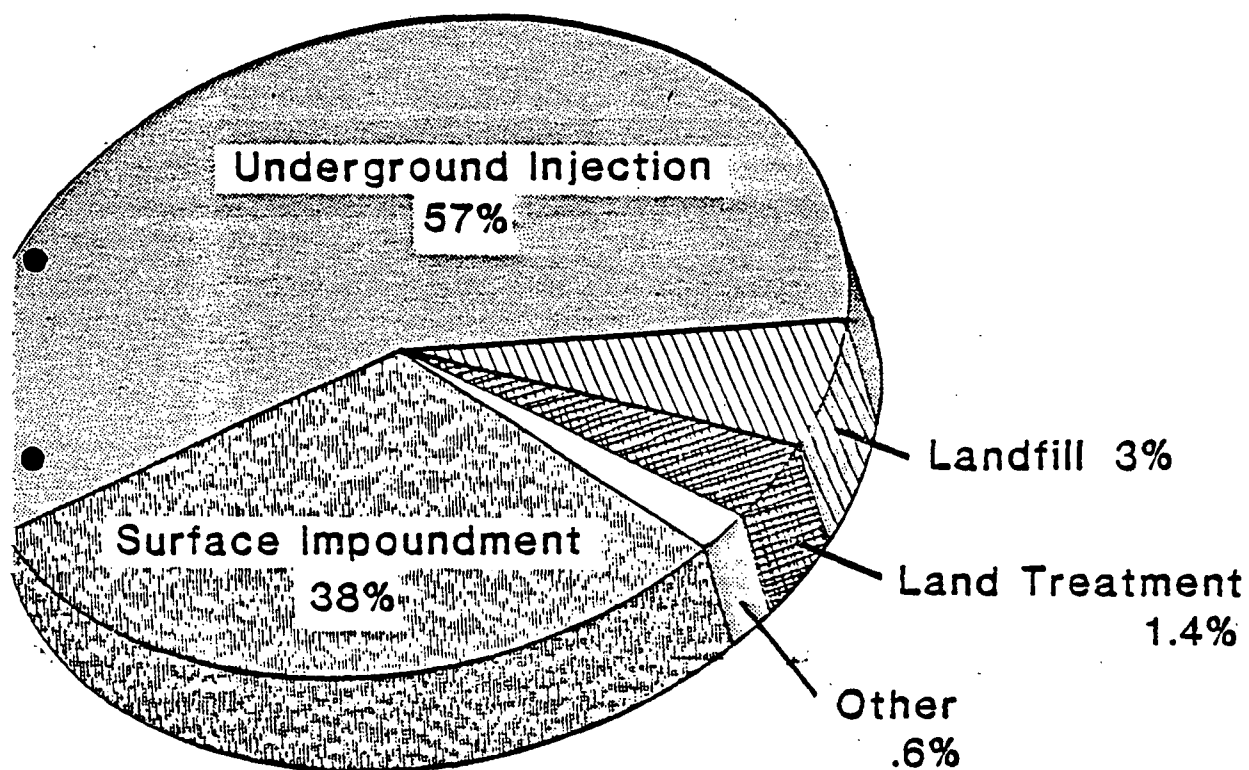
Figure 16 (Preliminary Data)
QUANTITY GENERATED
VERSUS MANAGED



**QUANTITY MANAGED EXCEEDS GENERATION
BECAUSE OF :**

- **Out-of-system wastes**
- **Inter facility shipments**
- **Multiple stage processing**
- **Existing stocks carried over**
- **Non-hazardous wastes
“managed as hazardous wastes”**
- **Respondent error/imprecise questions**
- **Sampling variability**

Figure 17 (Preliminary Data)
**QUANTITIES OF HAZARDOUS WASTE
DISPOSED IN 1981**



TOTAL QUANTITY DISPOSED:
15.6 Billion gallons (58 Million metric tonnes)

Figure 1.8

ADDITIONAL STUDIES UNDERWAY

1. **Mail Survey Report on Generators & TSD's**

(Nov 83)

2. **Mail Survey Follow-Up**

A. Design - Identify gaps, uncertainties

(Fall 83)

- Develop methodology & design data gathering plan

B. Implement design & report on revised estimates

(Spring 84)

3. **Special Analyses by Process Type**

(Fall 83-
Winter 84)

4. **On-going Analysis File Update**

(83-84)

-based on EPA office feed back & further facility confirmations

5. **Small Quantity Generators - National Survey**

(Fall 83)

6. **Waste as a Fuel**

(Fall 83)

-Track 1 Rept. (convenience sample)

-Track 2 Rept. (National survey)

(Winter 84)

7. **Analyses of RCRA Annual Reports**

-Reports submitted from handlers

(Winter 84)

-State summaries to EPA

(Fall 84)

-EPA summary report

(Winter 85)