An Assessment of Household Hazardous Waste Collection

by

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(ABSTRACT)

Many civic groups and local governments are involved in campaigns to safely collect and dispose of "household hazardous waste." Although it is difficult to define, household hazardous waste is generally considered to be any chemical waste generated in a family dwelling which, if disposed of improperly, may be harmful to human health or the environment. Growing concerns are centered around the disposal of these potentially toxic wastes by burying them in landfills or pouring them down drains or storm sewers.

The most popular method of addressing the problem of household hazardous waste is that of holding "collection days," at which householders are encouraged to bring their hazardous waste to some central location for proper handling by responsible authorities. Although the availability of information about the total costs of holding these collections days is presently limited, it is apparent that the expense per household served is quite high. Some people have questioned whether the expense is justified, since there has been little documentation of the risks associated with the handling of household hazardous waste in the municipal waste stream.

This thesis presents the findings to date of a study examining the quantities of household hazardous waste present in the municipal waste stream (in order to assess the risks associated with their disposal) and the costs associated with collection days. A telephone survey was used to develop a preliminary estimate of the nature and quantity of hazardous waste generated by households in a Virginia city. Cost data from collection days held in Virginia and elsewhere in the United States are documented and discussed.

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Introduction

An extensive set of regulations exists which track hazardous wastes from the point of generation to the point of disposal. These regulations were promulgated by the United States Environmental Protection Agency (USEPA) in response to the passage of the Resource Conservation and Recovery Act (RCRA) by Congress in 1976. Initially, only generators of more than 1000 kg per month of hazardous waste, and some generators of smaller quantities of certain acutely toxic hazardous waste, were subject to full regulation under RCRA. The federal regulatory program recently expanded (due to the Hazardous and Solid Waste Amendments of 1984) to include "small quantity generators" who generate between 100 kg and 1000kg of hazardous waste monthly. Currently included in exemptions from federal regulations are two sources of hazardous waste, namely, households and businesses generating less than 100 kg of hazardous waste monthly. This study addresses the subject of hazardous waste generated by households.

One politically popular approach for managing household hazardous waste (HHW) has been the holding of collection days. For such collection days, householders are encouraged to bring any hazardous waste products to a central location and have them disposed of by responsible personnel at little or no charge. These collection days have proven to be costly while attracting only about 1% of local householders to the event. Costs associated with these collection days have not previously been examined in detail.

The dilemma faced by regulatory officials concerning HHW is as follows: on the one hand, the risk of HHW to human health and the environment is presently undefined due in part to limited data available concerning the nature and quantities of HHW. On the other hand, there is little sense of what is financially required to sponsor a collection day. The objectives of this study are as follows:

1. to increase knowledge of the nature and quantities of HHW in order to better understand the risks associated with HHW.

2. to improve knowledge of costs associated with collection days in order to better understand their advantages and disadvantages.

Chapter 2 of this study presents pertinent findings from a literature search concerning the nature and amounts of HHW in the waste stream and HHW collection programs. Chapter 3 contains a description of research methods employed in this study. The results are presented in Chapter 4, while Chapter 5 contains a short discussion of these findings. Chapter 6 contains concluding remarks. In addition to the above information, the appendices contain further information concerning the organization of collection days.

Methods

The following chapter contains research methodologies used in this study in order to identify and estimate quantities of HHW and methodologies used to obtain cost data on collection days.

1. Quantity Estimates

A telephone survey was used to collect data concerning the nature and quantities of hazardous waste products present in households. A copy of the survey instrument is found in Appendix B. The survey sample was selected from Roanoke, Virginia, a city in southwestern Virginia with a population of approximately 100,000. The survey sample was pre-stratified by median family income on the basis of census track data. Respondents were selected from a reverse directory from appropriate street addresses as identified by census tracks. Due to the exploratory nature of the survey, no attempt was made to obtain a truly random sampling. One hundred responses were obtained. Quantity estimates were generated on the basis of responses given. Data were evaluated using a mass balance analysis. An example of a mass balance calculation is located in Appendix C.

2. Costs

Data concerning costs of HHW collection days were obtained by a review of the literature and through personal contact with collection day organizers and a review of the literature. Information concerning "hidden" factors contributing to total costs was obtained by personal observance of collection days and through personal contact with organizers of the Fairfax County, Virginia, collection days.

Literature Review

This chapter presents data currently available in the literature concerning the nature and quantities of HHW. Although limited information is available, the prominent studies are cited in this section. Published costs and associated information are also presented in this chapter.

1. HHW in the Domestic Waste Stream

   a. Definition of HHW

      There are many definitions of household hazardous waste (HHW) found in the literature. There is, however, a standard definition for hazardous waste which is taken from the Resource Conservation and Recovery Act. It defines hazardous waste as "solid waste that may cause or significantly contribute to serious illness or death or that poses a substantial risk to human health or the environment when improperly managed" (PL 94-580,1976). According to the Code of Federal Regulations, substances are hazardous waste if they are listed by the EPA as hazardous waste (40 CFR Part 261.33) or they exhibit any of the following characteristics: ignitability, corrosivity, reactivity (explosiveness), or toxicity (40 CFR Parts 261.21 through 261.24).

Advocates of HHW collection programs generally define HHW as any waste associated with the use of household products which, if disposed of improperly, poses a risk to human health or the environment (Metro, 1982). Recent opponents of officially sanctioned collection programs disagree with this definition and contend that "there is no single or standard definition of household hazardous waste," while further stating that the definition seems to vary according to who is defining it (Huth citing Engel, 1986).The chemical specialties industry voices its concern that a perception is emerging that household waste is "of the same character and possibly the same hazard as industrial toxic waste" (Huth, 1986).

According to the Metro Report (1982), household products which are most often cited as exhibiting hazardous characteristics may be placed in four general categories: pesticides, paint products, household cleaners, and automotive products. It is known that these products are typically less toxic than chemicals used in industrial processes; nevertheless, supporters of HHW collection programs believe that small amounts of hazardous waste accumulated and improperly disposed of by thousands of households may be harmful and cause contamination of land and water (Purin *et al.,* 1984).

b. Nature and Quantities of HHW

Several studies have been conducted which give some insight into the nature and quantities of HHW in the domestic waste stream. One study, conducted in the Department of Anthropology at the University of Arizona, focused on identifying types of HHW and quantifying hazardous containers disposed in one year. Results of this study indicate that approximately 100 hazardous containers are disposed of per household in one year. Research at the University of Arizona has focused on counting containers rather than quantifying contents. Table 1 presents some of the findings of this study (University of Arizona, 1985).

Table 1. COMPARISON OF HOUSEHOLD HAZARDOUS WASTE LISTS

University of Arizona (1)	Los Angeles County, CA Sanitation Dist. (2)	City of Albuquerque, NM (3)	Mother Earth News (4)	Wastes Listed in Exhibit 3-2 and Markedly Different from U of Az or LA County Lists
Household and Laundry Cleaners and Maintenance - toilet bowl cleaners - drain openers - laundry and dish cleaners - furniture, floor, and metal cleaners and polish - oven cleaner	Household and Cleaning Products - bleach - drain opener - window cleaners - metal polish - oven cleaner - charcoal lighter - glue	Household Products - cleaners - polishes - drain openers - glue	Utility Room - drain, toilet bowl and window cleaners - oven cleaners - laundry products - pesticides - shoe care products - furniture polish - refrigerants	Household Products - disinfectants
Automotive Maintenance - oil - anti-freeze - engine treatments - degreasers and solvents	Automotive Products - motor oil - oil filters - radiator sealers - anti-freeze - brake fluid	Automotive - motor oil - anti-freeze	Kitchen - preservatives - emulsifiers - flavoring/colorings - pots and pans - dinnerware	Automotive - waxes, polishes, and cleaners - transmission additives
Paint and Glue - oil-based paint and thinner - stains - glue - solvents and paint removers	Paint Products - paint - paint thinner	Paint Products - paints - solvents and thinners	Bathroom - medications - cosmetics (included in original article)	Paint Products - latex paints, probably not hazardous
Plant, Yard and Pet - fertilizers - pesticides and herbicides	Insecticides, Pesticides Herbicides - insect sprays - germicides - weed killers	Plant, Yard and Pet - weed killers - fertilizers - pesticides - poisons	Living Room - asbestos - formaldehyde - radon gas - vinyl chloride	Personal Items - items containing alcohol or other flammables
Other - batteries - nail polish and remover	Personal Items - butane fuel - hair spray - suntan oil - deodorant	Personal Items - shampoo * - mouthwash *		Other - swimming pool chemicals - photo processing chemicals - electronic items
	Other - Freon 12 - peroxide	Other - sawdust *		

Source: USEPA, 1986.

The Los Angeles County Sanitation Districts have been involved in waste characterization studies since 1979. A study was initiated in that year designed to identify and quantify types of hazardous and non-hazardous industrial wastes in landfills. Findings indicated that hazardous waste composed only a small portion of wastes received at the landfills surveyed. The Districts estimated that less than 1% of the refuse received was hazardous while emphasizing the fact that most of these hazardous materials came from commercial sources. In 1984 the Districts began another study which entailed sorting refuse systematically in order to quantify hazardous wastes. Of the 15,000 tons of refuse examined, only 0.00147% was identified as hazardous. The following types of hazardous materials were identified in the 1979 waste characterization study of 155 tons of refuse:

- Household and Cleaning Products 40%
- Automotive Products 30.1%
- Personal Items 16.4%
- Paints and Allied Products 7.5%
- Insecticides, Pesticides, and Herbicides 2.5%
- Other 3.5%

In Albuquerque, New Mexico, a different approach to studying HHW was employed. Some 386 households were surveyed in order to gain a better understanding of the following: types of products that householders identified as being hazardous; the degree of hazard that householders associated with a list of items; and the quantities of hazardous materials disposed of by the householder in the past year and disposal methods for these materials. Researchers concluded the following (City of Albuquerque, 1983):

- 40% of respondents could not name more than one type of hazardous household product: the most commonly identified product was household cleaner.
- A wide range of opinions exists concerning types of hazardous items in the home.
- 0.5% of the residential waste stream is hazardous.

c. Study of Hazardous Waste Generators

A review of current literature and data available concerning generators of hazardous waste in the United States was conducted. Figure 1 graphically depicts these findings. Approximately 292 million tons of hazardous wastes are generated in the United States each year (Phillips, 1987). Of this quantity, approximately 99.6% is generated by large quantity generators (which generate more than 1000 kg of hazardous waste monthly). These generators (LQG's) were first brought under the authority of EPA in 1980 under the provisions of RCRA (which was passed 1976). The small quantity generators, those which generate between 100 and 1000 kg of hazardous waste each month, came under EPA authority in 1986 in response to HSWA of 1984. Hazardous waste generated by small quantity generators represents approximately 0.3% of the total amount of hazardous waste generated annually. Currently the above generators, and some generators of acutely toxic wastes in smaller quantities, are the only generators of hazardous waste regulated by EPA.

Generators which contribute a much smaller amount of hazardous waste are businesses generating less than 100 kg monthly. These businesses were surveyed in 1986 by EPA. Examples of these types of generators are many vehicle maintenance and repair shops and non- manufacturing industries. Hazardous waste generators of less than 100 kg monthly are estimated to contribute 0.07% of total hazardous wastes. Households, which are exempted from RCRA regulations, were estimated by the EPA to generate between 1000 and 100,000 tons of hazardous waste annually (USEPA,1986). This translates into 0.003-0.035% of the total hazardous waste generated each year. Using figures obtained from the EPA pertaining to municipal solid waste (133 million tons in 1984), estimates of HHW generated represent between 0.00075% and 0.075% of total municipal solid waste generated. Household hazardous waste, according to all data available, represents a very small portion of the hazardous waste and municipal solid waste generated in the United States.

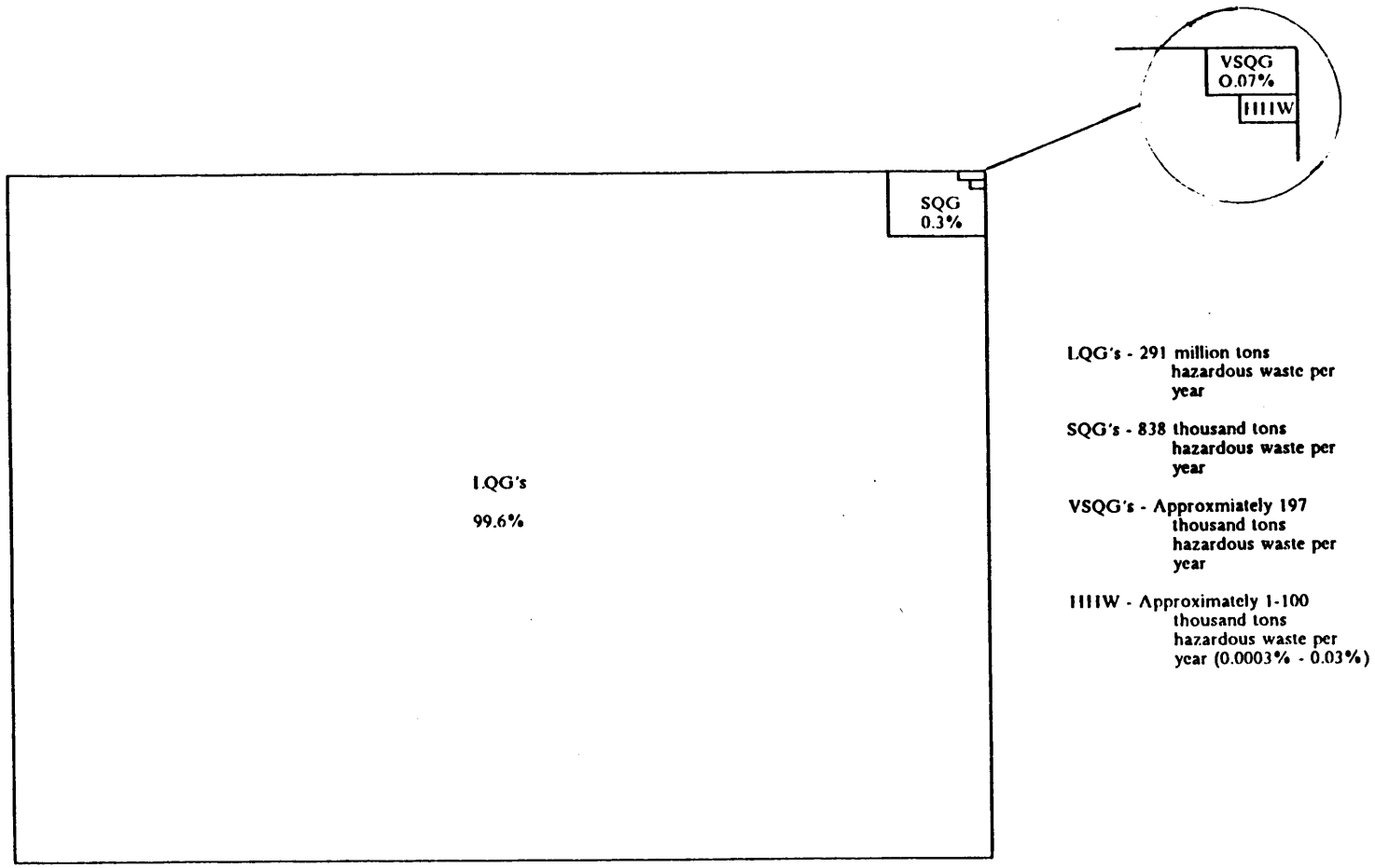

Figure 1. Amounts of Hazardous Waste Generated Per year in the United States

d. Potential Risks Associated With HHW

Means by which HHW may enter the environment include:

- throwing waste products into the trash,
- pouring the waste down the drain
- pouring waste into storm drains
- burying the waste or pouring it on the ground
- evaporation of waste components into the atmosphere

Table 2 contains a summary of potential problems associated with each disposal method (Purin *et al.,* 1984)

The threat of groundwater contamination is a leading fear associated with the disposal of hazardous wastes from households. Most wastes from households are incorporated into the municipal solid waste (MSW) stream. Because the most common form of disposal for MSW is landfilling, these waste end up with the potential to pollute groundwater. Of the estimated 133 million tons of MSW generated in 1984, nearly 126.5 million tons (95%) were landfilled (USEPA, 1986). According to this report, most landfills which receive MSW are not properly equipped to handle hazardous waste. For example, only 15% of MSW landfills have clay or synthetic liners, only 5% have leachate collection systems,and only 25% have groundwater monitoring capabilities. Because of the inadequacy of most municipal landfills to contain leachate, many persons believe that landfills pose a threat to groundwater quality. In a recent survey conducted by the EPA, 6.3% of Subtitle D municipal landfills were found by state inspectors to violate groundwater contamination standards (USEPA, 1986). Although this number is not considered to be exact due to the variance in criteria used by different states in defining groundwater quality and the fact that many violations go unreported, it does suggest that there are many municipal landfills releasing pollutants into the environment.

Table 2. Potential Problems Associated With Disposal of HHW*

Route of Entry	*Concern*
Solid Waste Stream	A. Injuries to Refuse Handlers B. Damage to Collection Equipment C. Contamination of Leachate D. Air Quality
Wastewater	A. Disruption of Septic Tank System B. Disruption of Wastewater Treatment Plant Operations C. Combined Sewer Overflows
Storm Drain / Surface Runoff	A. Disruption of Wastewater Treatment Plant Operations B. Contamination of Surface Water
Direct Disposal on Ground / Burial in Ground	A. Soil Contamination B. Pollution of Groundwater
Evaporation	A. Transference of Volatile Toxic Substances into the Atmosphere

*Source: Purin, (1984).

The question of whether HHW poses a threat as a landfill contaminate is an issue of debate between advocates and opponents of collection days. Supporters of collection programs contend that although small amounts of hazardous waste are disposed of by each household, a combined effect of thousands of households disposing of small quantities of wastes may eventually contaminate landfill leachate (Purin *et al.,* 1984). Opponents of this view make the claim, however, that large volumes of non hazardous waste in a landfill can safely absorb the hazardous waste, thus preventing contamination of leachate (Purin *et al.,*1984). The Chemical Specialties Manufacturers Association (CSMA) argues that there is "considerable scientific evidence" to prove that HHW does not pose a problem to municipal landfills and that hazardous waste is absorbed by paper in landfills, broken down, and detoxified by biological processes (Huth, 1986). These statements appear to be supported by results of the study conducted by the Los Angeles County Sanitation Districts in 1980 (Metro,1982). Upon examining 29 loads of refuse (1/2 residential and 1/2 commercial or mixed commercial and residential), 49 gallons of hazardous liquid were identified. Of the containers examined, 92% of them were empty. The Districts concluded that there was a solid to liquid ratio of 759:1 which they believed indicated that there was sufficient capacity in the L.A. County landfills to absorb the hazardous liquid wastes (Metro, 1982). The Metro Report points out, however, that the region where the study was conducted has very little rainfall and they assume it to have less of a leachate problem than other areas.

Another concern in the disposing of HHW in the household waste stream is one of upsetting septic tank systems. The disposal of inorganic pollutants found in household products may decrease the efficiency of a septic tank system by destroying bacteria in the tank or allowing pollutants to pass through the system unaltered (Metro, 1982). In either case, contamination of groundwater is possible because of the volatile nature of organic toxicants (for example toluene, carbon tetrachloride, benzenes, chloroform etc.) found in common household products. Because of their volatility, they are "less likely to remain

in the wastewater or soil, and without a direct escape route to the air, are most likely to migrate through the soils to groundwater supplies" (Metro, 1982). Supporters of collection programs are concerned by the ability of these chemicals to contaminate drinking water quality while pointing to the fact that approximately 50% of citizens in the U.S. rely on groundwater for their drinking water supply.

Municipal sewer systems may become contaminated when toxins are introduced into the influent. Although commercial and industrial wastes contribute the most highly concentrated wastes, Washington's Metropolitan Control Program has shown that residential wastewaters contain many contaminants entering a municipal wastewater treatment system (Purin *et al.*, 1984). Toxic substances which have been detected by investigators of residential wastewater across the country include: heavy metals, solvents, phthalates, and phenols. Problems which may arise in sewer systems due to disposal of these substances are the disruption of bacterial populations in the secondary phase of a treatment plant and the passage of pollutants to surface waters via the plant effluent.

Finally, disposal of wastes directly in or on to the ground surface may cause soil and groundwater contamination. Wastes may be carried into the sewer system or directly into the surface water by storm water runoff. Also, if buried in the ground, a container may degrade and release its contents into the soil thus causing soil and groundwater contamination (Purin *et al.*, 1984).

Potential risks associated with HHW are not limited to contamination of the environment but extend to the health and safety of refuse collectors and damage to collection equipment. Although data are difficult to obtain, there have been injuries to refuse collectors which suggest that disposal of HHW in household garbage is a problem. Reports of injuries ranging from nausea to blindness are documented (see Appendix D for a more detailed analysis). Damage to collection equipment has also been reported with the most

common problem being fires which occur when wastes of incompatible nature are placed together in a compaction truck. (Purin *et al.,* 1984)

HHW poses a potential threat to the health and safety of homeowners as well as refuse collectors. Although the author knows of no reported injuries to homeowners, improper storage of HHW is thought by many collection day advocates to be a problem.

2. Collection Programs

The organized collection of household wastes began in Lebanon, Kentucky (1981) when the County Health Department sponsored a five day collection program in which pesticides from area residents were accepted. The Health Department in Lexington, Massachusetts sponsored a collection day and expanded the idea by including "household toxics" (Purin *et al.,* 1.1984). Since 1981, many communities have followed suit, organizing collection programs to meet their own requirements. According to Dana Duxbury, a leading advocate of collection programs, a total of 530 collection days have been held, and it is estimated that by 1986 nearly 200 programs will be in operation (USEPA, 1986).

While many public interest groups support the concept of collection days for household wastes containing hazardous substances, there are organizations which believe organized collection programs are necessary only for certain types of wastes. Dr. Gary Moore, chair of the Environmental Science and Health Program at the University of Massachusetts, Amherst, believes that the disposal of household chemicals such as waste automotive oil, paints and solvents, and radiator fluids are not a hazardous waste problem and that by using the products to completion, recycling the waste products, or upgrading landfills with clay liners and leachate collection systems, risks to the environment will be reduced (Moore, 1986). The Chemical Specialties Manufacturers Association (CSMA) agrees with Dr. Moore adding that consumer products, when used and disposed of properly, do not pollute the environment significantly.

The CSMA believes that some products, such as persistent pesticides (for example, DDT), extremely toxic materials in large quantities, such as arsenic and strychnine, used motor oil or gasoline, explosive materials, and suspicious unidentified products should be separated from the general household waste stream. The CSMA supports collection programs for these and certain hazardous materials that homeowners have collected over a long period of time, provided that the programs are voluntary and licensed RCRA operators and disposal facilities are contradicted. They do not believe, however, that such collection programs should include products that may be disposed of in normal collection systems (Etter, 1986). The basic contention of CSMA and others who support their views is that municipal landfills should be upgraded to include clay liners and leachate collection systems. Dr. Moore believes that if all sanitary landfills were upgraded to meet these standards that wastes from household products would not be a threat to the environment (Moore,1986).

Presently, there are several different approaches for the collection and management of HHW. Programs in Connecticut, Rhode Island, Florida, and Virginia are examples which differ by organizational approach, disposal methods employed, or by sources of funding for the collection program. While collection days held in Virginia will be emphasized in this report, cost data will be presented in the following chapter on collection programs held in Connecticut, Rhode Island, and Florida. The following is a brief summary of collection programs held in these states.

Connecticut operates its collection days with combined local funding and private donations which are matched 50-50 by the state government. A major component of Connecticut's HHW collection program is public education. The state employs three educators to present a one week program to school children in hopes that informed children will make more knowledgeable decisions as adults and that they may have some influence over disposal practices of their parents. The program is designed to educate the children on toxic substances in the home and difficulties in dealing with the proper handling and disposal of these substances. Connecticut is currently using *A Curriculum and Resource Package on Household Hazardous*

Materials developed by the Golden Empire Health Planning Center in Sacramento California, with additional material added to make the program more applicable to the state of Connecticut (State of Connecticut, 1986).

Florida has recently completed collecting and disposing of HHW under the authority of the Quality Assurance Act "Amnesty Days" project (1983). Because Florida's water supply is subject to easy contamination, and because the state is dependent upon groundwater for human consumption, many state officials were alarmed by the improper disposal of hazardous wastes from homes, schools, farms, and small businesses. The "Amnesty Days" project was initiated to help keep hazardous wastes from contaminating Florida's drinking water supply. Florida's HHW collection system was operated somewhat differently than other programs. Centrally located mobile transfer stations were located throughout the state and homeowners, farmers, or small quantity generators could, on a one time basis, dispose of up to 450 pounds of hazardous wastes at these transfer stations free of charge. These stations had staff who were professionally trained in the area of hazardous waste handling and disposal, including chemists, industrial hygienists, and hazardous waste specialists. The state contracted with a licensed hauler to receive, package and ship the wastes to a proper treatment and disposal facility. The " Amnesty Days" project scheduled six collection days which were held from May 1, 1984 - December 31,1986 (Simon, 1984). Cost results from three of the four phases of "Amnesty Days" are located in the following chapter.

The State of Rhode Island collects HHW using a regional approach with centrally located collection sites in each region. The state contracts with a waste management firm and pays for advertising. The funds which are used to operate the HHW collection days are raised through a state wide bond issue (Leo, 1986).

Factors cited as contributing to the costs of collection days include:

- hours spent by local government staff organizing the collection day
- site charges
- publicity charges
- charges made by waste management firm to package, transport,and dispose of wastes collected
- overtime paid to local government personnel working on site during a collection day.

The literature to date focuses on the direct costs of collection days. These costs are defined by the author to include all costs directly associated with the packaging, transport and disposal of the collected wastes, and all site and publicity charges. These charges are readily available as they are usually directly billed to the sponsor. Indirect costs or costs associated with organizational hours and employee compensation during the collection day are less obvious and more difficult to assess. The Environmental Protection Agency estimates that a well publicized program, with a high participation rate, costs in excess of $2.00 per lb. of hazardous waste collected, while a program with limited participation by householders may cost well over $9.00 per lb. (USEPA, 1986). Cost data are found in Table 5.

Results

This chapter presents results from a telephone survey concerning the nature and quantities of HHW in the domestic waste stream. Also presented in this chapter are cost data including direct costs and factors contributing to "indirect" costs.

1. Nature of HHW

Telephone survey results indicated that waste oil was the major type of hazardous material disposed by householders surveyed in the past year. The following is a list of types and percentages of hazardous products disposed.

- Waste Oil 53%
- Oil Based Paint 35%
- Kerosene 10%
- Household Cleaners 1%
- Pesticides 1%

A detailed analysis concerning the nature of HHW is located in Appendix E.

2. Quantities of HHW

Survey results indicate that HHW comprises only a small portion of the total domestic waste stream. Table 3 contains a summary of survey results while Table 4 contains quantitative estimates of HHW as indicated by survey data. Approximately 0.04% of the total domestic waste stream was estimated to be hazardous.

Survey results were analyzed using SPSS^{x} (statistical package for social sciences expanded). Results of crosstabulations are found in Appendix F.

3. Data From HHW Collection Days

Three HHW collection days have been held during the past year in the state of Virginia, two in Fairfax County and one in Chesterfield County. The first collection day, held in Fairfax County on October 1985, attracted 251 participants who brought approximately 2,400 items for disposal. Two sites were maintained at high schools in the county, which were open from 9:00 am until 3:00 pm. The collection day was termed an "unqualified success" by county officials and, based on this success, a second collection day was planned. The second collection day was held on Saturday April 24, 1986 and again two sites were maintained at high schools in different parts of the county. Surveys indicated that 477 citizens participated in this collection day and a total of 319 drums of waste were collected. The sites were open from 9:00 am until approximately 2:00 pm and staffed by county employees (including a hazardous materials team from the fire department fire department, police officers, and persons conducting interviews and employees of the contracted waste management company). Estimated costs and other significant information for the two Fairfax County collection days are found in Table 5.

Table 3 Summary of Telephone Survey Results

Income Level	# Surveys	Ave. # of yrs. lived in home	% who have haz. waste in home	% who have disposed of hazardous product	% who have disposed of empty containers
UPPER	20	14.25	6%	10%	70%
MODERATE	60	14.5	22%	12%	90%
LOWER	20	14.85	5%	0%	70%
AVERAGE	100 Total	14.5	11%	7%	77%

Income Level	Methods For Disposing Of Hazardous Products			# Who Would Use Collection Center	% Who Rinse Container Prior to disposal	Disposal Method for Rinse Water	
	Trash	Ground	Recycle			Drain	Ground
UPPER	92.3%	0.0%	3.7%	70%	35%	86%	14%
MODERATE	92.3%	3.7%	0.0%	72%	20%	75%	25%
LOWER	100%	0.0%	0.0%	85%	25%	80%	20%
AVERAGE	95%	1.2%	1.2%	76%	27%	80%	20%

Table 4. Quantity Estimates of Hazardous Waste In Households as Indicated by Telephone Survey Results

Income Level	Average Hazardous Waste* Quantity in Household At Present	Estimated Quantity* Hazardous Waste Disposed In Past Year	Estimated % of** Hazardous Material in Total Domestic Solid Waste Stream
UPPER	0.11 gallons	0.26 gallons	0.10%
MODERATE	0.20 gallons	0.06 gallons	0.03%
LOWER	0.06 gallons	0.0 gallons	0%

*Average per household interviewed
**Percentages estimated using mass balance analysis (see Appendix C)

Table 5. Costs Associated with Selected HHW Collection Days

Location	Paticipants	Drums Collected	Cost	Cost/Person
Fairfax Co. VA	251	128	$46,881	$186.00
Fairfax Co. VA	477	308	$65,000	$136.00
Chesterfield Co. VA	142	41	$16,370	$115.00
Ridgefield CT	85	15	$5,000	$58.00
Mansfield CT	100	45	$11,400	$110.00
Westport CT	200	81	$18,600	$90.00
Greenwich CT	125	45	$8,750	$70.00
East Providence RI	210	*	$8,561	$41.00
North Kingston RI	186	*	$7,285	$39.00
Florida (II)	344	*	$637,436	$1,853.00
Florida (III)	503	*	$176,024	$349.00
Florida (IV)	3,147	*	$840,070	$245.00

* Data not Available

Chesterfield County held its first HHW collection day at Manchester High School on October 4, 1986. The clean up day was organized by the Keep Chesterfield County Clean Corporation, a volunteer group associated with the Chesterfield Extension Service. The Chesterfield County Board of Supervisors sanctioned the clean up day. Approximately $10,000 was donated by private businesses to help fund the event. A total of 142 households participated in the HHW disposal day which is 0.22% of the total number of households in Chesterfield County. Unlike Fairfax County's collection day, all non-recyclable hazardous waste was transported to a secure landfill for disposal. A total of 150 gallons of waste oil, 20 propane tanks, 55 gallons of kerosene, and 79 batteries were collected for recycling or other uses. Charges for transportation and disposal of wastes are listed in Table 5.

Cost data obtained from some collection programs held in the United States are presented in Table 5. These data costs include site charges, publicity costs and charges made by the waste management firm. As indicated in this table, there are significant differences between collection programs cited. Factors contributing to these differences will be discussed in the following chapter.

Some important factors were discovered which contribute to the indirect costs of collection days. Table 6 contains examples of some hidden personnel costs. Table 7 contains data from collection days held in Fairfax County, Virginia, including an estimation of both direct and indirect costs (Byrd, 1986).

Table 6. Estimates of "Hidden" Personnel Costs Associated with Collection Day Fairfax Co. VA. (two stations), April 24, 1986

Location	Workers	Job	Compensation
South Lakes HS	6	Firemen	Overtime (1 1/2)
South Lakes HS	1	Bomb Squad Off.	On Duty
South Lakes HS	1	Police Officer	On Duty
South Lakes HS	1	County Officer	Overtime
South Lakes HS	2	Co.Sanitation Workers	Overtime
South Lakes HS	8	Co. Staff Personnel	Compensatory
W Springfield HS	6	Firemen	Overtime (1 1/2)
W Springfield HS	2	Bomb Squad Off.	(Unavailable)
W Springfield HS	2	Police Officers	On Duty
W Springfield HS	2	Co.Sanitation Workers	Overtime
W Springfield HS	3	Firemen	On Duty
W Springfield HS	7	Co.Staff	Compensatory

Table 7. Costs ($) Associated with HHW Collection Days Fairfax Co., VA., October 1985 & April 1986

Contractor costs	112,564
Staff costs	60,312
Publicity costs	4,154
Site charges	3,740
TOTAL COSTS	190,770
Avg. cost/drum	406
Avg. cost/participant	245

Discussion

This chapter contains an analysis by the author of data obtained during this investigation. Results from the telephone survey as well as cost data are discussed.

1. Telephone Survey Results

   a. Nature of HHW

      Types of household products containing hazardous chemicals disposed by respondents is consistent with data from previous studies indicating that the major components of hazardous products disposed by households are as follows:

      - automotive related products
      - waste paint and related products
      - household cleaners
      - pesticides
      - other

   b. Quantity Estimates of HHW

Quantity estimates calculated by using data obtained through the telephone survey indicate that HHW comprises approximately 0.04% of the total domestic waste stream. These findings are consistent with other research characterization studies that have found that HHW comprises less than 1% of the domestic waste stream. Quantity estimates from this study and the Albuquerque study were based on the recall of respondents and can not necessarily be considered exact reflections of wastes disposed. Findings from this study and other types of characterization studies, however, do suggest that HHW comprises less than 1% of the domestic waste stream.

Data obtained from the telephone survey were analyzed using SPSSx. There was not, however, enough data to make any correlations between incomes, years lived in residence, and apartment types with the amount of hazardous waste disposed in the past year by a household or the amount of hazardous waste stored or contained in a household. Results from SPSSx analysis are found in Appendix F.

As indicated in Table F-1, 7% of respondents living in apartments indicated they had hazarodus waste stored or contained in their dwelling. This compared to 16.5% of the respondents living in houses. These responses are similar to responses obtained when respondents were asked how much waste they had disposed of in the past year. Again, 7% of apartment dwellers indicated they had disposed of some type of hazardous waste, while 10.5% of persons living in houses stated they had disposed of hazardous waste in the past year.

Tables F-3 and F-4 present crosstabulations of amounts of hazardous material disposed of in the past year or stored in the home versus the number of years lived in residence. Table F-3 suggests indicates that persons living in homes for a period of 6-10 years identified less hazardous waste than others interviewed. The other categories were very similar with 18% of respondents living in their homes for 0-5 years indicating they had hazardous waste products stored in their dwelling, 17% of persons living in their residence for 11-24

years stating they had stored hazardous materials, and 14% of persons residing in their dwelling more than 24 years stating they had stored HHW. Table F-4 varies somewhat with 6% of respondents living in their dwelling for 0-5 years indicating they had d disposed of some type of hazardous waste, 0% of householders living in their residence more than 24 years indicated they had disposed of hazardous materials in the past year while 19% and 17% respectively of respondents residing in their dwelling for 6-10 years and 11-24 years indicated they had disposed of hazardous materials in the past year.

Tables F-5 and F-6 present cosstabulations of amount stored and amount disposed in the past year by income levels. Data suggest that moderate income householders stored more in their homes and disposed of more hazardous wastes than other income levels.

Data obtained from the telephone survey could not be used to make any correlations concerning amounts of hazardous stored and disposed by households with types of dwellings, number of years lived in residence and income levels. The data obtained may be used to make some broad generalizations as was presented in the preceding paragraphs. One conclusion that can be drawn, however, is that not many householders, whether they live in an apartment or house, have just moved into their residence or have lived their for 30 years, or are of the upper, moderate, or lower economic classes indicate that they store or dispose of HHW.

2. Collection Day Costs

A considerable difference between the costs of collection days held in Fairfax County, Virginia, and Connecticut and Rhode Island is evident from the data in Table 5. One reason for this is that two sites were maintained per collection day in Fairfax County as opposed to one site in Connecticut and Rhode Island. Another reason is that some companies contracting for the transport and disposal of HHW in Connecticut (and Rhode Island) allow "bulking" of all or some of the wastes.

Bulking involves combining similar substances instead of packaging materials separately and in their original containers. After containers are emptied, they are thoroughly rinsed and sent to a secure landfill for disposal. This saves a considerable amount of money because fewer drums are needed for transport and contractors usually charge on a per drum basis.

This practice is not without its disadvantages, however. A highly trained field chemist must be on-site to supervise the mixing of the chemicals to ensure the safety of the process, and all products must be categorized and bulked with wastes of similar chemical composition. The three major categories of substances bulked are poisons and pesticides, corrosives, and flammables. These chemical types must never be mixed together due to the potential for adverse reactions such as explosions or the release of toxic gases. Because of possible dangers associated with bulking, it may be difficult to find a contractor who will allow this process (Leo, 1986).

The disposal method used also affects the cost of a collection day. Some of the most expensive collection days surveyed were held in Fairfax County, Virginia. Wastes collected here were incinerated, except for the non-hazardous wastes which were taken to the local landfill for disposal. Fairfax County selected incineration in order to reduce the County's potential long-term liability for the waste (see Appendix A for a discussion of liability). Chesterfield County, on the other hand, chose to have the waste landfilled in a secure landfill operated by the contracted waste management firm in order to reduce costs. Cost per participant was $30 - $70 less than collection days held in Fairfax County. It is important to note that the same waste management firm was contracted for the first HHW collection day in Fairfax County as for the collection day in Chesterfield County. Thus, assuming that other factors are similar, the cost to incinerate versus the cost to landfill is approximately $70 greater per participant (according to this specific contractor). Waste collected at clean-up days held in Connecticut and Rhode Island were disposed through a combination of incineration and landfilling.

Cost data from Florida's collection program seem disproportionately higher than other programs reviewed. One reason for this is the organization of the "Amnesty Days" project. Mobile collection sites were operated in a region up to six days depending on the expected turnout instead of one day as were other programs. Also, the State of Florida encouraged participation by small quantity generators as well as householders allowing them to dispose of up to 450 lbs. of hazardous waste. If the amount of hazardous waste disposed of by a participant exceeded 450 lbs., a 25% discount on the original disposal fee was given (Florida Department of Environmental Regulation, 1984).

The costs presented in Table 5 reflect publicity and transport and disposal costs only. As one might suspect, there are hidden costs associated with these collection days. Government employees (whether state, city, or county) organizing the project are usually present at these collection days (usually held on Saturdays) and may be paid overtime or receive compensatory time. A hazardous materials or emergency response team from the local fire department is usually present and members of the police department and bomb squad may also be represented. All of these additional costs should be considered when evaluating the true costs of a HHW collection day. Table 6 contains a list of county employees working on-site at the April,1986, HHW collection day in Fairfax County. These are examples of compensations that add to the realized cost of a collection day. Total cost estimates for the two collection days held in Fairfax County are found in Table 4.

Fairfax County recently reviewed both fall and spring HHW collection days, concentrating on monies spent in additional salaries paid to county employees working on site during the collection days. It was determined that the average salary cost for employees was $12.00 per hour and it was estimated that 41 employees were compensated for their work at these collection days.

Two methods of reducing the number of compensated employees at the collection site were observed by the author during this investigation. They include using trained volunteers

(whenever possible) instead of government employees, and locating the collection site near a fire or emergency response station. Trained volunteers are capable of performing simple tasks such as interviewing residents as they enter the collection site and directing traffic flow. Sources for volunteers include: local civic organizations, such as the League of Women Voters, the Rotary Club, Kiwanis etc.; garden clubs; local boy and girl scout troops; and environmental organizations such as the Sierra Club. Secondly, by locating the collection site near a fire station, as was the site in Chesterfield County, Virginia, the number of firemen required on site is reduced while still providing adequate safety in the event of an accident.

Other costs which are more difficult to analyze are associated with the hours spent in planning and organizing a HHW collection day. Although these hours are difficult to quantify and vary from place to place, local government officials should be aware that they do exist and should be considered when evaluating costs for a collection day. Fairfax County estimated the total planning hours for their fall and spring collection days as 3,090 hours for 19 staff members. The cost to the county for these hours was determined to be $45,686.

Conclusions

The findings of this study are consistent with data presented by other researchers suggesting that HHW comprises a very small percentage of the total domestic waste stream. Although the results of all studies observed indicate that only very small amounts of hazardous materials are deposited by households into the waste stream, there is not sufficient evidence to assess the threat HHW poses to human health or the environment.

A study of collection days reveals that these programs, on the whole, are expensive to operate. This study presents data on indirect costs along with direct costs. Findings suggest that indirect costs, which have been overlooked by many in the past, contribute significantly to the total costs paid by the sponsors of collection days. Costs of collection days vary considerably depending on whether the waste is bulked, on the disposal method selected, and on the number of employees whom the sponsor must compensate.

Because of the small amount of HHW identified in the waste stream, the high cost of collection days, and the small number of residents which usually participate in these events, it is difficult to make a clear cut case for sponsoring collection days. Efforts might be redirected towards upgrading landfills receiving household wastes to include groundwater monitoring and leachate collection systems. For this reason, the United States EPA was directed by the Hazardous and Solid Waste

Amendments of 1984 to upgrade all landfills receiving wastes from households to include, at a minimum, groundwater monitoring systems.

This process, however, will probably be lengthy and so local governments may wish to pursue other measures such as collection days or educational programs. Educational programs which teach householders how to properly dispose of waste products would appear to reduce the threat of HHW to the environment and the health and safety of refuse collectors. These programs might include teaching householders to:

- buy only amount of product needed
- wrap waste containers with paper or place them in cat litter (or another type of absorbent material) prior to disposal
- use product to completion or give to someone who can (making sure that labels and disposal instructions are intact)
- leave waste contents in original containers and dispose of them in trash as opposed to pouring contents down the drain or on the ground.

The author concludes that the main contribution of collection days is the increase in awareness they generate regarding proper storage and disposal of hazardous waste products in the home. Although the risks associated with HHW are presently poorly defined and collection programs tend to be expensive to operate, the latter may be an option that local governments should consider in addressing the proper management of HHW.

Officials should not, however, lose sight of priorities when addressing the management of hazardous wastes from households. Results from a survey of hazardous waste generators suggest that hazardous waste generated by businesses in quantities less than 100 kg of per month, may be more of a concern than hazardous wastes generated by households due to the greater volumes generated by these sources. Officials might consider developing a program to address the collection and disposal of these wastes as they might possibly pose a greater threat to the environment than waste from households.

It is the opinion of this author that by educating householders to the proper storage and disposal of waste products, such as wrapping waste containers prior to disposal, the threat of HHW to the environment and to the health and safety of refuse collectors can be reduced.

Appendix A. Collection Day Organization

The following attachment contains information concerning the organization of collection days. This information was obtained by contacting sponsors of collection programs, attending collection days, reviewing the literature, and attending a conference on HHW in Washington, D.C.(sponsored by USEPA).

The collection day involves a considerable amount of planning and organization. If a local government is sponsoring the event, a committee must be formed which will be responsible for coordinating all aspects of the collection day. This committee must select a contractor who will provide quality service at a reasonable price and which will best meet the needs of the sponsor. For example, the sponsor may wish to be charged a flat fee instead of being charged per drum of waste received. Also, if a specific method of disposal is desired, such as incineration, a contractor with these capabilities must be found. The firm selected should be licensed by the EPA to transport hazardous waste and the disposal facility should also be licensed to accept treat and dispose of hazardous waste. It is very important that the selected contractor have liability insurance in order to cover any mishaps that might occur while on site at the collection day or while waste is being transported to the disposal facility. The locality may also be liable for the wastes and should also have insurance (see discussion below). It is desirable for a service contract to be drawn up and

signed by the sponsor and contractor. This contract should state all of the services that will be provided and the types of insurance coverage that will be provided by each party.

After selecting a contractor, deciding upon a disposal method, and signing a service agreement, the organizers are now ready to determine the site location, date, and time of the collection. An important consideration in determining the location of the event is that of accessibility. The site should be as convenient as possible to the area in order to maximize participation. This site should also be conducive to safe and organized traffic flow.

After determining the date, time, and location of the collection day, the committee must now publicize the event. Some methods of advertisement have proven to be more successful than others. Table 8 contains a listing of advertising methods employed by Fairfax and Chesterfield Counties in Virginia.

Included in advertising materials should be a list of wastes which will be accepted at the collection site. Sponsors should decide prior to publicizing the event whether they will accept and store wastes, such as dioxins, for which there is currently no acceptable method of disposal, or wastes which are unidentifiable. If they decide to accept these wastes, someone must be prepared to handle them on site. Even if these wastes are explicitly banned from the collection day and this is clearly stated in the publicity materials, it is possible that someone will bring in these types of wastes for disposal. Therefore, it is a good idea to formulate a policy dealing with unwanted wastes. Sponsors should be aware of the fact that if wastes are rejected the of these ending up improperly disposed may be increased. A member of the organizing committee should be designated to answer questions from interested householders concerning the collection day. Their phone number should be readily available in the publicity materials.

At the site on the day of the collection, residents should enter the area through well marked entrances and may be met by volunteers or county personnel and asked to respond to a survey. Persons interviewing householders should be prepared to answer any questions participants might

have and then give any directions concerning the delivery of waste to authorized personnel. Participants should be requested to stay in their cars while on site in order to avoid confusion and reduce liability. Participants should proceed from the surveying point to some designated area where authorized personnel from the waste management firm remove the waste from the car. The participants then exit the site following the designated route. Wastes removed from the householder's cars are taken to a table staffed by the contractor's employees where the wastes are identified and written into a manifest. Persons employed by the waste management firm should be highly trained field chemists capable of identifying and characterizing most hazardous wastes. After the wastes are identified, they should be packaged in drums and placed in a truck for transport to a disposal facility.

EFFECTIVENESS OF ADVERTISING

Having evaluated data form interviews conducted on site at Fairfax County and Chesterfield County collection days, several insights were made as to the most effective sources of advertising. Brochures and flyers distributed in schools, newspaper and radio advertisements, posters and homeowners newsletters appear to be the most effective means of reaching private citizens. Other methods of advertising which were less effective were cable television ads, advertisements in food stores, advertisements in work places, and advertisements in hardware stores. The success of all methods varied from site to site in Fairfax County and a difference was also seen between fall and spring collection days, but general trends in effectiveness do appear. In Chesterfield County, the most effective method appeared to be flyers placed in utility bills along with newspaper advertisements.

ADDITIONAL SOURCES OF FINANCIAL SUPPORT

Financial support is necessary to hold a HHW collection day in order to pay the waste management firm for collecting, packaging, waste disposal, travel expenses, and liability insurance. Funding will also be needed for advertising the collection day in order to attract participants. Although the sponsor may have financial support from municipal or county tax revenues, additional sources of funding might also be available. The following is a guide developed by the Connecticut Department of Environmental Protection for locating additional support if it is needed.

- Businesses and industries, especially those who generate hazardous wastes, may be willing to contribute money or materials to the collection program. Any request for assistance should be accompanied by a proposal outlining the request for financial assistance.
- Civic groups such as the Rotary Club and Kiwanis are sometimes willing to support projects which are in the community's interest. Someone on the organizational staff should prepare a presentation (both written and oral) for these groups early in the planning stages as these groups often take some time in making funding decisions.
- Many private foundations, public interest groups, or environmental interest groups may have funding available for environmental projects. These groups are also a very good source for volunteers if needed for tasks such as publicity before the collection day and surveying on-site.
- Some state governments may be willing to help support the collection day by sending staff, materials, or by matching existing funds with state donations (as does Connecticut).
- Finally, if the sponsor needs more funding after sources are exhausted, it might be necessary to charge participants a small fee for the proper disposal of their wastes. This fee should be kept at a minimum, however due to the negative affects this might have on participation.

LIABILITY/LEGAL CONCERNS

Probably the most common concern among prospective sponsors of HHW collection programs is that of being held legally responsible in the event that someone is injured or damage occurs. Under the Comprehensive Environmental Response, Compensation, & Liability Act (CERCLA), the liability threat is indeed very significant and far-reaching. There are some precautions, however, which may help to ensure a safe program and, at the same time, reduce the liability risk to the organizer. This section of the document includes a summary of these precautionary measures as well as important legal and insurance issues which need to be addressed by potential HHW collection day sponsors.

Some misunderstanding appears to have arisen in the past as to whether any stage of a household hazardous waste collection program is subject to federal hazardous waste regulations under Subtitle C of the Resource Conservation & Recovery Act. HHW by definition is exempt from regulation under Subtitle C of RCRA. Regulations promulgated in response to RCRA (CFR 261.4(b)(1)) clearly state that household waste is never considered by the federal government to be hazardous waste, even when collected in quantities that would otherwise be regulated or when the wastes are transported, stored, treated or disposed (Lehman, USEPA official, 1986). The common practice of requiring the contracted waste management firm to accept generator status is useless because household wastes are not subject to regulation under RCRA. Compliance to RCRA regulations may be undertaken *voluntarily* in the hope that this would minimize potential liability in the event of a mishap. The hope might be, for example, that a court would take voluntary compliance as evidence of a good-faith effort to make the program as safe as possible, and as a defense against any claim of negligence. Furthermore, the treatment, storage, or disposal facility to which the wastes are taken may insist on the Subtitle C requirements being observed as a condition for the wastes' acceptance.

Wastes collected on site during a collection day will only become regulated under RCRA if wastes from small quantity or other regulated generators are mixed with the HHW. It is advisable, from a liability standpoint, not to accept any commercially produced hazardous waste because of the difficulty of proving the status of the generator.

Although not subject to regulation under RCRA, a municipality has long term liability for the waste under CERCLA. According to CERCLA, household waste containing hazardous chemicals is defined as solid waste with hazardous substances and must be managed properly in order to prevent environmental pollution. This liability is not different, however, than the liability a municipality has if it collects and disposes of the waste in a municipal landfill. A town is responsible for the safe disposal of collected waste whether they sponsor a collection day or not. According to EPA officials at a recent HHW conference (1986), if a municipality sponsors a collection day their liability probably decreases because wastes are disposed in a secure landfill or treated by

another EPA approved method such as incineration. Although a municipality can technically be held liable for releases at a licensed facility, EPA officials indicated at the conference that the risks are minimum. They stated that the EPA would first seek compensation from the facility under RCRA, and would only proclaim it a superfund site (liable under CERCLA) if the facility goes bankrupt. It is therefore highly unlikely that a municipality will be liable for wastes taken to a licensed treatment and/or disposal facility.

Although citizens are not required to comply with regulations set forth in RCRA, a permit is required in some states (not Virginia) to hold an HHW collection day. Organizers should contact their state's environmental agency to determine if a permit is required and if there are any special instructions or advice from the agency. The State of Virginia Department of Waste Management (previously the Department of Health) will provide information concerning permitted hazardous waste management contractors but will not make any judgments as to the competence of the company nor will the agency assume any liability for the sponsor's selection. The Department of Waste Management is also available to consult with potential sponsors on other issues such as liability. Representatives from the Department of Waste Management were present at both collection days held in Fairfax and Chesterfield Counties to answer questions and provide assistance.

In order to protect participants and workers, emergency response teams should be alerted whenever an HHW collection day is held. Many fire departments will send their hazardous materials (HAZMAT) team to the site of a collection day as a precautionary measure. A police officer stationed on-site is desirable in case of an emergency or to direct traffic in order to avoid congestion. At the collection days held in Fairfax County Virginia, members from the HAZMAT team, police officers, and even bomb squad officials were on-site to provide assistance in the event of an accident or emergency. In addition, there should be trained staff from the collection firm who can properly identify, package, and remove all wastes from the collection site. The hazardous waste facility should also provide any equipment or materials necessary to clean up or contain a spill should one occur. The facility should be prepared to clean up any spill on-site or one that might occur during transportation to the disposal facility.

In view of what has already been said about potential liability, insurance coverage is certainly desirable, if not essential. Unfortunately, such coverage may be difficult or impossible to obtain, given the present state of the insurance market. If possible, a policy should be obtained which would cover any accidents which might arise from an HHW collection program. This coverage may be available under existing policies or by attachment of riders for Environmental Impairment Liability and/or non-employee assistants. All workers, whether staff or volunteers should be covered. Also, citizens participating in the program should be covered while at the collection site. The policy should cover any damages such as fire or explosions while on-site and also damages that might occur after the waste leaves the collection site.

Appendix B. Questionnaire - Hazardous Waste in the Home

Hello, my name is Denise Scott. I am a graduate student at Virginia Tech researching the disposal of household wastes in landfills and the impacts it might have on the environment.

I need to speak with a head of household or spouse. Are you eligible?
YES___ NO___

Would you be willing to answer a few questions concerning household wastes? Your name and phone number will be kept confidential.

1. Do you live in a house or apartment?
2. How long have you lived in your current residence?
3. What is the size of your household?
4. I am going to read you a list of products. Please tell me if any of them are in your home or garage?
   a. _____Pesticides
   b. _____Household Cleaners
   c. _____Motor Oil
   d. _____Antifreeze
   e. _____Paints or thinners
   f. _____Pool Products
   g. _____Wood Preservatives
   h. _____Weed Killers

i. _____Fertilizers

j. _____Auto or Furniture Polishes

k. _____Chemical Drain Openers

l. _____Other Potentially Hazardous Substances

m. _____List _____

n. _____

o. _____

p. _____

5. Of the products you identified as being in your home, how many (how much) are not presently being used, and are not likely to be used in the future, and might just as well be thrown out? If you need some time to check I will be happy to call you back at a convenient time.

6. Have you disposed of any of these products or containers in the last year?

7. If so, what were they, how much did you dispose of, and how did you dispose of them? Did you rinse the containers? Where did you put the rinse water?

8. As far as you know, is it legal to put the products we discussed in the trash?

9. If there were a center in your community where you could take these kind of products for safe disposal at no cost to yourself, would you do so?

Appendix C. Mass Balance Calculation

TABLE C-1. Example of MASS BALANCE CALCULATION

Amount of Waste Generated by 100 Households in a Year

$$2.75 \frac{\text{people}}{\text{home}} \times 100 \text{ homes} \times 1.97 \frac{\text{lbs. domestic waste}}{\text{person/day}}* \times 365 \frac{\text{days}}{\text{year}} = 198000 \frac{\text{lbs dom.waste}}{\text{year}}$$

Amount of Hazardous Material Disposed by 100 Households in a Year**

$$9.2 \frac{\text{gallons of hazardous material disposed} \times 65 \text{ lbs/ft}^3}{7.5 \text{ gallons/ft}^3} = 80 \frac{\text{lbs hazard.material disp.}}{\text{year}}$$

Percentage of Total Domestic Waste Stream Hazardous Material Composes

$$80 \frac{\text{lbs hazardous material disposed}}{\text{year}} \; / \; 198{,}000 \frac{\text{lbs domestic waste disposed}}{\text{year}} = 0.0004$$

$0.004 \times 100 = 0.04\%$

*Source: Vesilind and Rimer, 1981.

**Source: Telephone Survey (see Table 4)

Appendix D. Injuries to Refuse Collectors

Table D-1. EXAMPLES OF INJURIES TO REFUSE COLLECTORS*

Serious injury to one refuse collector has been directly related to HHW. A refuse worker in San Diego, CA lost his sight when hazardous waste from a residence spilled on his face. The hauling firm notified the residents of the injury and identified wastes that should not be discarded in residential waste. The San Diego Environmental Health Department was barraged with phone inquiries on how to dispose of HHW. A task force was formed that subsequently developed the current City program.

A private firm in Lemon Grove, CA reported a number of incidents in which swimming pool chemicals splashed on collection personnel during the compaction of residential refuse. One worker lost 50 percent of the use of his left eye.

Used motor oil caused severe eye irritation of three disposal personnel in Lemon Grove, CA.

Severe eye irritation in one incident was caused by contact with paint thinner also in Lemon Grove, CA

Some 42 incidents have been reported in Los Angeles County, CA related to HHW. Injuries to refuse collectors have been caused primarily by oil, battery acids, swimming pool chemicals, paints, and solvents.

A refuse collector in Sacramento County, CA lost his sight when splashed by swimming pool acid during compaction.

At least three injuries per month occur in San Francisco, CA, caused by exploding aerosol cans.

A caustic material in residential refuse caused severe skin irritation to a refuse collector in Roscoe, IL.

*Source: USEPA, 1986.

Appendix E. Types of Hazardous Wastes

Table E-1. Types and Amounts of Hazardous Materials Disposed in One Year*

Income Level	Waste Oil	Kerosene	Household Cleaners	Pesticides	Oil Based Paint
Upper	656 ozs	128 ozs.	10 ozs.	--	--
Moderate	16 ozs.	--	--	16 ozs.	448 ozs
Lower	--	--	--	--	--
Total	672 ozs	128 ozs	10 ozs	16 ozs	448 ozs

*Based on Survey Results

Appendix F. SPSSx analysis

Table F-1. Amount of Hazardous Waste Presently Stored or Contained in Households by Type of Dwelling

	Amount (ozs.)					
House Type	None	1-8	9-32	33-64	> 65	% That Had Waste
Apartment	14	0	1	0	0	7
House	69	3	5	2	4	16.5
Column Total	83	3	6	2	4	15

Table F-2. Amount of Hazardous Waste Disposed in Past Year by Householders by Type of Dwelling

	Amount (ozs.)					
House Type	None	1-8	9-32	33-64	> 65	% That Had Waste
Apartment	14	0	1	0	0	7
House	74	2	3	1	3	10.5
Column Total	88	2	4	1	3	10

Table F-3. Amount of Hazardous Waste Presently Stored or Contained in Households by Years Lived in Residence

	Amount (ozs.)					
# YEARS	None	1-8	9-32	33-64	> 65	% That Had Waste
0-5	27	3	2	0	1	18
6-10	15	0	1	0	0	6
11-25	24	0	2	1	2	17
> 25	17	0	1	1	1	14
Column Total	83	3	6	2	4	15

Table F-4. Amount of Hazardous Waste Disposed by Householders in Past Year by Years Lived in Residence

	Amount (ozs.)					
# YEARS	None	1-8	9-32	33-64	> 65	% That Had Waste
0-5	30	0	1	0	1	6
6-10	13	1	1	0	1	19
11-25	24	1	2	1	1	17
> 25	21	0	0	0	0	0
Column Total	88	2	4	1	3	10

Table F-5. Amount of Hazardous Waste Presently Stored or Contained in Households by Income Level*

	Amount (ozs.)					
INCOME $	None	1-8	9-32	33-64	> 65	% That Had Waste
11,000	19	0	1	0	0	5
18,500	46	3	5	1	4	22
28,000	18	0	0	1	0	6
Column Total	83	3	6	2	4	15

* From City of Roanoke, Virginia Census Tract Data

Table F-6. Amount of Hazardous Waste Disposed by Householders in Past Year by Income Level*

	Amount (ozs.)					
INCOME $	None	1-8	9-32	33-64	> 65	% That Had Waste
11,000	19	0	0	0	0	0
18,500	52	2	2	1	2	12
28,000	17	0	2	0	0	10
Column Total	88	2	4	1	3	10

*From City of Roanoke, Virginia Census Tract Data

Key Terms

RCRA - Resource Conservation and Recovery Act

CERCLA - Comprehensive Environmental Response, Compensation and Liability Act

HSWA - Hazardous and Solid Waste Amendments to RCRA of 1984.

USEPA - United States Environmental Protection Agency

HHW - Household Hazardous Waste

MSW - Municipal Solid Waste

LQG's - Generators of 1,000 kg or more of hazardous in one month.

SQG's - Generators of 100-1,000 kg of hazardous waste in one month.

VSQG's - Generators of less than 100 kg of hazardous waste in one month.

CSMA - Chemical Specialties Manufacturers Association

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