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ABSTRACT

Presented are key issues to be addressed by state, regional, and local governments and agencies in creating effective hazardous waste management programs. Eight chapters broadly frame the topics which state-level decision makers should consider. These chapters include: (1) definition of hazardous waste: (2) problem definition and recognition: (3) principles of waste management: (4) transportation: (5) land use and related policy issues: (6) facility operations: (7) waste sampling and analysis, and leachate sampling: and (8) elements of state programs. Each chapter summarizes appropriate existing background information and relates it to the implementation issues facing state officials. Appendices include a model state hazardous waste management act and information regarding the disposal of particular categories of wastes. The guide does not preempt regulatory decisions still to be made at federal and state levels, since public input on these policies has not yet been solicited. (Author/WB)

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Chapter 1

SUMMARY

SUMMARY

This guide presents the key issues to be addressed by State, regional, and local governments and agencies, in creating effective hazardous waste management programs. Basically a policy-oriented "checklist," the guide highlights topics which have been confronted by existing hazardous waste management programs, or which can be expected to concern such programs since the passage of the new Resource Conservation and Recovery Act of 1976 (RCRA).

Background

EPA began work to survey, investigate, and evaluate options for hazardous waste management programs well before the passage of RCRA. Many of the findings from studies performed both in-house and under contract, which would be applicable to developing State programs, have not been restated specifically for State program managers, or have been available only as unpublished papers. Therefore, EPA, Office of Solid Waste (OSW) determined the need to collect these materials in one reference volume.

RCRA encourages broader State authorities on many waste management issues, particularly in establishing a hazardous waste regulatory program. As a result, the topics covered in this guide are especially relevant to State programs that are just getting started.

This guide does not preempt regulatory decisions yet to be made at Federal and State levels, since EPA intends to have broad public input before making such decisions at the Federal level. This guide serves to highlight issues about which decisions must be made by responsible public officials.

Legislative Context

This guide was conceived in the context of providing State officials with a comprehensive legislative base from which to develop a broad hazardous waste control program. Such a base could be constructed either by adapting existing legislation to cover the multifaceted nature of the problem, or by devising a comprehensive act to deal specifically with hazardous wastes.

Appendix A is a Model State Hazardous Waste Act developed through the assistance of many State waste agency managers, the waste management industry, and others. It represents a suggested model legislative framework for dealing with the hazardous waste regulatory issues presented in this guide.

Issues of Concern

Eight major chapters are included in this guide which broadly frame the topics to be addressed by State decision makers:

- Definition of Hazardous Waste
- Problem Definition/Recognition
- Principles of Waste Management
- Transportation
- Land Use and Options for Hazardous Waste Management
- Facility Operations
- Waste Sampling/Analysis and Leachate Analysis
- State Program Elements

Each chapter attempts to summarize background materials available to EPA and to relate these materials to the implementation issues facing State decision makers. EPA Regional Office staffs are available to assist State program managers who wish to discuss these issues in greater detail.

Two appendixes are included that address significant hazardous waste disposal problems often cited by State officials as particularly bothersome. Appendix B summarizes the sources of information for disposing of small batches of hazardous wastes. Appendix C reviews the status of the regulation of the storage and disposal of pesticides, pesticide containers, and pesticide-related wastes.

Appendixes D and E reprint disposal advice prepared as guidance under the Solid Waste Disposal Act, as amended. Wastes containing polychlorinated biphenyls and vinyl chloride-containing aerosol cans were specifically addressed under this earlier program.

Appendix F details the Federal agencies that deal with the problem of hazardous waste disposal. This guide does not purport to provide all of the answers to State agency managers. It does categorize and analyze many of the significant questions that need to be addressed and suggests evaluative and background information to aid in reaching conclusions. Many of the final Federal decisions must await the outcome of the public participation process which began with the passage of RCRA and will culminate in regulations that will respond to the need to control hazardous wastes.

Chapter 2

BACKGROUND FOR DEFINING HAZARDOUS WASTES

There are two major methodologies presently in use to identify wastes as hazardous—a list approach and a criteria approach. Both approaches are difficult to implement. The criteria approach addresses the problem more directly. It identifies those properties of waste that cause hazardous effects to the environment and then recommends methods and procedures to measure these properties (or effects). The list approach, on the other hand, is more indirect. The waste is analyzed for certain prescribed species, and depending upon the presence of these species (and possibly their concentration), a hazard judgement is made. The following discussion will address methods presently available to implement a criteria approach.

Since some aspects of the safe management of hazardous waste are identical to safe management of other regulated substances, some of the methods mentioned herein are those recommended by other agencies for the testing of these other regulated substances. Waste materials, however, do possess certain peculiarities of form and function for which existing criteria may not be adequate or appropriate to characterize a waste's hazardousness. In these cases, the differences are mentioned and the problems addressed. The criteria that will be discussed are: flammability, corrosiveness, and reactivity. These criteria can be viewed as properties of the waste as disposed and can be measured by directly testing the waste.

There are other criteria, such as waste toxicity, etiologic activity, genetic activity, and tendency to bioconcentrate, which must be considered in the context of their routes of exposure. A waste containing a contaminant conforming to these criteria can only be a hazard if there exists a vector (exposure route) by which this contaminant can be made available to the environment under disposal conditions. In order to measure these criteria in a meaningful way, the measurement must be done on the exposure vector, be it eluent from the waste, vapor due to waste evaporation and sublimation, or air float particles from waste particulates. For example, a waste may contain a toxic constituent, but if this toxicant is bound up in the waste matrix in such a way that it cannot leach (elute), vaporize, air-float particulate, or sublimate under disposal conditions, the waste does not present a toxicity hazard. Therefore, any testing done to identify wastes that would conform to the above criteria should ideally be done on these vectors. Testing of this sort is complex and still under development in both the public and private sectors. This chapter will not deal with these criteria further.

FLAMMABILITY

Flammability is one criterion for defining a waste as hazardous. Flammable wastes may cause damage directly, from heat and smoke production, or indirectly, either by providing a vector by which other hazardous wastes could be dispersed (such as convection currents carrying toxic particulates or dust), or could cause otherwise benign wastes to become hazardous (such as plastics which, when ignited, undergo condensation reactions or depolymerize to emit toxic fumes). For these reasons, it is desirable to identify wastes that are flammable, so they can receive proper handling.

One method by which the degree of flammability of a material can be defined is by the flashpoint (FP) of the substance. This is the lowest temperature at which evaporation produces sufficient vapor to form an ignitable mixture with the air near the surface of the liquid, or within the vessel used. (By "ignitable mixture" is meant a mixture that, when ignited, is capable of the initiation and propagation of flame away from the source of ignition. By "propagation of flame" is meant the spread of flame from layer to layer independently of the source of ignition.)

The initiation of flame is always the result of the progressive auto-acceleration of reaction, which becomes possible only under definite thermal conditions brought about by an external source (for example, spark discharge, hot walls of a vessel, etc.) Most combustion reactions are exothermic (heat producing), and as they proceed they raise the temperature of the surroundings. Since reaction rate is a function of temperature (a measure of available energy), these reactions accelerate themselves by the thermal energy they release in reaction. (The reaction here is oxidation, that is, the exhaustive combination of the vapors with the elemental oxygen in the atmosphere.)

In defining flammability, only the flash point need be considered since direct vigorous oxidation of a substance not in the gaseous state is very rare at normal temperatures. While all agencies and organizations that define flammability use flash points as their limiting criteria there is no consensus as to what that limit should be (for example, Department of Transportation F.P. < 100°F, California F.P. < 80°F). In landfill situations, there are many available external sources of energy which could provide the impetus for combustion—electrical energy resulting from sparks generated by bulldozers, thermal energy resulting from the heat of neutralization when wastes of differ- pH's are mixed, biologically-initiated thermal energy from the decomposition of organic wastes, etc. These sources could raise the temperature at the landfill surface above the ambient temperature. Data should be gathered on the temperature and energy sources at landfills to help address the question of what flashpoint limit should be chosen to avoid conflagrations due to these external sources.

Another source of concern is the fact that disposal sites often contain wastes that are not hazardous by themselves, but when burned become hazardous (for example, certain plastics give off noxious fumes when burning, beryllium dust may leave the site by a vector supplied by the fire, etc.) For this reason, it may be desirable not only to require that flammable wastes be placed in a hazardous waste facility, but also combustible wastes. Combustible wastes can be managed in a safe manner at these facilities by being segregated from those wastes which become hazardous upon burning.

The established tests for flammability take the physical state of the substance into consideration, since the state will affect the vapor pressure and consequently change the flash point. Therefore, flammability will be examined for the four following physical states of wastes: (1) pure liquid; (2) solution; (3) sludge, (4) solid. The testing modifications that must be made for each state, and a short discussion of each state follow:

I. Pure Liquids

The vapor, as measured by the vapor pressure, produced by a pure substance is directly proportional to the ambient temperature. (The reference is primarily to liquids, although there are certain solids, e.g., camphor, that sublime, that is, change from a solid to a vapor, at ordinary temperatures, and that have a meaningful vapor pressure.) The "ideal vapor pressure" of a substance is defined as the sum of the vapor pressure of each constituent multiplied by its mole fraction. Temperature is a manifestation of molecular motion, which in turn is a physical consequence of the kinetic energy of the molecules themselves. At any given temperature, the molecules in a sample will have a "spread" of kinetic energies that can be statistically described as a Boltzman distribution.

A molecule must possess a certain minimum threshold energy in order to overcome the attractive forces of its neighboring molecules in the close-packed liquid state. As the temperature is raised, the entire curve shifts toward higher kinetic energy and more molecules now possess the prerequisite energy to escape into the gaseous state.

It has been suggested that flash points be standardized to a particular atmospheric pressure, since barometric pressure does vary with different locations, and with time at the same location. The reason for this suggestion is as follows: Atmospheric pressure is the measure of the amount of air available at any given point. Thus, as the atmospheric pressure drops, less vapor (that is, lower vapor pressure) is necessary to attain that concentration which defines an ignitable mixture, and the temperature which produces this lower vapor pressure (that is, the flash point) is also lower. One might assume then that if the barometer drops appreciably after a flash-point determination is made, what was tested as a nonflammable substance at the higher reading may be flammable at the new pressure. However, this seems to be an unrealistic concern since according to the National Oceanic and Atmospheric Administration (NOAA), the largest barometric deviation in a single day (excluding hurricanes and tornadoes) *is less than 20 mm Hg,* and this would change a flash point of 80°C by less than 3°C.

There are several common methods of determining the flash point of a liquid. The methods vary only slightly with the apparatus used, and these apparatus are of two types–open cup testers and closed cup testers. The method is basically as follows: the sample is placed in the sample cup and heated at a slow but constant rate. A small test flame is passed across the cup at regular, specified intervals. The flash point is taken as the lowest temperature at which application of the test flame causes the vapor at the surface of the liquid to flash.

The apparatus on the market differ in four ways: (1) sample cup type; (2) cup insulation type; (3) heating mechanisms; (4) agitation.

The most important of these is the type of sample cup. Open cup testers as a class give higher flash points than closed cup testers, and are normally used for determinations on liquids with relatively high flash points. These higher determinations result from the fact that the design of the top of the sample cup in an open cup tester allows the sample to be in greater contact with the atmosphere, preventing any quantitative buildup of vapors over the liquid as it is heated. Closed cup testers have smaller openings above the sample cup; this keeps the vapor from quickly dissipating and results in a mixture richer in vapor. Thus, closed cup testers would be representative of the worst, or most dangerous situation.

There are two types of cup insulators (temperature baths): liquid bath and air bath. Since the purpose of these temperature baths is to ensure a uniform temperature around the entire sample, a liquid bath is superior to an air bath, due to the better thermal transport properties of liquids as compared to air.

As far as temperature control mechanisms are concerned, it makes no difference whether the apparatus has a gas or electric burner. Both are equally accurate at the low temperature of concern, and the choice becomes one of convenience (electric) versus economy (gas).

The final choice that must be made is whether or not to include a method of sample agitation in the apparatus. If the sample to be tested is very viscous, tends to skin over, or contains suspended solids, a stirrer should be incorporated into the apparatus to agitate the sample and prevent local temperature variations. Since a pure nonviscous liquid can also be run on such an apparatus without a stirrer, it is recommended that a stirrer be incorporated into the apparatus.

There are a number of different flash-point testers offered by the vendors, Fischer and Sargent to name two, with various combinations of the above features (Table 1).

The following is a short discussion on three types of physical state deviations from a pure liquid and and how they should be handled.

II. Solution

A solution is the least complex deviation from a pure liquid, and the procedures for ascertaining flash points of solutions have also been developed. The vapor pressure of solutions will vary either positively or negatively from the ideal vapor pressure (where the "ideal vapor pressure" is defined as the sum of the vapor pressure of each constituent multiplied by its mole fraction). Solutions can be tested in the same manner as pure liquids with the following procedural change. If the flash point is determined to be 6.6°C (20°F) or higher, a sample of the liquid evaporated to 90 percent of its original volume should be tested. The lower value of the two tests can then be used as the flash point of the material. The purpose of this procedure is as follows: Since the different components in the mixture have different volatilites,

TABLE 1
FLASH-POINT TESTERS

Type	Sample Cup	Stirrer	Bath	Type of Temp. Control	Cost (1974)
Pensky-Martens (Fischer)	Closed	No	Air	Electric	$395
Pensky-Martens (Fischer)	Closed	Yes	Air	Electric	$470
Tagliague (Fischer)	Open	No	Liquid	Electric	$200
Tagliague (Fischer)	Closed	No	Liquid	Electric	$300
Cleveland (Fischer)	Open	No	None	Gas	$265
Cleveland (Sargent)	Open	No	None	Gas	$120
Cleveland (Sargent)	Open	No	None	Electric	$240
Pensky-Martens (Fischer)	Closed	No	Air	Gas	$330
Pensky-Martens (Fischer)	Closed	Yes	Air	Gas	$400

the composition of the liquid phase changes, which produces a change in the composition of the resultant vapor phase, which in turn will affect the flash point. The evaporation of 10 percent of the more volatile composition ascertains whether this change in composition will produce a flammable mixture.

III. Sludges

Sludges, including slurries, colloids, etc., pose a much more difficult testing problem. Following is a short discussion of some of the physical peculiarities of sludges which might affect flash-point testing. If the sludge is stratified, which is likely due to the differing densities of most substances, then the upper layers will inhibit evaporation of the lower layers. The evaporation of the lower layers will occur at the normal rate only when they are in direct contact with the atmosphere at either thermally or mechanically produced holes. This problem can be overcome by taking two testing samples, representing the two extreme situations, these situations being: (1) no mechanical or thermal agitation present so that only the least dense (top) layer is in contact with the atmosphere and able to evaporate; (2) the vigorous agitation so that all components of the sample come into contact with the atmosphere and can evaporate.

If two samples representing these extremes are taken and tested (a sample of just the top layer, and a sample of the waste when agitated) and neither results in a flammable solution, then any linear combination of the two situations should also be nonflammable.

The theoretical rationale for this evaporation inhibiting effect of layer stratification is as follows: at any given temperature the molecular motion, which is simply a manifestation of the kinetic energy of a sample, can be statistically described in terms of a Boltzman distribution. Only those molecules with a kinetic energy above a certain level have enough energy to escape the attractive forces of the other molecules in the liquid phase and can escape into the gas phase. Obviously, those molecules far below the surface have a very small chance of reaching the surface with this minimum kinetic energy intact, since they are constantly being involved in inelastic collisions (collisions where momentum, and hence kinetic energy, is exchanged) and will, on the average, lose energy in these exchanges since they are themselves above the mean in energy.

IV. Solids

The final situation is one in which the sample to be tested is a solid. In the burning of most substances, the actual combustion takes place only after the substance has been vaporized or decomposed by heat to produce a gas. Most solids have lower vapor pressures than liquids, due usually to the stronger intermolecular forces existing in solids. For this reason, they are less likely to be flammable since it takes more energy, that is, a higher "temperature," to volatilize them. It is rare for a solid to have a flash or fire point in the normal temperature range except for those solids having a meaningful vapor pressure, like napthol. Because of this fact, there is less danger of fire from solids. Since solids can exist in many different "states" (granular, amorphous, rigid, etc.), the flammability testing procedures must be very general with few of the specific details one has come to expect in standards.

Also tests which measure the ignition or flame point of solids tend to give results which are highly dependent upon the conditions of heating. Solids, as a rule, do not conduct heat as well as liquids, for this reason localized hot and cold spots can develop when testing a solid, and give rise to an observed ignition point which may be different than the actual ignition temperatures. Therefore, presently available testing methods measuring such properties as the auto-ignition point of solids do not seem to be useable in a regulatory system, due to the inconsistency of the available test methods, and the problems associated with obtaining representative samples for testing. What can be used in place of a testing method could be a prose definition similar to that used by the State of California: "A flammable solid is a solid which may cause fire through friction or which may be ignited readily and when ignited burns so vigorously and persistently as to create a hazard . . ."

CORROSIVENESS

Corrosive wastes are of two-fold concern. The primary concern is for the safety of the waste handlers (haulers and disposers). Wastes capable of damaging tissue by corrosive action must be identified, and then properly labeled to insure that they receive cautious handling. The second concern is that if wastes which are to be stored for a period in a container are corrosive, they may corrode the container, leak out, and cause damage. There are standard methods available to judge if a specific waste might be cause for either concern. The Food and Drug Administration (FDA), the Department of Commerce, the Occupational Safety and Health Administration (OSHA), and the Department of Transportation (DOT) all reference a test which can be used to determine how corrosive a particular waste would be to mammalian tissue (Title 21, CFR 191.10, .11). The test specificies use of an albino rabbit, and there is good correlation that substances corrosive to the skin of an albino rabbit would also be corrosive to human tissue. Unfortunately, this test is very expensive and time-consuming when run on a regular basis, that is, for each batch of waste.

The second area of concern, the corrosion of the container holding a hazardous waste, can be addressed by a standard test described by the National Association of Corrosion Engineers. This test determines how corrosive a sample is to certain metal alloys. This is necessary if: (1) the waste is hazardous and is to be stored in a metal container; and (2) the waste will come into contact with metal containers which contain hazardous wastes. This test is described in the National Association of Corrosion Engineers Standard (TM-01-69). The test consists of placing a sample of metal of known surface area into the suspected corrosive waste and measuring the weight loss due to corrosion after specified time intervals. This weight loss is then manipulated by algebraic equations to give such information as mils metal corroded per year (perpendicular to the metal surface).

It is important to realize that this standard was written for the primary purpose of determining the ability of a particular metal to withstand corrosion, whereas our interest is in whether a particular "solution" (sludge, slurry, etc.) is itself corrosive. This difference in philosophy, however, does not affect the validity of the test, and seems to necessitate only minor procedural changes.

In the test as it was originally devised, the exhaustion of the corrosive constituents of the sample solution was avoided by the addition of more corrosive constituents, or by changing the solution during the test. For waste identification purposes this is unnecessary, for while the test was designed to determine the corrosion rate of a material which is being constantly assaulted by fresh solution, our metal containers are only in contact with a very limited, specific amount of solution. As long as the ratio of the surface of test alloy to the amount of test solution is smaller than the ratio of the inside surface of the container to the total amount of solution in the container, any error will be on the safe side. Obviously, the alloy tested should be the one of which the container is made.

This protocol would not be foolproof. Pitting, galvanic, intergranular and other types of corrosion can cause leakage within a time period within which the test results would indicate that no leakage would occur. A decision would have to be made as to what time period a waste might be allowed to remain drummed before it would have to be tested.

Another alternative to specifying a corrosiveness testing protocol is to specify container standards. The container lining and drum gauges could be specified for wastes which are to be stored for stipulated periods of time.

REACTIVITY

There are presently no recognized standard general testing methods for reactivity. The present regulatory method of describing "reactive" materials is to publish a list of such, and then give a catch-all definition. These definitions do not, however, indicate a positive test for reactivity, but rather describe the physical peculiarities of these reactive materials, for example, "a strong oxidizer" or "a self-polymerizer." This ambiguity results from the fact that while "highly reactive" substances are found to belong to specific classes or chemicals (for example, peroxides, etc.), there is no particular structure of chemical composition that can be used as an a *priori* indicator of "reactivity." This is because reactivity is solely a function of the thermodynamic description of the initial, transition, and final states of the reaction components.

These highly reactive hazardous substances are substances which:

I. Autopolymerize
II. React vigorously with air or water
III. Are unstable with respect to heat or shock
IV. Are strong oxidizing agents
V. React readily to give off toxic fumes
VI. Are explosive

These categories are not discrete, but overlap. For instance some peroxides would fit four of the above categories.

All these categories (except IV) usually require an external impetus to precipitate the reaction either in the form of energy as a "shock" or the addition of an initiating agent.

One common link among highly reactive substances, and an important reason for their hazardousness, is that their reactions can cause the formation of steep temperature or pressure gradients with time. There are standard methods of testing for and measuring these effects. Differential Thermal Analysis DTA (ASTM E475) is one procedure that can be used to identify wastes which give off large amounts of heat when reacting. The procedure consists of confining the sample in a specially designed vessel equipped with a shielded thermal-couple.

The test assembly is put into a temperature bath and then heated at a constant temperature increment rate. The differential temperature (sample temperature minus bath temperature) is recorded versus bath temperature or versus a thermally inert control material. The differential temperature curve (that is, sample temperature, due to reaction exothermicity versus bath temperature, due to constant thermal input), is graphically analyzed to determine the threshold temperature for initiation of measurable reaction.

Likewise, wastes which react to form high pressure gradients can be identified by use of a reaction vessel equipped with a pressure transducer. This can then be heated and the pressure increase with time analyzed graphically.

The problem with these two methods lies in the fact that the results must be analyzed and a judgment made. The results can be ambiguous and not readily interpretable. For example, the pressure transducer only reads the pressure increase, but gives no indication as to the nature of the vapor being formed.

There are standardized testing methods available to identify those materials which are pressure sensitive, or can be detonated by shock, such as the Picatinny Arsenal test.

A test method which could be used to identify strong oxidizers would be use of a redox electrode. Oxidation can be thought of as the loss of electrons: a redox electrode measures the potential difference between the test solution and a standard electrode. From this potential, a test solution can be judged as either oxidizing or reducing, and to what extent. This test method can only be used on a liquid waste, and specific protocols are not presently available to use this method for determining the redox potential of wastes.

The tests mentioned above are all specialized testing procedures which should only be run on a small percentage of wastes. An alternative method of handling the identification of highly reactive wastes would be to develop prose definitions of the effects of these reactive wastes similar to the National Fire Protection Association categories for reactive substances or oxidizers, with a sample listing for each.

SUMMARY

As the foregoing discussion illustrates, the definition of a hazardous waste (as required by Section 3001 of the Résource Conservation and Recovery Act) promises to be both scientifically, and in a policy sense, a very complex task. The variety of options for definition of these simpler, physical parameters will compound greatly when the acute and chronic toxicity factors are addressed.

Chapter 3

PROBLEM RECOGNITION AND DEFINITION BACKGROUND

BACKGROUND

According to current estimates by the Office of Solid Waste, 336 million metric tons (wet weight) of industrial wastes are produced annually in the United States, with a yearly growth rate of about 3 percent. It is also estimated that about 10 percent of this industrial waste is potentially hazardous. The inadequate management of these hazardous wastes has the potential of causing an adverse impact on public health and the environment. This impact combines both the acute (short-range or immediate) and chronic (long-range) effects of a hazardous compound or a hazardous combination of compounds, and is related to production quantities and distribution. In EPA's Report to Congress* on hazardous wastes, EPA concluded that the prevailing methods of hazardous waste management are inadequate and result in the uncontrolled discharge of hazardous residues into the environment.

TYPES OF DAMAGE INCIDENTS

OSW has compiled hundreds of case studies of damages resulting from the improper management of industrial residues, of which some have been published. In the course of this data-gathering effort, OSW has recognized six major routes of environmental transport that can result in the improper land disposal of hazardous wastes: (1) groundwater contamination via leachate; (2) surface water contamination via runoff; (3) air pollution via open burning, evaporation, sublimation, or wind erosion; (4) poisoning via direct contact; (5) poisoning via the food chain; and (6) fire and explosion. Many cases document the immediate and long-term danger to man or his environment from improper disposal of such hazardous wastes. Three examples follow:

- Fifteen thousand drums of toxic and corrosive metal industrial wastes were dumped on farmland, resulting in the deaths of large numbers of cattle from cyanide poisoning and the contamination of nearby surface water by runoff.
- Hexachlorobenzene (HCB) was dumped in a rural landfill, where it sublimed into the air. The HCB was ultimately absorbed into the body tissues of cattle, resulting in the quarantine of 20,000 head of cattle by the Louisiana Department of Agriculture at a loss of approximately 3.9 million dollars to ranchers.
- Chemical wastes were illegally stored and dumped, causing the contamination of the Cohausey aquifer by petrochemicals. This resulted in the condemnation of 150 private wells.

TABULATION OF DAMAGE DATA

OSW has compiled an inventory of over 400 cases of damage resulting from waste-disposal practices. The majority of case studies in the inventory relate to industrial processing waste disposal; however, damages from the disposal of pesticides and pesticide containers have also been incorporated. The primary sources for this data-gathering effort were State environmental regulatory agencies.

Based on 421 industrial and pesticide waste-related damage case studies compiled to date, OSW has prepared a number of tabulations which may help in reaching some preliminary conclusions about prevailing damage trends.

*Section 212 of the Resource Recovery Act of 1970 required that EPA prepare a comprehensive report to Congress on the storage and disposal of hazardous wastes.

Table 2 categorizes the damage mechanisms involved in the analyzed case studies by disposal method. It indicates that groundwater contamination is the most common type of damage reported, followed by surface-water contamination. Moreover, in most cases of established groundwater contamination, actual water supply wells (as compared to monitoring wells) have been affected. The table also shows that "other land disposal," which generally refers to promiscuous dumping or dumping on land not designated for this purpose, is the most significant source of damage.

It should be noted that the data summarized in the table are not nationally representative since 65 of the 421 cases studied were obtained from an incomplete survey of one State that already has a permit system for landfills and surface impoundments. The most flagrant environmental offenses generally occur in those States that do not have regulatory programs for industrial waste disposal. Further, such States generally do not have adequate documentation of damages.

The contaminants, listed in damage incidents by disposal method, comprise a wide range of harmful and potentially harmful substances (Table 3). The largest category, miscellaneous organics (identified in 88 separate incidents), includes some known and suspected carcinogens. It should be emphasized, however, that in most documented damage cases, chemical analysis of the contaminants is incomplete. This is mainly due to the expensive nature of thorough laboratory analysis, especially when organic contaminants are involved.

Two other interesting observations derived from the tabulation of case studies should be noted. One is that in 63 percent of the incidents of damage, the

Table 2

MECHANISMS INVOLVED IN INCIDENTS OF DAMAGE BY DISPOSAL METHOD[a)]

Disposal Method	Surface Impoundments	Landfills, Dumps	Other Land Disposal[b)]	Storage of Wastes	Smeltings, Slag, Mine Tailings
Number of Cases	89	99	203	15	15
Damage Mechanism (number of cases)					
Groundwater (259)	57	64	117	10	11
Surface Water (170)	42	49	71	·	8
Air (17)	3	5	9	·	·
Fires, Explosions (14)	·	11	3	·	·
Direct Contact Poisoning (52)	1	6	40	5	·
Wells Affected[c)] (140)	32	28	74	4	2

a) The tabulation is based on 421 cases studied thus far. The numbers in the matrix add up to more than 421, because several damage incidents involved more than one damage mechanism.
b) Haphazard disposal on vacant properties, on farmland, spray irrigation, etc.
c) Not included as a damage mechanism.

Note. The data presented in this table have been derived solely from case studies associated with land disposal of industrial wastes.

TABLE 3

CONTAMINANTS INVOLVED IN DAMAGE INCIDENTS BY DISPOSAL METHOD

CASES STUDIED: 421

Disposal Method / Contaminant	Total	Surface Impoundments	Landfills, Dumps	Other Land Disposal*	Smelting, Slag, Mine Tailings	Storage
As	19	5	4	10		
Cd	5	3	1	1		
Cr	33	11	9	12	1	
Cs	1		1			
Cu	20	6	4	7	3	
Fe	40	10	20	6	4	
Hg	11	1	1	9		
Mn	26	3	15	4	4	
Ni	13	5	2	5	1	
Pb	22	5	6	8	3	
Zn	22	9	5	5	3	
Cl^-	27	11	6	9	1	
CN^-	19	6	4	9		
F^-	8	5		3		
NH_3	14	6	2	6		
NO_3^-	16	6	2	7		1
$SO_4^=$	18	9	2	5	2	
Inorganic Acids	27	9	4	10	4	
Misc. Inorganics	83	21	25	29	6	2
PCBs	3		1	2		
Petrochemicals	27	10	5	10		2
Phenols	31	9	10	12		
Misc. Organics	88	19	25	39		5
Bacteria	11	1	2	8		
Pesticides	71	1	6	57		7
Radioactive	9	2	3	1	1	2
Unspecified Leachate	25	5	18	1	1	
Total	689	178	183	275	34	19

*Disposing on vacant properties, on farmland, spray irrigation, etc.

causative waste disposal action occurred on the property of the waste generator, although in many instances the damage had spread off-site when it was discovered. The second observation relates to the time frame of discovery of damage. Sixty percent of the available damage incidents were discovered during the past 5 years; however, the acts of waste disposal responsible for the damage may have occurred years or even decades earlier.

EPA INDUSTRY STUDIES

Under Section 212 of the Resource Recovery Act of 1970, the Office of Solid Waste began examining problems associated with hazardous wastes. As required by the Act, EPA submitted a report to Congress detailing their findings and conclusions, that can be summarized as follows:

- Substantial quantities of toxic and otherwise hazardous industrial waste are generated annually.
- Land-disposal of these materials is increasing as a result of increased production and consumption, and due to the institution of air and water pollution controls.
- Regulation of nonradioactive hazardous wastes is, at present, nonexistent at the Federal level, and variable in extent and inconsistent in enforcement on both the State and local level.
- There is little economic incentive for generators to dispose of their hazardous waste in an environmentally adequate manner.

As a result, the Administration proposed that Congress enact legislation designed to prevent dangerous and environmentally unsound hazardous-waste treatment and disposal practices.

It was apparent that should the proposed legislation pass, the preventive measures must be based on a firm foundation of knowledge and indisputable evidence in order for resulting standards to be practical, equitable, and implementable. This would require considerably more information on the generation and characteristics of hazardous wastes, and on the technology available for adequate treatment and disposal than had been developed to date. Therefore, the Office of Solid Waste undertook a series of 14 industrial studies to determine: (a) types, quantities, and sources of those potentially hazardous wastes, which are or will be generated by industry; (b) present practices for treating and disposing of hazardous wastes; (c) control technology which could be applied to reduce the hazards presented by these wastes upon disposal; and (d) the cost of control technology.

Hazardous Waste Quantities

The 14 industrial waste studies conducted by the Office of Solid Waste began in January 1974, and were completed in January 1977. The majority of data collected were through telephone interviews, plant visits, and a sample and analysis program. Approximately 200 million metric tons of total industry waste and 29 million metric tons of potentially hazardous waste (wet weight) were generated in 1974 by the 14 industrial sources (Tables 4 and 5).

TABLE 4

U.S. INDUSTRIAL WASTE GENERATION (MILLION METRIC TONS ANNUALLY) (1974)

Industry Category	Total Dry	Total Wet
1. Batteries	0.000	0.010
2. Inorganic chemicals	40.000	68.000
3. Organic chemicals, pesticides, explosives	2.200	7.000
4. Electroplating	0.909	5.276
5. Paints	0.370	0.396
6. Petroleum refining	0.625	1.757
7. Pharmaceuticals	0.244	1.218
8. Primary metals	100.342	109.902
9. Textile dyeing and finishing	0.310	2.099
10. Rubber and plastics	2.007	3.254
11. Leather tanning and finishing	0.064	0.203
12. Special machinery	0.305	0.366
13. Electronic components	0.037	0.060
14. Waste oil re-refining	0.057	0.057
Totals	147.470	199.598

TABLE 5

POTENTIALLY HAZARDOUS WASTE QUANTITIES (U.S.) (MILLION METRIC TONS ANNUALLY) (1974)

Industry	Dry Basis	Wet Basis
1. Batteries	0.005	0.010
2. Inorganic chemicals	2.000	3.400
3. Organic chemicals, pesticides, explosives	2.150	6.860
4. Electroplating	0.909	5.276
5. Paints	0.075	0.096
6. Petroleum refining	0.625	1.757
7. Pharmaceuticals	0.062	0.065
8. Primary metals	4.454	8.335
9. Leather tanning and finishing	0.045	0.146
10. Textile dyeing and finishing	0.048	1.770
11. Rubber and plastics	0.205	0.785
12. Special machinery	0.102	0.162
13. Electronic components	0.026	0.036
14. Waste oil re-refining	0.057	0.057
Totals	10.763	28.755

Two interesting observations derived from the tables should be noted. First of all, the hazardous portion of the waste is approximately 14 percent (wet weight) of the total industrial quantity. This percentage is larger than the 10 percent estimated for all industrial wastes. Therefore, these particular Industries are thought to generate the majority of the nation's hazardous wastes. The second observation is that four industrial categories—primary metals; organic chemicals, pesticides, and explosives; electroplating and metal finishing; and inorganic chemicals—account for 83 percent of the total hazardous waste produced (wet weight) from the 14 industries.

The geographical distribution of potentially hazardous waste quantities shows that the majority of hazardous waste is generated in EPA Regions III, IV, V and VI, which are the major industrial sectors of the country, that is, the Mid-Atlantic Region, Southeast Region, Great Lakes Region and Gulf Coast Region (Table 6).

When the potential hazardous waste growth for the years 1977 and 1983 is projected, indications are that all 14 industries will generate a greater quantity of hazardous waste (Table 7). The generation rates will range from a 24 percent growth in the primary metals industry to a 2000 percent growth in the batteries industry. A large percentage of the growth is due to the institution of air- and water-pollution control technology that has been or will be added (Figure 1).

Treatment/Disposal Technology

In conducting the 14 industrial waste studies, treatment and disposal operations were also contacted to assess the types of treatment/disposal methods used for the various types of wastes. From the studies, it was found that land disposal (that is, landfill, surface impoundment, etc.) is the most prevalent method (approximately 83 percent) used by industry to manage their potentially hazardous watses, with treatment and recovery techniques (such as, incineration, recovery, etc.,) making up the remaining 17 percent.

TABLE 6

POTENTIALLY HAZARDOUS WASTE QUANTITIES BY EPA REGION[a)b)]

(MILLION METRIC TONS ANNUALLY)

EPA Region	Dry Basis	Wet Basis
I	205,171	1,208,486
II	586,460	1,920,524
III	1,720,138	3,888,173
IV	1,434,088	4,451,865
V	2,647,572	6,541,708
VI	2,797,065	7,120,978
VII	161,932	558,595
VIII	220,071	517,736
IX	550,693	1,487,911
X	439,818	1,059,038
Total	10,763,008	28,755,014

(a) Quantity figures were obtained from contractor estimates of those wastes which are potentially hazardous in 14 industrial categories.
(b) Appendix B indicates the States located in the different EPA Regions.

National Impact of Hazardous Waste Practices

In order to gain an understanding of the nationwide potential for health and environmental damages related to industrial waste disposal, OSW made an assessment of the environmental adequacy of current disposal practices, as related to the estimated 29 million metric tons of potentially hazardous residuals that have been identified in the industry categories considered. The assessment of environmental adequacy was based on the disposal practices employed by typical manufacturing facilities—those which employ average disposal technology relative to other plants in the same industry. The modes of disposal have been identified as environmentally adequate or inadequate.

Prevailing disposal practices can be categorized on the basis of estimated environmental adequacy, and the percent of total wet weight attributable to each

TABLE 7

POTENTIALLY HAZARDOUS WASTE GROWTH PROJECTIONS

	Amount (Mill. Metric Tons/Yr.)						
	1974		1977		1983		% Growth*
Industry	Dry	Wet	Dry	Wet	Dry	Wet	'74 - '83
1. Batteries	0.005	0.010	0.082	0.164	0.105	0.209	2000
2. Inorganic chemicals	2.000	3.400	2.300	3.900	2.800	4.800	40
3. Organic chemicals, pesticides and explosives	2.150	6.860	3.500	11.666	3.800	12.666	77
4. Electroplating	0.909	5.276	1.316	4.053	1.751	5.260	92
5. Paint and allied products	0.075	0.096	0.084	0.110	0.105	0.145	40
6. Petroleum refining	0.625	1.757	0.715	1.841	0.811	1.888	30
7. Pharmaceuticals	0.062	0.065	0.070	0.074	0.104	0.108	68
8. Primary metals smelting and refining	4.454	8.335	4.732	9.104	5.536	10.418	24
9. Textile dyeing and finishing	0.048	1.770	0.500	1.870	0.179	0.716	375
10. Leather tanning	0.045	0.146	0.050	0.143	0.068	0.214	51
11. Special machinery	0.102	0.163	0.094	0.153	0.157	0.209	54
12. Electronic components	0.026	0.036	0.036	0.078	0.050	0.108	92
13. Rubber and plastics	0.205	0.785	0.242	0.944	0.299	1.204	46
14. Waste oil re-refining	0.057	0.057	0.074	0.074	0.144	0.144	253
Totals (To Date)	10.763	28.755	13.795	34.174	15.909	38.089	48

*Figures based on dry weight quantities.

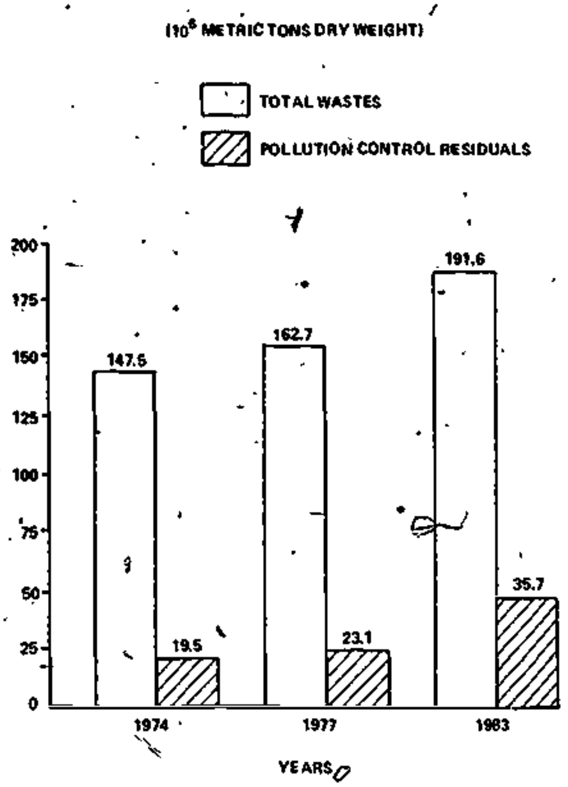

Figure 1. Projected Growth in Waste Quantities for Fourteen Industries

disposal practice can be estimated (Table 8). The primary disposal method employed for hazardous industrial wastes is lagooning in unlined surface impoundments, and this method accounts for nearly half of the total of these wastes disposed. Lined impoundments that were considered adequate receive less than 0.1 percent of the total. Dumps or other nonsecure land surfaces receive the second largest quantity. Together, these forms of land disposal account for approximately 80 percent of the total. Incineration is the third major management practice now in use, with uncontrolled incineration accounting for almost twice the amount adequately handled through controlled incineration. The result is that over 90 percent of the approximately 29 million metric tons (wet weight) of potentially hazardous waste generated yearly by the 14 key industries is handled by disposal practices which do not seem adequate to provide protection of public health and the environment. This estimate may be somewhat pessimistic because a small percentage of unlined surface

TABLE 8

ESTIMATED ENVIRONMENTAL ADEQUACY OF DISPOSAL PRACTICES FOR POTENTIALLY HAZARDOUS WASTES*

Disposal Practice	Percent of Total Wet Weight of Potentially Hazardous Wastes
Environmentally Inadequate**	
Unlined Surface Impoundments	48.3
Non-Secure Landfills	30.3
Uncontrolled Incineration	9.7
Deep-Well Injection	1.7
Landspreading	.3
Use on Roads	< .1
Sewered	< .1
Total	90.4
Environmentally Adequate	
Controlled Incineration	5.6
Secure Landfills	2.3
Recovery	1.7
Lined Surface Impoundments	< .1
Wastewater Treatment	< .1
Autoclaving	< .1
Total	9.6

*Based on annual generation in 14 key industries during the period 1973 - 1975.

impoundments and nonsecure landfills may be located in areas that preclude the escape of pollutants into the environment. On the other hand, this estimate may not be so exaggerated if one considers that the locations for landfills and dumps traditionally have been selected on the basis of economic rather than environmental considerations. Waste disposal usually takes place on land that has little or no value for other uses, in such areas as marshlands, abandoned sand and gravel pits, old strip mines, limestone sinkholes, etc. Most of these sites have hydraulic connections with natural waters. Similarly, most industrial surface impoundments are unlined and were not sited on the basis of hydrogeological considerations. Therefore, one could venture to say that up to 90 percent of potentially hazardous wastes are disposed of by questionable methods and are ultimately susceptible to escape into the environment.

There are other circumstances underscoring the significant potential for nationwide damages from industrial waste disposal. One is that most manufacturing industries are located in the "wet regions" of the nation, where groundwater and surface water contamination are most likely. This point can be illustrated by superimposing the major areas of industrial activity on a contour map combining rainfall and evapotranspiration data (Figure 2). The areas of maximum rainfall and minimum evaporation are generally in the eastern third of the nation, where most manufacturing and, consequently, industrial waste disposal take place.

A similar map shows where the nation's principal underground aquifers are located in relation to industrial concentration (Figure 3).. One can draw three general conclusions from this map. The first is that most areas of high concentration are underlaid by principal aquifers. The second is that some of the most heavily used aquifers are located in dry regions of the nation, where the risk of groundwater contamination from land disposal practices is relatively small. The relatively small risk is counterbalanced by the fact that any contamination of these scarce water resources would result in particularly severe environmental and economic damage. The third conclusion derived from this map is that many groundwater aquifers in highly industrialized areas are not currently exploited as major water resources. This interpretation is somewhat misleading, however, since the map does not designate those areas where groundwater usage is moderate at present but expected to increase significantly. From an environmental perspective, of course, the risk of groundwater contamination should be viewed with concern, regardless of current usage rates.

OTHER SURVEY APPROACHES

The data collected from the 14 industrial waste studies have been most helpful in presenting a broad national picture of the hazardous waste management problems. However, the quantities calculated are based on a very limited data base. A comparison of the number of personal visits made to the 14 industrial categories with the actual number of facilities

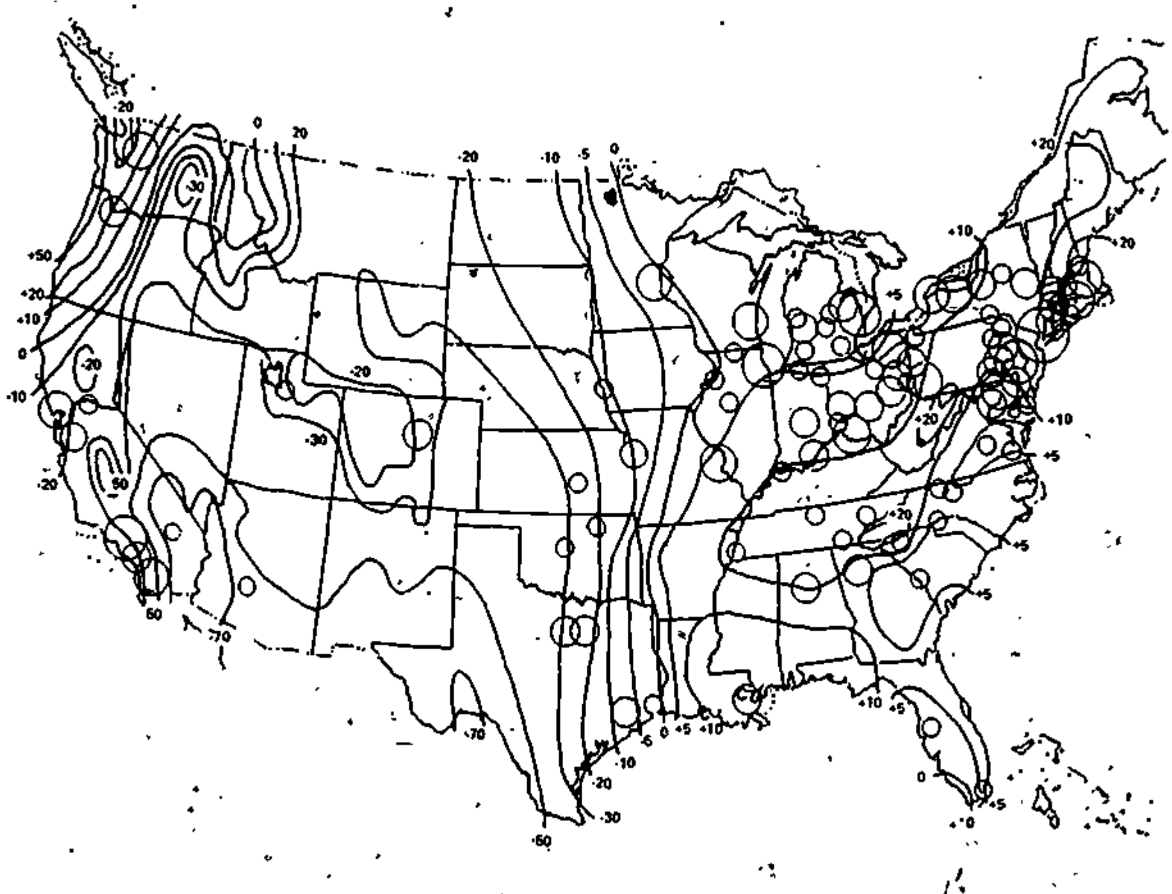

Figure 2. Precipitation - Evapotranspiration Potential Contours and Industrial Centers of the Conterminous U.S.

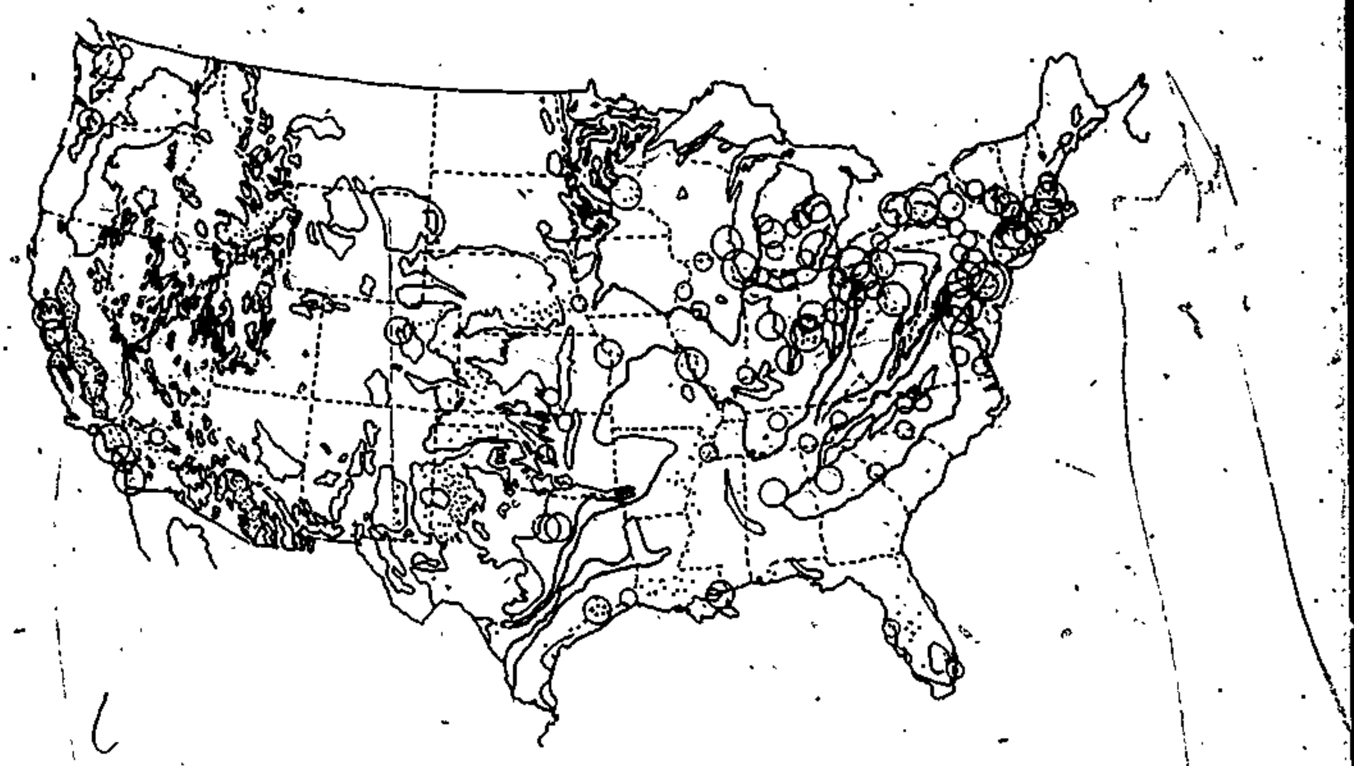

Figure 3. Major Aquifers, Well Withdrawals, and Industrial Centers of the Conterminous U.S.

operating, indicates that except for the waste oil re-refining industry, no more than 7 percent of the industry was contacted and contributed data (Table 9). Also, in only five of the industries was a sample and analysis program performed (most of the samples collected were grab samples). Additional surveys should be performed on a smaller scale to increase the confidence of these data. This could be accomplished through State hazardous waste surveys and through information collected through the planning agencies created under Section 208 of the Federal Water Pollution Act as amended ("208" Planning Agencies).

State Hazardous Waste Surveys

As a first step in managing the increasing hazardous waste problem, each State should conduct a statewide hazardous waste survey to establish an information base. For the short term, this information base will demonstrate the magnitude of the hazardous waste problem, document the need for legislation and regulation, and identify the hazardous waste sources and sinks that should be regulated. Over the long term, the information base will indicate the effectiveness of a State's hazardous waste management program. A good survey will also help establish surveillance priorities and enforcement actions.

TABLE 9

NUMBER OF PLANT VISITS

Group I	No. Visits	No. Plants
Batteries	15	263
Inorganic chemicals	63	1607
Petroleum refining	16	247
Organic chemicals, pesticides, explosives	53	2200
Pharmaceuticals	35	1058
Paint	71	1550
Primary metals	53	2717
Electroplating	40	20,000
Group II		
Tanneries	28	386
Special machinery	35	3906
Textiles	80	2000
Rubber & plastics	85	2150
Electronic components	23	2855
Waste oil re-refining	5	27

A comprehensive survey should include facilities that generate hazardous wastes; facilities that receive hazardous wastes for storage, treatment, and final disposal; and the collectors and haulers who transport hazardous wastes. The objective of the survey would be to establish a statewide mass balance of hazardous wastes. Surveying only one portion of the hazardous waste life cycle will not define the total problem.

Authority to Request Data

In a few States, legislation has been enacted to specifically regulate hazardous wastes. Pursuant to that legislation, formal reporting, registration, or permit systems are being implemented. The data from these systems can provide the information necessary for a hazardous waste survey. In some other States, the solid waste management legislation is broad enough to include wastes other than municipal solid wastes, that is, hazardous wastes. In these cases, reporting, registration, or permit systems can also be used to gather data.

If existing waste-management legislation is not broad enough to require information from generators, collectors and haulers, and disposal facilities, it may be possible to use information-gathering authority provided in other legislation (for example, air-pollution-control legislation or water-pollution-control legislation). States can and have required generators to provide hazardous waste information with their water discharge permit applications. This approach requires coordination with and the cooperation of other State environmental programs.

In situations where a response is mandatory, the data gathered should be fairly reliable and nearly complete. Many States, however, will not be able to use any existing information-gathering authority to conduct a hazardous waste survey. In these cases, the States will have to rely upon the good faith of the industries which they are surveying. States that have conducted hazardous waste surveys by mail and without data-gathering authority have received less than 50 percent response to their inquiries. Telephone follow-up to the mailings has increased the response to as much as 70 percent. Other States without data-gathering authority have conducted on-site interviews with potential generators with a much higher success rate (greater than 90 percent). Therefore, the on-site interview is the best approach to assure maximum coverage of hazardous waste sources and also to minimize data of poor quality. It has been found that even when industries respond, the reliability of the data may be suspect, which is due in part to the reluctance of industry to provide data which eventually may be used to formulate regulations.

Survey Procedure (Onsite)

Each facility that generates or receives a hazardous waste should be visited, and operating personnel at each facility should be interviewed, if possible. The State can achieve greater depth and increased accuracy of information, as well as better response rates from a visit to each generator and disposal facility. Firsthand knowledge of hazardous-waste problems gained during interviews will be of lasting benefit to the State hazardous waste program.

Most State environmental programs have field personnel (in regions or districts) who can assist in conducting a survey. With minimal training, these individuals could conduct approximately 20 interviews per month. Each individual conducting interviews must receive basic training for the task, and should review the technical literature before each interview to familiarize themselves with the types of processes and wastes which they are likely to encounter during the interview.

Before actually beginning interviews, the proper groundwork should be laid by identifying potential generators and disposal facilities, developing interview forms, and most importantly, soliciting the cooperation of other organizations (for example, trade associations, local health departments, other State agencies, etc.). Without this cooperation, the results of most surveys would not be as productive and useful.

Each generator, disposal facility, etc., to be surveyed, should be contacted to make an appointment and to briefly discuss the reasons for the survey.

Potential Generators

Several States have used Standard Industrial Classification (SIC) codes to identify groups of hazardous waste generators and have found the codes to be inadequate. (SIC codes are established by the Office of Management and Budget and are published in the *Standard Industrial Classification Manual*.) The manual and codes do not identify individual facilities or potential generators, and they are not as descriptive and inclusive as would be necessary for a complete hazardous waste survey. The electroplating industry can be used to illustrate the problem. Approximately two-thirds of the electroplating industry in the United States consist of "captive shops," which are not listed under the SIC code for the electroplating industry. Therefore, if a hazardous waste survey of the electroplating industry focused only on those electroplating shops which could be identified by the SIC codes, many electroplating waste streams would be omitted.

Manufacturing directories, which may also be based on SIC codes, do identify specific facilities but do not include all of the industries which are potential generators of hazardous waste. Pesticide applicators, utilities (railroads electric utilities, etc.), mining operations, and Federal and State facilities are examples of potential generators that are not usually included in manufacturing directory listings. Manufacturing directories can also be out of date or incomplete. It is therefore recommended that other listings (for example, air pollution emission inventories, water discharge permit applications, etc.) be reviewed to expand upon the basic SIC code and manufacturing directory listings.

The Survey Data Collection Guide

A survey data-collection guide should be developed and used by all interviewers to insure that they are requesting and gathering similar data during their interviews. Development of the data-collection guide is one of the keys to a successful survey because the types and format of the questions included in the guide will dictate the quantity, quality, and usefulness of the data gathered. An individual with experience in conducting surveys and designing survey forms should be consulted for this aspect of the program.

Data should be gathered for a base year (for example, calendar year 1974), so the information on hazardous waste quantities, technologies, costs, etc., will be on a comparable basis with respect to time. Attachment A is an outline of topics which are considered appropriate for a hazardous waste survey.

Much of the information described in Attachment A can be obtained from air pollution emission inventories, water-discharge permit applications, or other State records. If information is available from these or other sources, it should not be requested again in the survey interview. Some of the information may be considered confidential or proprietary, and will therefore be difficult to obtain without adequate authority. The main objective of the survey is to learn about the life cycle of hazardous wastes. If specific information concerning hazardous wastes is not available, hazardous-waste generation rates can be estimated by using waste generation factors. Waste generation factors usually require data relating to a facility's production capacity (for example, 0.324 kg of waste per 1000 kg of product). Comparisons can also be made with similar facilities of known size, production capacity, and generation rates to estimate hazardous waste generation.

Various approaches can be taken in developing a data-collection guide. Specific guides can be developed for each industry (electroplating, battery manufacturing, etc.), or a single survey guide can be developed to survey the various phases of the hazardous waste life-cycle (generation, transportation, treatment, disposal, etc.). The advantage of the latter type of guide is that it is not limited to a single industry. Each State should tailor the data collection guide to its individual needs.

Data Storage, Handling and Display

The data gathered during the survey should be reviewed for completeness and accuracy, and then stored so that it is readily available and usable. The data will probably first be used to produce a survey report describing hazardous waste management practices in the State. Topics that would be of interest for a hazardous-waste survey report include the types, quantities, and distribution of hazardous wastes within the State; the types, numbers, capacities, and distribution of treatment and disposal facilities that handle hazardous wastes in the State; and the flow of hazardous wastes into and out of the State. In order to standardize hazardous-waste reporting, quantities of hazardous waste should be reported on a dry-weight basis. An estimate of the weight of the water portion of hazardous waste should also be given. Projections of future hazardous waste generation based on growth projections for the State's population and industry are also appropriate.

The hazardous waste survey will probably be subject to refinement as the hazardous waste management program matures. For example, if a permit or registration system were implemented, hazardous waste generation and disposal data would become more readily available and more accurate. From time to time it will probably be necessary to produce new or supplementary survey reports to describe the status of the program. The data storage and handling system should be flexible enough to permit the development of summary reports, to track the progress of the overall program, and to track the progress of individual facilities.

"208" Planning Agencies

The Federal Water Pollution Control Act Amendments of 1972 delineate water quality goals which are to be met by 1983 and 1985. The Act calls for the formation of state and area-wide planning agencies to "encourage and facilitate the development and implementation of area-wide waste treatment management plans." These plans are to present an integrated comprehensive system for managing water quality problems.

Authority to Request Data. The Act calls for planners to develop techniques to control the disposition of all residual waste generated within the planner's jurisdiction that could affect water quality, and to control the disposal of pollutants on land or in subsurface excavations to protect groundwater and surface water quality [Section 208 (b) (2) (J) and (b) (2) (K)].

Residual wastes are defined as those solid, liquid, or sludge substances resulting from man's activities in the urban, agricultural, industrial, and mining environment that are not discharged directly into water after collection and treatment, if any. Residual wastes include municipal solid waste, industrial wastes and sludges, hazardous wastes, and sewage sludge.

State (or designated area-wide) planning agencies can develop alternatives to control the disposal of residual wastes only after assessing the problem, examining alternative practices, and soliciting appropriate public participation.

Survey Procedure. The term Best Management Practices (BMP) refers to a practice or combination of practices that has been determined to be the most effective and practicable (from a technological, economic, and institutional standpoint) means of preventing or reducing the amount of pollution generated by nonpoint sources to a level compatible with water quality goals. A BMP does not necessarily imply a single approach; rather, a BMP for residuals may be a combination of techniques and practices that must be integrated into an overall effective residual waste management system for a given area. This concept can apply to a hazardous waste management system. However, before the overall hazardous waste management plan is derived, the State or designated area-wide planning agency should determine the extent of their problem. A survey technique similar to the one discussed in the previous section "State Hazardous Waste Surveys," would be most appropriate to determine the hazardous waste management problem.

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ATTACHMENT A
DATA COLLECTION GUIDE FOR AN INDUSTRIAL WASTE SURVEY

A. General information (to be obtained from each facility).

Facility name ________________________________

Facility location ________________________________

____

Facility owner ________________________________

Facility mailing address ________________________________

____

Facility manager ________________________ Telephone no. __________

Facility contact ________________________ Telephone no. __________

SIC group name and four digit number. Primary ________________________

Secondary ________________________________

Time period for which data is representative ________________________

Number of employees __________ Facility area ________________________

Either obtain a plat of the facility showing the location of onsite process waste storage, treatment, and disposal from the facility personnel or sketch a diagram of the facility on the back of this page.

B. Waste characterization (applicable to generator, treatment, and incinerator facilities).

Process waste			
Process origin			
Quantity of waste			
Annual rate			
Average hourly rate			
Maximum hourly rate			
Waste stream composition (weight basis)			
Process products			
Quantity			

Attach flow diagrams of each process showing product and waste streams, if available.

C. Storage methodology (applicable to generators, treatment and disposal facilities, and collectors and haulers).

Process wastes stored			
Quantity			
Type of storage			
Frequency of transfer to the storage area			
Frequency of transfer from the storage area			
Methods of transfer to and from storage			
Safety procedures			
Emergency plans			

D. Transportation methodology (applicable to generator, storage, and treatment facilities and collectors and haulers).

Wastes transported			
Quantity			
Destination			
Waste composition			
Special handling procedures			
Emergency plans			

E. Treatment methodology (applicable to generator and treatment facilities).

Wastes treated			
Quantity			
Composition of wastes treated			
Treatment methods			
Equipment used to treat wastes			
Products			

Describe the wastes from the treatment facility using the waste characterization portion of the guide.

F. Disposal methodology (applicable to generator, treatment, and disposal facilities).

Land disposal

Waste			
Quantity			
Composition			
Type of disposal			
Liner type			
Thickness			
Leachate collection			
Depth of facility			
Distance to ground water			
Site security			
Leachate treatment			
Burial methods			
Types of leachate analysis			

Describe methods used to identify and mark the location of hazardous wastes.

F. Disposal methodology (continued)

Incineration

Wastes			
Quantity			
Composition			
Type of incinerator			
Rated capacity			
Auxiliary fuel used			
Quantity			
Design specifications			
Temperature			
Dwell-time			
Air pollution controls			
Air pollution permits			
Residue disposal			
Waste storage prior to incineration			

F. Disposal methodology (continued)

Other disposal methods

Wastes			
Quantity			
Ocean dumping			
Reclaimer			
Well injection			
Other			

Chapter 4

CONCEPTUAL FRAMEWORK FOR EFFECTIVE HAZARDOUS WASTE MANAGEMENT

The potential for damage to public health and to the environment from mismanagement of hazardous wastes (see Chapter 3) justifies the need for implementation of an effective hazardous waste management program.

Current EPA air and water legislation concerning pollution discharges focuses on industrial stationary-source emissions by requiring new source performance standards and effluent limitation guidelines. Such requirements on industrial categories are Congressionally mandated. Emission controls appeared necessary because (1) man-made ambient "controls" (other than water dilution) are impossible, (2) sources are geographically fixed, that is, each plant is faced with an immediate problem of treatment, and (3) surveillance and enforcement of emission limits are much more practical than is waste-load allocation or ambient-air modeling.

In other words, with regard to air and water discharges, plants are stationary and emit to a moving receiver (air or water). Thus, regulation at the receiving end (ambient levels) is very difficult. Sampling the emissions into the receiving medium and exercising control at the discharge site is not only logical but, perhaps, the only practical approach. Also, with a moving receiving medium (air or water), it is difficult to establish a direct link between a specific plant's emission in terms of its effect on the environment and public health. In the case of air, this is due to such variables as wind velocity and direction as well as the ambient levels to which the plant is contributing. Similar vagaries exist with water discharges. Streams have different flow rates, bottom sediments have differing sorption characteristics, etc.

Land disposal, on the other hand, is a more readily controllable medium. The sink (the land) is fixed, and the wastes entering it are the variables subject to control in terms of the capabilities of a particular site to accept specific amounts of certain wastes.

WASTE MANAGEMENT

Industrial hazardous wastes (whether solids, powders, cakes, sludges, slurries, liquids, or contained gases) are a unique problem because they are transportable, and they may be immediate polluters of the land as well as future hazards in the air and water media on both a short- and long-term basis. Thus, the integrity of the pathways which wastes seek (land deposition, incineration, chemical treatment, etc.) is the critical environmental factor to be controlled.

Several important trends are evident from industry-oriented hazardous-waste studies. First, many wastes have similar characteristics in terms of the disposal options selected. Waste disposal practices are usually determined by the physical properties of the waste (liquid, sludges, etc.) rather than by its chemical properties. Analysis of the studies shows more variation within an industry segment in terms of treatment/disposal methods than between the industry segments surveyed. Also, characteristics of several diverse wastes can often be exploited beneficially at waste treatment/disposal centers.

Second, since wastes are often transported for treatment/disposal, and off site treatment and disposal are a significant private-sector business, waste streams are not "stationary" in the sense that air and water emissions are. Because economic waste treatment/disposal usually requires an accumulation of sufficient quantities for processing, the prospect of waste movement, and the environmental integrity of such transport is a major source of regulatory concern.

Finally, land deposition is the most popular waste-disposal option. Current technological variety is minimal at present; for many wastes, land disposal is the process that needs regulation, not industrial process streams. However, there is a finite amount of land available for disposal of hazardous wastes.

A hazardous waste management program should result in creation of a system with certain characteristics: adequate treatment and disposal capacity, lowest cost to society consistent with public health and environmental protection, equitable and efficient allocation of cost to those responsible for waste generation, and conservation of resources achieved by recovering materials and energy from wastes.

The system should combine onsite (point of generation) treatment of some wastes, offsite (central facility) treatment for hazard elimination, and secure land disposal of residues that remain hazardous after treatment.

WASTE DISPOSITION HIERARCHY

Due to their high potential for public health and environmental damage, some hazardous wastes require special control procedures. Management of these wastes means awareness and control over them from the time of generation through their transportation, temporary storage, treatment, and disposal (so-called "cradle-to-grave" control). This comprehensive management of hazardous wastes should be conducted or coordinated at the State level so that wastes may reach environmentally sound treatment and disposal facilities. Several States have adopted waste transportation control systems involving manifests or "trip-tickets" to monitor these waste flows. Such systems appear to be the most effective method to assure proper handling and tracking of wastes from generation to ultimate disposal. Effective identification and labeling of wastes by the generators is essential to the effective operation of any manifest-based system. A discussion of these topics is contained in Chapter 5 of this guide.

In addition, management of hazardous waste means more than careful disposal. It implies consideration of alternate methods and schemes, both institutional and technical, to reduce the amount and hazardousness of wastes.

A hierarchical structure of waste management options is offered below, based primarily on environmental concerns, while recognizing that economics will play a major role in the waste generator's decision process.

Reuse, energy recovery, and material recovery as well as treatment are desirable prior to ultimate disposal, especially land disposal. Thus, the desired waste management options are (in order of priority):

- Waste Reduction
- Waste Separation and Concentration
- Waste Exchange
- Energy/Material Recovery
- Waste Incineration/Treatment
- Secure Ultimate Disposal

Waste Reduction

Reducing the amount of hazardous waste at the source, through process changes, is desirable. Reduction of hazardous chemicals used in operations, substitution of less hazardous materials, and better quality control to reduce production spoilage are all examples of possible actions which would reduce the amount of hazardous waste requiring disposal. The less hazardous waste to be disposed, the less risk of environmental damage.

Waste Separation and Concentration

Even with the minimum amount of waste, it is possible to isolate the more hazardous or toxic waste streams from the mixtures in which they occur. Waste separation early in process-stream flows, as well as simple isolation of similar wastes into separate disposal containers, can reduce waste handling and disposal costs. Moreover, isolation of such hazardous wastes in separate storage areas would permit operating personnel to focus their attention on careful management of those wastes.

Concentration of wastes by dewatering (with appropriate air-pollution controls) will reduce the amount of wastes requiring treatment or disposal. This process not only reduces the cost of ultimate disposal but, more significantly, minimizes transportation costs, which are frequently the major variable in total waste-management costs. A savings in transportation costs could offset any added costs of dewatering and might even reflect true savings to the waste generator. Concentration of the wastes could cause the waste to be defined as hazardous while it was not so in the diluted or watered stage. A trade-off exists between the cost of handling and disposing of a smaller amount (concentrated) of hazardous waste compared to a larger amount of nonhazardous waste.

Waste Exchange

Next in priority is the concept of waste clearinghouses where pretreated or untreated hazardous wastes are transferred. These clearinghouses operate on the principle that "one man's waste can be another man's feedstock." At least six waste exchanges in Europe and ten formally organized waste exchanges in the United States testify to the feasibility of this concept under a variety of institutional arrangements. Such clearinghouses are desirable but may only be feasible at a State or multi-State level. An EPA report on this subject is available from the National Technical Information Service, Springfield, Virginia.* Since this concept is relatively new, additional information is provided in the next section.

Energy/Material Recovery

Recovery of potentially useful substances, energy, or materials from hazardous wastes is desirable. Many wastes contain valuable basic materials, some of which are in short supply, making material recovery logical from both resource conservation and environmental viewpoints. Extraction of materials from concentrated waste usually requires less energy, and generates far less air and water pollution, than the mining and processing operations required to produce the material from virgin resources. As material shortages become more widespread, material recovery from hazardous waste will become more attractive.

Likewise, the combustion of such wastes to recover energy or heat value for other purposes is endorsed. Such operations usually require special high-temperature equipment with emission control systems and effluent monitors.

Other limitations are imposed by the "quality control" aspects of waste utilization for energy. The user facility must have an adequate supply of fuel with consistent heat value on a regular or full-time basis. Also, some provisions must be made for stand-by or emergency operations. These limitations must be carefully considered and integrated into the planning for any system using industrial wastes for fuel.

Incineration/Treatment

Incineration even without energy recovery is desirable, in its proper order of priority—mainly to destroy organic wastes. Other nonburnable wastes should be detoxified and neutralized to the greatest extent possible through physical, chemical, and biological treatment. Careful attention to environmental emissions, using control equipment and monitoring devices is still required, regardless of the process employed.* Alternate treatment techniques are being investigated by the Office of Solid Waste and several reports will be forthcoming.

Secure Land Disposal

For those hazardous wastes not amenable to recovery, treatment, or destruction, volume reduction to minimize land-use requirements should be performed prior to secure land disposal. Secure land disposal either through encapsulation of small quantities of waste or through the use, on a larger scale, of a chemical waste landfill is recommended.

In general terms, a chemical waste landfill provides complete long-term protection for the quality of surface and subsurface waters from hazardous waste deposited therein, and prevents hazards to public health and the environment. Such sites should be located or engineered to avoid direct hydraulic continuity with surface and subsurface water flow into and out of the disposal area. Monitoring wells should be established, and a sampling and analysis program conducted. Air emissions should be controlled and monitored as well. Additional characteristics of a chemical waste landfill are described in Chapter 6.

WASTE TRANSFER CONCEPTS (WASTE EXCHANGE)

Waste transfer is both similar to and different from the purchase and reuse of industrial by-products. In both cases, an industrial process generates, in addition to its principal product, some material which is not usable by the generating company, but which can be sold economically for reuse by another company. When the material has a well recognized value that justifies the costs of recovery, handling, and transportation, it is known as a by-product. When the material has a value which has not been recognized, it is a potentially transferrable waste. As long as disposal

*"Waste Clearinghouses and Exchanges. New Ways for Identifying and Transferring Reusable Industrial Process Wastes," PB-261287.

is easy and inexpensive, disposal will be the waste generator's economically preferred course. Transfer to another plant or industry is economically attractive only when disposal presents major problems, as will increasingly be the case with tighter restrictions and higher costs.

While some transfers occur directly through the initiative of either the waste's generator or its potential user, larger-scale realization of the concept requires a third party or "transfer agent." This is because the possible uses are not well established, generators and potential users usually do not know about each other, and companies are reluctant to reveal information about their processes and waste materials. A transfer agent is needed therefore, to identify generators and users to each other, while at the same time protecting confidential information until a promising match is identified. Even more transfers can be made if the transfer agent is able to offer additional services, such as assistance with negotiations, consultation about uses and reprocessing requirements, or actual handling of the materials.

The term "waste" has two meanings that are related but distinct. It can refer to damaged, defective, or residual material resulting from an industrial process, which retains some or much of its original value; this is "scrap waste" or "scrap." In everyday usage, "waste" can refer to any kind of refuse, with no value, which can only be thrown away; this is "trash waste" or "trash." What is considered trash by one person may be considered useful by another. This difference between two values seen in one waste is central to both the economic and the technical viability of waste transfer, and creates opportunities for transfer agents.

Transfers can occur only after many conditions have been established for both generator and user. Each, depending upon his own business and perspective of what is important, must consider the following:

- *Technical feasibility* - the matching of the chemical and physical properties of available waste streams with the specifications of raw materials they might replace.
- *Economic feasibility* - balancing of disposal costs foregone and raw material costs saved against the administrative and transport costs of implementing a waste transfer.
- *Institutional and marketing feasibility* - guarantees of supply and anonymity; and mutual confidence among generator, user, and transfer agent.
- *Legal and regulatory feasibility* - protection of confidentiality, legality, and unlikelihood of liability suits.

When generators and users cannot satisfy all requirements for a transfer by themselves, they may seek help elsewhere. Their first recourse is to informal networks of colleagues. The second is to professional societies and the advertising columns of technical journals.

The third is to an information clearinghouse, which serves the limited function of linking interested trading partners. A clearinghouse transfers only information, playing only a passive role in the transfer process and leaving generators and users to negotiate directly.

The fourth recourse is to a dealer, reclaimer, or materials exchange that is equipped to handle, treat, and certify the characteristics of chemical materials. Such agents play an active role, because they stand as intermediaries between generator and user. Of course, many companies reclaim materials with well-recognized reuse value.

THE PATHWAY APPROACH TO CONTROL

The differences between air and water pollution clean-up programs, and programs of hazardous waste management result from basic differences in the nature of the problem, such as transportability, similarities in waste treatment, and the threat by hazardous waste to both air and water. These fundamental differences coupled with the resource/enforcement problems of other regulatory experiences have led to the "pathway" control approach.

The regulation and control of the pathways which wastes follow provide a more effective solution to the problem of land-destined hazardous residuals compared with control of specific industry by industry sources. Not only is industry left with more flexibility in terms of disposal options, but also, State governments can minimize and target their enforce-

*Additional information on incineration may be found in EPA publication, *Incineration in Hazardous Waste Management* (EPA/530/SW-141).

ment and surveillance resources.

This approach permits the State to apply its technological resources in areas of its chartered expertise, rather than having to meet challenges as to its knowledge of industrial process techniques. Based on industry studies, the best regulatory approach seems to be to channel wastes to environmentally adequate facilities, and to let innovative corporate managers and technical decision makers choose among acceptable options.

If wastes were free to flow to the most economic treatment/disposal process, and if these processes were environmentally sound (pursuant to air/water emission limits), then environmental integrity and the public health would be protected. At the same time, the generating industry would be free to evaluate the costs of different waste disposal options, both in terms of impact on the manufacturing process and in disposition of its wastes. This approach could also protect any proprietary or competitive positions, by not prescribing the specific means of compliance with regulatory controls. Thus, industry would be free to devise technologies to meet its needs (including waste reduction and exchange opportunities as alternatives to disposal).

Similarities among wastes which can provide useful treatment/recovery opportunities as well as their ease of movement are also accommodated by regulating the waste disposal "pathway."

In addition, from the perspective of the State, resources can be concentrated on surveillance/enforcement activities at regionalized facilities as opposed to the regulation of thousands of individual plant sites. Depending upon the costs associated with offsite treatment and disposal, however, some firms may choose to treat/dispose onsite. These cases would be handled by requiring permits for these operations as well.

Included in a permit-oriented approach to regulating these waste "pathways" or destinations must be an information system to assure that all hazardous wastes generated are transported carefully and indeed are received by permitted facilities. Thus, the concept of waste transport manifests or "trip-tickets" has been introduced and is discussed in Chapter 5.

INTRA-/INTERSTATE COOPERATION

In many States, where hazardous waste regulation is being or has been considered, it is the latest addition to a series of regulatory authorities. When planning for or developing legislation and regulations for hazardous waste control, consideration should be given to integration with other regulatory/control authorities. It is desirable to use existing legislation/regulation to provide the necessary degree of environmental protection without an additional level of bureaucratic authority. (It will also invite less opposition from the controlled industries by mitigating grounds for complaints of overregulation and duplication of control.)

A prime example of the need for internal coordination lies in the area of transportation control of hazardous wastes. Many States already have a Public Service Commission (PSC) or Public Utilities Commission (PUC) (or similar agency) which has regulatory control over hazardous material transportation. From the Federal viewpoint, the Department of Transportation has interstate authority and, based on an interpretation of its legislative mandate, indicates that its authority applies equally to intrastate movements of hazardous materials. Be that as it may, it would be advisable for the State environmental protection agency to attempt to use this existing authority, rather than developing its own expertise on transportation control. Morevoer, it may well be within the legislative authority of the State transportation authority to modify its regulations to include whatever environmental concerns are not already accommodated.

Internal coordination should also be pursued in areas of planning. There may exist agencies that were created pursuant to Section 208 of the Federal Water Pollution Control Act, or other regional authorities who have exercised and developed area-wide planning techniques. These should be consulted and perhaps integrated into the planning process. The major concern in using organizations should be with achieving the necessary environmental protection, although the management problems involved are recognized.

These same levels of cooperation and coordination should be sought on an interstate level. Since commerce usually flows freely across state borders, consistency of regulation (and documentation) is a worthy goal. Materials (and wastes) flow to meet an economic market. Over-regulation, such as a prohibition of the importation of wastes, may well have a negative impact on overall industrial growth of a State or region. Interstate coordination, through a common set of requirements, is more likely to produce the desired environmental protection, since there would be no easy way for the "gypsy dumper" to avoid regulatory control.

Chapter 5

CONTROL OF HAZARDOUS WASTE TRANSPORTATION

The primary objective of a comprehensive hazardous waste management program is to assure that hazardous wastes are properly handled to prevent undue harm to public health and the environment. Elements of a comprehensive hazardous waste management program include reporting by waste generators, the regulation of temporary waste receptors (storage), the regulation of permanent waste receptors, and the regulation of hazardous waste transportation. Although control of hazardous waste transportation is only one element of a hazardous waste management program, it is a key element. By controlling hazardous waste transportation, a State can follow the flow of hazardous waste into and out of the State, and monitor the movement of hazardous waste within its jurisdiction. The key uses of a waste transportation control program are to ensure that hazardous wastes are transported to appropriate waste receptors and to generate information for planning and surveillance purposes.

A State's system for the control of hazardous waste transportation should be developed to regulate all types of hazardous wastes produced in any form (liquid, solid, or contained gas) and transported by any mode (surface, air, or water transport). The basic elements necessary for a control system are: a licensing system for waste haulers, a permit system for treatment/disposal facilities, and a hazardous waste manifest system. In addition, for a comprehensive hazardous waste management program, there should be proper containerization; labeling and placarding of waste containers and vehicles; equipment identification and requirements for equipment inspection; provisions for accident and incident reporting; and interstate cooperation.

LICENSING SYSTEM FOR TRANSPORTERS

Although not mandatory under requirements of the Resource Conservation and Recovery Act, many States have found a licensing system to be useful.

A licensing system should be designed to regulate the transporter of the waste. Any individual or corporation wishing to transport hazardous waste within or through a State's jurisdiction would be required to obtain a license. Existing State requirements for the licensing of intrastate carriers may be sufficent with specific controls for hazardous waste haulers. The approval of a license by the State would indicate that the transporter has the proper equipment to handle the wastes in a manner which provides for the protection of public health and the environment. The State licensing agency may have requirements respecting operator training, tariffs, routing, insurance coverage, handling of waste, etc. A license is different from the permit issued to waste treatment/disposal facilities in that the major criteria for the issuance of a permit would be that the facility is designed and operating in an environmentally acceptable manner as defined by the State.

In addition to licensing the waste hauler and issuing a permit to the treatment/disposal site, a State may wish to require the registration of all waste transportation and handling equipment.

Equipment identification would make it easier for hazardous waste shippers, hazardous waste disposal or treatment site operators, and State enforcement personnel to identify equipment that has been authorized to carry hazardous waste.

Each license applicant should be able to demonstrate that a viable program for the inspection of the transport equipment has been established. An inspection program should include a schedule for equipment check-ups and a list of specific areas or points that should be inspected.

HAZARDOUS WASTE MANIFEST

The major purposes of a hazardous waste manifest are: 1) to provide the State with a means of tracking the flow of hazardous waste within the State and with data on the quantities and disposal locations of the hazardous waste; 2) to certify that the wastes being hauled are accurately described; and 3) to provide information for recommended handling, disposal/treatment, and emergency response.

Hazardous waste haulers would carry a manifest provided by the shipper which would describe the hazardous wastes being transported, the composition of the waste, the quantity of the wastes, specific hazards, and the precautions which should be taken in the event of any emergency. At a minimum, manifests should contain the address of the permitted storage/treatment/disposal site, the hauler, and opportunity for each party to certify completion of his obligation. The State may require additional information such as identification of the process that generates the waste, information on the hazardous properties of the waste, and recommended treatment/disposal methods.

A certification by the shipper, hauler, and receptor of the hazardous waste is needed in order to track the flow of the waste. Certification by the shipper as to the nature of the waste and its consignment to a licensed hauler should be required. The carrier should certify that the waste was hauled to a permitted storage/treatment or disposal facility and the disposal facility should certify that the waste was received.

The manifest should be used primarily by the State as a means of tracking the flow of hazardous waste within its jurisdiction and insuring the generator that the waste was delivered. The manifest is filled out by the waste generator and signed by the hauler. The generator, who bears the responsibility of selecting a licensed hauler and designating a permitted facility, is assured by this process that the waste is being handled by a responsible carrier. The carrier, in turn, is assured as to the waste's properties and composition because they are certified by the generator. After receiving certification that the waste was received by the hauler, the generator should maintain a copy for his records.

Upon delivery of the waste to the disposal facility and acquiring certification of receipt, the hauler should maintain a copy of the shipping document for his records. Again, the certification procedure assures the hauler that the waste has been received by a responsible waste disposal facility. For the manifest system to work properly, the information entered on the manifest by the waste generator, transporter, and waste management facility should be made available to the State. Based on these data, the State will be able to verify that the hazardous waste has reached its destination, and that the total amount of waste delivered to the transporter was received at the waste management facility. In addition, data on the manifest will provide the State with useful information on the amounts and points of generation of the hazardous wastes, and on the disposal locations of the wastes. The data can also be used as a planning tool to determine future needs for waste management facilities.

LABELING AND PLACARDING OF WASTE CONTAINERS AND TRANSPORT VEHICLES

Each person who offers a container containing a hazardous material for interstate transport must label and package in compliance with U.S. Department of Transportation (DOT) hazardous materials regulations. Proper labeling is important because it indicates the danger while handling, transporting, and storing the materials. DOT labels represent the designated classification of the hazardous material (that is, explosive, flammable, corrosive, oxidizers, etc.). Labels are required on all shipments of hazardous materials, except when an article is classified as exempt from the labeling requirement because of size and quantity or because of special packaging. Multiple labeling is required for packages containing a material classed as an Explosive A or Poison A. Materials that meet the definition of more than one hazard class must be labeled as required for each class. In addition, each package containing a material classed as a flammable liquid, a flammable solid or an oxidizer, that meets the definition of a Poison B must also be labeled.

Many substances that are hazardous to the public health or the environment (especially due to chronic hazards) do not presently require distinctive labels because they are not defined by DOT as a hazardous material The Resource Conservation and Recovery Act of 1976 gives EPA the authority to work with DOT to accommodate this need.

In addition to proper labeling of all materials, a carrier may not move a transport vehicle containing a hazardous material unless the vehicle is marked and placarded Any substance which does not require a label does not require a placard.

A State program for hazardous waste transportation control must identify materials that are hazardous to the environment and the public health in addition to those listed in the Hazardous Materials Transport Regulations (49 *CFR* 172). The labeling and placarding requirements of DOT may not be sufficient for environmental protection, since they do not indicate that the material may present an environmental hazard. Additional labeling and placarding may be required to be developed pursuant to RCRA for any substance designated as hazardous, to indicate that a public health or an environmental hazard would exist in the case of a spill or accident.

The additional labeling and placarding of environmentally hazardous materials would notify emergency response personnel that the material should be contained and not washed away as a first response to a spill or accident.

ACCIDENT AND INCIDENT REPORTING

DOT requires that any time there is an unintentional release of hazardous materials (in any quantity), the carrier must submit a hazardous materials incident report to DOT. The basic information required includes the shipper's name, address, etc., the amount of materials released, the hazard of materials involved, the nature of failure that caused the spill, and a description of the essential facts of the incident.

To avoid duplicative effort by hazardous waste haulers, each State may require that haulers submit copies of the DOT report of accidents or incidents involving hazardous wastes to the State. The haulers should include on the report their State license number.

Section 311 of the Federal Water Pollution Control Act requires that immediate notification be given to the Coast Guard in the event of a discharge of a substance designated as hazardous from a vessel or from an onshore or offshore facility. Currently 303 substances have been selected, the list of selected hazardous substances should be promulgated in 1977. These substances were identified as hazardous because they present an " . . . imminent and substantial danger to public health or welfare . . . " EPA's hazardous substance spill list is not identical to the DOT hazardous materials list. The DOT list includes explosives, compressed gases, and other substances which do not necessarily constitute a significant water pollution threat.

INTERSTATE COOPERATION

If a hazardous waste is generated in one State and transported to another State for treatment or disposal, the waste hauler may well be required to obtain hazardous waste transportation licenses from the States which he will pass through. Arrangements to exchange information concerning the movement of interstate hazardous waste shipments are being contemplated pursuant to RCRA regulation development. The objective of this information exchange is to be sure that the hazardous wastes are actually reaching their assigned destinations and are not being dumped in transit. There are two occasions on which the exchange of information is especially important. The first occasion is when a State learns from its generator or license applications, reporting system or other means, that a waste generated within the State may be shipped to another State. The other State(s) involved needs to be notified and should respond by sending license information to the hauler. The second occasion is when a State learns through a reporting system that a waste has been transferred from one State to another. If the waste does not reach its destination, an investigation should be initiated to determine the disposition of the waste and the hauler's fitness to continue to transport hazardous wastes.

CURRENT FEDERAL AUTHORITY

Federal authority for the regulation of interstate transportation of hazardous materials is shared by the Interstate Commerce Commission (ICC) and the DOT. The ICC bears the broad responsibility for economic regulation to assure that the public has an adequate and efficient transportation system under private ownership. One area of ICC involvement is the licensing of interstate common and contract carriers of hazardous materials which are considered property. In order to receive a license to operate, the carrier must demonstrate the existence of a need for his service, and his ability to provide the service in a manner which assures highway safety, and protection of the public and the environment. The licenses are issued for a period of 5 years, at which time the carrier must again demonstrate a need and his fitness to perform the transportation service. If it is found that a carrier is releasing hazardous substances to the environment during the transportation of a hazardous waste, the State or local government may request that the ICC not issue or reissue a license for that carrier to operate in interstate commerce.

According to the Hazardous Materials Transportation Act of 1974, " . . . any requirements of a State or political subdivision . . . which is inconsistent with any requirement set forth in this title, or in a regulation issued under this title, is preempted." DOT has indicated that the Hazardous Materials Regulations may therefore pertain equally to inter- and intrastate transportation of hazardous materials. The Hazardous Materials Regulations basically require that all hazardous materials be shipped in DOT- (49 CFR 173) approved containers, tank cars, tank trucks, etc., that a shipping paper, which may take the form of a shipping order, bill of lading, or other shipping document, must accompany all shipments of hazardous materials; and that all containers, tank trucks, etc., must be properly marked, labeled and placarded. In addition, DOT must be notified in case of an accident or spill that meets the incident reporting requirements.

The Hazardous Material Regulations require that each person who offers a hazardous material for transportation shall describe the hazardous material on the shipping paper. Each description of a hazardous material on the shipping paper must include 1) proper shipping name, 2) the class prescribed for the material, and 3) total quantity of the hazardous material. A shipping paper may contain additional information concerning the material, provided that the information is not inconsistent with the required description. In addition, a shipping paper must contain a shipper's certification that states. "This is to certify that the above named materials are properly classified, described, packaged, marked, and labeled, and are in proper condition for transportation according to the applicable regulations of the Department of Transportation."

LIMITATIONS OF CURRENT FEDERAL AUTHORITY

The ICC does not regulate all transportation. State governments retain jurisdiction within their States, although no part of an interstate movement is subject State control. ICC does not regulate any intrastate transportation of goods or materials.

It is important to recognize that the hazardous materials transport regulations are aimed at protecting the transport workers and the general public from acute hazard due to intermittent or one-time short-duration exposure. EPA believes that substances should also be considere[illegible]zardous because of their chronic long-term effect[illegible] potential for environmental degradation.

DOT has the authority to prescribe and enforce safety regulations for motor carriers, oil pipelines, railroads, etc., and for the transportation of explosives and dangerous articles. DOT regulations are concerned only with safety on the highways, airways, waterways, or railways, and do not currently address themselves to environmental protection. DOT has published an Advance Notice of Proposed Rulemaking (HM-145 FR December 9, 1976), giving notice that it is considering whether new or additional transport controls are necessary for classes of materials that present certain hazards to the public health and to the environment and that are not currently subject to the existing Hazardous Materials Regulations. DOT Hazardous Materials Regulations classify materials according to their nature, they do not provide specifically for any classification or designation of a hazardous waste by name. Instead, the general methodology is to categorize hazardous materials into a limited number of generic classifications [for example–explosives, flammable, compressed gases, flammable liquids, combustible liquids, oxidizing materials, and toxic materials (poisons)]. A waste material may contain a mixture of different active ingredients having differing hazard characteristics, for example, flammability and toxicity. Under the DOT Classification system, Section 173.2, a hazardous material having more than one hazard must be classed according to the following order of hazard. This will also pertain to a mixture: 1) Radioactive Material, 2) Poison A, 3) Flammable Gas, 4) Nonflammable Gas, 5) Flammable Liquid, 6) Oxidizer, 7) Flammable Solid, 8) Corrosive Material, and 9) Poison B. Therefore, a waste mixture containing, for example, acid sludge (corrosive material) and arsenic (Poison B), is classified only as a corrosive material.

Under the placarding requirements, motor vehicles containing less than 1,000 pounds of the following substances need not be placarded:

- Class C Explosives
- Nonflammable Gas
- Chlorine
- Oxygen
- Combustible Liquid
- Flammable Gas
- Flammable Liquid
- Flammable Solid
- Oxidizer
- Organic Peroxide
- Poison B
- Corrosive Material
- Irritating Material

When a vehicle contains a mixture of these substances, the vehicle may be placarded DANGEROUS.

The regulations being developed under RCRA to be promulgated April 21, 1978 will address many of the subjects discussed. Generator standards that impact the transporter will require the labeling of those materials defined as hazardous waste, the furnishing of information, the appropriate packaging of the wastes, and the development of a manifest system. For the transporter of hazardous wastes, the regulations will address recordkeeping concerning hazardous waste transported; acceptance of waste for transport, compliance with the manifest system and delivery of all the hazardous waste to the designated facility. Delivery standards could include safe operation of vehicles, accident/spill reporting, and appropriate handling of leading containers.

SOURCES

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2. Hazardous Materials Regulations, Title 49 (Transportation) Code of Federal Regulation, 1975, parts 100-199.
3. Interstate Commerce Commission. Washington, U.S. Government Printing Office, 1974.
4. Transportation Act of 1974: Hazardous Materials; Title I of Public Law 93-633, 93rd Cong. HR15223, January 3, 1975. Washington, U.S. Government Printing Office, 1975. 9p.
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Chapter 6

LAND USE AND POLICY ISSUES CONCERNING HAZARDOUS WASTE MANAGEMENT

The establishment of an effective State hazardous waste management program requires the recognition of a number of policy issues by the decision maker. The purpose of this chapter is to highlight and elaborate upon issues related to land disposal of hazardous wastes such as the definition of disposal, safe quantities for disposal, groundwater protection, public land use, and others. The discussion in this chapter should serve to focus attention on the need for explicit consideration of these issues by the State official as he moves to implement a viable hazardous waste management program.

DEFINITIONS OF STORAGE, TREATMENT, AND DISPOSAL

The complexity and structure of a State permit granting process of the type specified in the Federal Resource Conservation and Recovery Act of 1976 (RCRA) are affected by the definitions governing storage, treatment, and disposal.

In Section 1004 of RCRA, the term, storage, as it applies to hazardous waste, is defined as "the containment of hazardous waste, either on a temporary basis or for a period of years in such a manner so as not to constitute disposal of such hazardous wastes." The term, treatment, when used in conjunction with hazardous wastes is defined as "any method, technique or process, including neutralization, designed to change the physical, chemical or biological character or composition of any hazardous waste, so as to neutralize such waste or as to render waste nonhazardous, safer for transport, amenable for recovery, amenable for storage, or reduced in volume." The term, treatment, also "includes any activity or processing designed to change the physical form or chemical composition, so as to render a waste nonhazardous."

Finally, the term, disposal, is defined in Section 1004 as "the discharge, deposit, injection, dumping, spilling, leaking, or placing of any solid waste or hazardous waste into or on any land or water so that such solid waste or hazardous waste or any constituent thereof may enter the environment or be emitted into the air or discharged into any waters, including groundwaters." Although these definitions draw rough distinctions between sites or facilities having no or zero emissions to the environment (that is, storage) and those having some emissions (that is, disposal), these definitions require that a secure land disposal site (no emissions) be included in the same category as a tank farm storing hazardous wastes.

DETERMINATION OF SAFE QUANTITIES FOR DISPOSAL

Central to the question of permitting land disposal facilities is the development of a methodology for considering how much of a particular waste can be disposed on a specific plot of land without resulting environmental degradation.

This decision requires:

- the development of a defensible procedure to make such a judgment in a replicable way and:
- a policy that sets forth the degree of environmental degradation (especially groundwater contamination) allowable in the State.

In order to protect the public health and the environment, EPA is developing a procedure that State decision makers can use to evaluate any given land site for its disposal potential for hazardous wastes. The procedure might incorporate a matrix, a set of nomographs or criteria, or a mathematical model, that will describe what is happening to the contaminants in the soil.

The modeling of the dispersion of contaminants through soil involves modeling of two distinct zones: 1) the unsaturated zone and 2) the saturated zone, which also includes the aquifer (the water table and below). Most research has been in the latter regime, the saturated zone and the aquifer. Of most interest to the State decision maker is the prediction of activity in the unsaturated zone, because soil attenuation of contaminants takes place mostly in this zone. The mechanisms of adsorption, absorption, chemical interaction (ion exchange, bonding and forming of complex ligands, etc.) occur in the unsaturated zone, and it is in this zone where contaminants must be sufficiently attenuated, to protect the groundwater.

Modeling of the unsaturated zone is in its infancy. Models and analogs do exist which treat this zone, but they are for very specific contaminants and for very specific boundary conditions. To be of use for the implementation of a permit program for the land disposal of hazardous wastes, a data matrix of waste types and soil types should be developed based on experimental and field data. The matrix should consider the attenuation of wastes separately and in combination with a range of soil types. The conspicuous absence of laboratory and field data addressed toward the unsaturated zone will hamper efforts to develop a generalized model for the zone. Further, the specific applications for describing the attenuation of wastes in the unsaturated zone require a large base of very specific laboratory and field data over a long period of time to calibrate and then to validate the model.

An extensive data base is required to develop a viable test procedure for the attenuation of hazardous pollutants in soil for calibrating models of the unsaturated zone. Additional monitoring data at untested sites are necessary to validate the adequacy of the model describing soil attenuation. Thus, only after a model has been calibrated and validated, can it be used as a predictor model with reasonable confidence. When such a model is ready for use in conjunction with a permit program, it must consistently receive the proper input data, and the actual field site must satisfy all boundary conditions of the model; otherwise, the predicted results will be inaccurate. In such cases, the degree of inaccuracy should be determined, so that appropriate safety factors can be applied. Confidence in such a model should be rather high in order to realize consistent and equitable decision making by State officials. This requires concurrent data and model development to fit most circumstances likely to be encountered in the field. The use of safety factors will have to be incorporated to allow for any shortcomings in confidence level and to be certain that the model errs on the safe side from a health protection standpoint, when granting permits.

The procedure that is developed to evaluate a given land site should be analytically capable of assisting in decision making to support a hazardous waste landfill permit application and evaluating the attenuation capacity of various soils and various wastes separately and in combination, as would be encountered in typical field conditions. The procedure should also provide a fairly high degree of replicability in terms of consistency and repeatability of answers, and extrapolation to new or untried sites, particularly sites which may not exactly fit the assembled comparative data base.

Desired inputs for such a procedure might include:

- Information pertaining to how much and what kind of wastes have been, are being, and will be deposited at the site being evaluated and the disposal methods which were and are to be used.
- Basic information about the soil characteristics, the hydrogeology, and the climatology of each disposal site. Wherever possible, predisposal site conditions should be established for normal background conditions.

It is important that the data inputs be easy to obtain by State officials and permit applicants. Furthermore, permit applicants should not have to assume an undue financial burden or expend an excessive amount of time in gathering input data for the procedure.

The desired outputs of the procedure would include:

- A knowledge of how much and what kind of wastes can be deposited on a given parcel of land. The effects on the water can be compared to drinking water standards or other water-quality standards, such as natural background levels (where in excess of drinking water standards).

- A prediction of the maximum potential concentration of each pollutant in the groundwater: both immediately under the disposal site; and at the owner's property lines contiguous with other properties downstream of the site. The model should also indicate when and for how long this will occur. This information will be useful for assessing potential long-term changes and for settling possible court litigation suits.
- Information relating to the *transport*, *distribution* (at any given point or interface in the soil), and *chemical* interaction of specific pollutants through specific soils.
- Information on the atrenuation of pollutants in the unsaturated zone. It is desirable for attenuation of pollutants to occur mostly in this zone so as to maximally protect the groundwater. The actual mechanisms involved in attenuation (adsorption, ion exchange, etc.) need not be known, although this would be useful information.

In order to facilitate implementation, the outputs from the procedure should utilize charts, nomographs, and other visual summary aids in lieu of actual model runs, wherever this appears feasible.

The development of a predictive procedure designed to evaluate a specific site for its waste-handling capabilities will help to insure that land disposal of hazardous wastes will not pose an undue threat to the environment.

GROUNDWATER PROTECTION

The State policy with regard to groundwater preservation/degradation may range from zero discharge (implying nondegradation) to maximum utili-tion of soil attenuation and dilution (implying some possible added contamination). Another policy scheme revolves around allocation of land use based on aquifer usage. For example, the State of Maryland is attempting to establish criteria to provide a way of identifying the underground water supplies that need to be protected. In this way, the State of Maryland feels that better decisions can be made as to where hazardous waste can be disposed. For the purposes of controlling the pollution of groundwater, the Water Resources Administration in Maryland has identified four classes of aquifers and has also established criteria for groundwater quality. Maryland has also set effluent limits for any solid, liquid, semisolid or semiliquid wastes disposed in aquifers. These limits are based on the assimilative capacity of the aquifers and groundwater quality standards, and will be measured as determined by the Water Resources Administration.

By designating aquifer types and establishing effluent limits, the Water Resources Administration hopes to protect those aquifers that are used, or are capable of being used, for drinking water or agricultural and industrial water supplies.

Aquifers that are not designated as a source for any types of water supply will be used for waste storage and treatment. Since all aquifers cannot yield groundwater in sufficient quantities and of suitable quality to be useful, the State of Maryland has ruled that the use of these aquifers for waste treatment and storage represents a legitimate use of this resource.

THE QUESTION OF USE OF PUBLIC LANDS

Federal Agency Policies

Under RCRA, the EPA and the States have a responsibility to decrease pollution, including environmental purposes, including hazardous or solid waste facility sites. Program strategy places emphasis on private-sector initiatives for hazardous waste management.

EPA does not have a formal policy position on the use of public (Federal, State, local) lands for environmental purposes, including hazardous or solid waste facility sites. Program strategy places emphasis on private-sector initiatives for hazardous waste management.

The 1973 *Report to Congress: Disposal of Hazardous Wastes* by EPA includes a short discussion on the use of public lands. A partial reason for this stems from the history of the report. It resulted from Congressional concern about hazardous waste storage and disposal, which subsequently led to Section 212 of the Resource Recovety Act of 1970 requiring that EPA prepare a comprehensive report to Congress on the feasibility of creating a system of national disposal sites. EPA research for the report resulted in the conclusion that strategies other than a national disposal site system should be emphasized for effective hazardous waste management. This issue understandably became intertwined with the use of public lands, especially Federal lands. To satisfy the requirements of Section 212, the report does present, in an appendix, a comprehensive report and plan for a system of national disposal sites, including hypothetical locations of ideally located sites, some of which are on public lands. Unfortunately, this appendix created confusion because EPA had no intention of recommending either specific sites or the concept itself. In fact, EPA does not advocate a system of national disposal sites involving the Federal Government. The Report to Congress, however, did state that it might be necessary to make public lands available if adverse public reaction or other reasons preclude the use of privately owned sites.

Experience does exist in the use of Federal lands for the processing and disposal of solid waste. The following discussion is presented to show the extent of Federal agency involvement in this area and to gain some insight into problems common to both hazardous and solid waste management.

The Department of the Interior's Bureau of Land Management (BLM) has State offices in many of the western States for the management of the BLM lands contained in a given State. In Colorado, the BLM leases land to approximately 30 to 40 local government units for solid waste landfills. The leases are generally for a period of 5 years, and the annual cost is nominal–about 25 cents per acre per year. After site closure, the terms of the lease require site restoration by the user which may be a governmental unit or an independent contractor. The BLM requires that sites be maintained according to State (Colorado) standards which are based on EPA guidelines.

Generally, BLM officials do not foresee any insurmountable problems for municipalities obtaining BLM lands for solid waste disposal sites, provided that suitable non-Federal lands are not available. Although urbanized areas in Colorado are limited, the BLM officials believe that pressures exist and will be increasing for the use of Federal lands in Colorado due to expanding national energy requirements. Increased oil shale production will generate large quantities of mill tailings, for example, which will require proper disposal, and Federal lands are a logical candidate for that disposal.

The U.S. Forest Service also manages large parcels of land in Colorado. The Forest Service land is very mountainous, and access is possible only 4 months of the year due to heavy snows. However, it does have five solid waste land disposal sites which are basically operated in a manner similar to those on BLM land. A need for a disposal site must be demonstrated in that suitable non-Federal lands are not available and the governmental unit must meet State standards which are based on EPA guidelines. The use can be free (for a governmental unit) or on a fee basis.

Regarding the use of Federal lands for hazardous waste management, the BLM field instructions prohibit the use of national resource lands for long term hazardous waste disposal. Their guidance states that leases be given for a maximum period of 5 years, and that hazardous wastes that do not break down into harmless components within that time should not be disposed of on national resources land. This, in effect, bans hazardous waste management on these lands.

Other Issues Concerning Public Land Use

The use of public lands for hazardous waste management facilities is an intricate subject that overlaps into many areas related to the overall hazardous waste management issue (for example, public acceptance and economic incentives). The remainder of this section will examine several key issues concerning the use of public land for hazardous waste management facilities. The following questions will be discussed.

- Is the use of public land necessary to properly manage hazardous waste and adequately protect the environment and public health?
- Will the enactment of the RCRA and related State laws provide enough incentive to hazardous waste management operators so as to make additional incentives or the use of public land unnecessary?
- Can the use of public land be supported on equity grounds?

Are Public Lands Necessary For Proper Hazardous Waste Management? The factors that make some existing public lands attractive for hazardous waste management facility sites–remoteness and geological suitability–may mitigate against the economic pragmatism of the use of such lands. Transportation costs of shipping hazardous wastes or residuals from their origin in an industrialized area to suitable public lands, possibly in a western State, can be prohibitively expensive. Also, it is possible that public opposition to the use of public lands–especially for wastes shipped from an industrialized area in the East to a western State–might be just as vehement as the opposition to siting environmentally suitable facilities in urbanized areas. The actual shipment of wastes from one State to another calls attention to the problem of disposal–witness the opposition encountered in early 1975 by Montgomery County, Maryland, when it attempted to transport municipal waste to a privately owned landfill in Ohio. Public opposition by local Ohio citizens caused the proposal to be withdrawn. It is purely speculative as to what the opposition would have been if the disposal site were on public land. Citizens and environmentalists may have protested with the same result. Public confidence in long term care may be enhanced by locating facilities on public lands, but that is not a guarantee.

The objective of environmentally safe hazardous waste management can be accomplished on private lands. They can be just as technically acceptable as public lands. Adequate safeguards can be established through the promulgation and enforcement of (State) regulations, and through the use of requirements such as bonding to ensure compliance and long term care. The use of public lands is not necessary to protect the environment and public health, and does not necessarily provide an effective and efficient solution to hazardous waste management. Further, their use does not always solve the real problems of long term security and public opposition to hazardous waste disposal sites. There may be better ways of attacking those problems, such as public education and strong regulation to provide safeguards for the public.

Will the enactment of the Resource Conservation and Recovery Act provide enough incentive to hazardous waste management facilities so as to make additional incentives or use of public lands unnecessary?. The passage of the RCRA is of special interest to the owners of hazardous waste management facilities because it is likely to create a substantial positive shift in demand for their services.

The provision of public lands either to generators or service facilities for hazardous waste management is, in reality, a subsidy or type of economic assistance. With the likely increase in demand for the services of hazardous waste management facilities that will result from the enactment of RCRA, it is doubtful that subsidies or incentives to the hazardous waste management industry will be necessary. Enforcement of the new regulations will create incentives for development of new facilities by ensuring additional markets for services. Regulatory activity should improve the financial soundness of hazardous waste management firms over time by increasing the rate of use of these facilities and thereby increasing the prices they can command for their services.

Can the use of public lands be supported on equity grounds? A desired goal of environmental legislation is to shift the costs of pollution control from society in general back to the specific producers and consumers of the pollution-producing products. In the particular case of hazardous waste generators or service firm facilities built prior to hazardous waste management regulations, an equity argument could be made for providing assistance to outdated facilities lacking advanced treatment and disposal technology. The installation of new technology for established firms can be costlier than installation performed during original construction. The prices for hazardous waste management facility services are not likely to be affected because the new, more efficient facilities tend to set prices, and older firms may not be able to recover higher control costs through increased product prices. However, the fact remains that hazardous-waste-management regulations, in themselves, could create a new market for the services of hazardous waste management facilities (which treat and/or dispose of 20 percent of all hazardous waste) and could provide them with the business and benefits that could form the basis of capacity expansion. On balance, it seems inequitable to provide any additional incentives, whether they be use of public lands or some other form of subsidy, beyond the potential economic stimulus arising from the regulation of hazardous wastes. If it is one of the goals of the new legislation to shift the burden of hazardous waste management from society (the public) to the generators and consumers, then the use of public lands cannot be justified on equity grounds.

Chapter 7

FACILITY OPERATIONS

One of the most sensitive areas for decision-making by State officials is the proper operation of facilities designed to accept hazardous waste. Increased attention will be focused on these decisions as a result of the Resource Conservation and Recovery Act. Even as national minimum standards for facilities are being developed under Sections 3004 and 3005 of that Act, however, decisions must be made as to the adequacy of ongoing and proposed operations. Thus, this chapter is intended to highlight topical areas that should be addressed by decision makers in approving hazardous waste management facility operations.

Facility operations involve more than the day-to-day operation of a waste management facility. This chapter presents the State decision maker with a discussion of some of the key elements to be aware of and plan for in the proper storage, treatment, or disposal of hazardous wastes. The chapter begins with a discussion on planning for and development of a hazardous waste management facility. Planning and development not only involve a determination of the need for such a facility, but also the site selection. Site selection depends on various physical and cultural variables: geologic, hydrogeologic, topographical, climatic, ecological, and economic factors as well as public acceptance.

After a facility has been constructed, it is important for the protection of public health and the environment that the facility be maintained properly both during and after operation. The responsible operation of an environmentally acceptable facility from the receipt of the waste to its ultimate disposition constitutes a major component in the control of hazardous waste facilities. Proper facility operation includes proper handling of the waste; waste compatibility in treatment and disposal; safety at the site; monitoring to assure protection of the environment; operator training; and financial responsibility. The final step in the control of hazardous waste facilities is proper closure. The owners need to plan for site closure, and long term surveillance, and the State must determine what the future uses of the land will be.

PLANNING AND DEVELOPMENT

With a data base describing the kinds and quantities of hazardous wastes requiring disposition (see Chapter 3), the decision maker can begin to consider the need for facilities to manage such wastes. This planning effort should be an integral part of the State planning process for all wastes, to be established under Subtitle D of the Resource Conservation and Recovery Act of 1976. In addition, planning, underway or contemplated pursuant to Section 208 of the Federal Water Pollution Control Act, will need to be interfaced with State decisions regarding hazardous waste facilities.

Regardless of the planning procedures used to determine additional hazardous waste facility needs, conscious decisions must be made as to the degree of control to be accorded to planning process decisions. At one extreme, no hazardous waste facilities except those on an approved State plan would be permitted to operate. In effect, this position could create State "franchised" market areas which might ultimately require economic regulation. On the other hand, a less detailed plan for facilities with less stringent facility operating standards opens the door to inadequate facilities due to undercutting competition from poorly controlled facilities. Thus, the "mix" between the degree of flexibility in the planning process and the stringency of regulations needs to be carefully balanced to meet the goals desired by the State for safe environmental control of such facilities.

As an aid in analyzing the need for facilities at the State level, EPA recently completed a contract report analyzing the expansion capabilities of the hazardous waste management industry. This report, *Potential for Capacity Creation in the Hazardous Waste Management Service Industry**, states a variety of factors increasing the demand for hazardous waste management services: air and water pollution control and land disposal regulations; industrial growth; pesticide controls; and new restrictions on ocean dumping of wastes. This increased demand for proper disposal of hazardous wastes will apparently require full utilization of the existing facilities and additional construction of new facilities. Today, however, it is estimated that only 53 percent of the overall capacity of about 100 facilities operated by the commercial hazardous waste service industry are currently used.

With the enactment of the Resource Conservation and Recovery Act of 1976, an estimated 50 to 60 additional sites for commercial use will be needed to adequately fulfill the demand for proper hazardous waste handling, treatment, and disposal. (The estimate includes the construction of approximately 20 secure landfills.) Typically, these facilities will be designed to handle a greater amount of waste materials than current operations and will, in most cases, offer both chemical treatment and incineration.

In order to determine whether a new facility is needed or increased utilization of existing facilities will adequately serve the fu[illegible] needs of the community, the distribution and current utilization of the industry must be examined in a given geographic area. On a national basis, the geographic distribution of sites is concentrated in EPA Region II, V, and IX as shown in the following list. These regions contain approximately 60 percent of the sites. (EPA regions are listed in Table F-1 in Appendix F.)

*Potential for Capacity Creation in the Hazardous Waste Management Service Industry and Environmental Protection Agency, August 1976 (PB-257 187).

EPA Region	Percent of Total
I	6
II	16
III	8
IV	6
V	25
VI	9
VII	7
VIII	1
IX	17
X	5

Of the 110 facilities identified in the report as hazardous waste management facilities, only nine are municipally controlled. Eight of the nine are located in Region IX and one is located in Region III.

Hazardous waste management facilities provide a variety of services to customers in their own State and other States including chemical treatment, incineration, secure landfill, resource recovery, and deep well injection of the hazardous wastes. Table 10

TABLE 10

FACILITY UTILIZATION (PERCENT UTILIZATION)

EPA Region	Chemical Treatment	Incineration	Secure Landfill	Deep Well Injection	Resource Recovery
I	45	30	30	--	50
II	50	50	50	--	60
III	45	75	30	--	50
IV	60	60	40		
V	50	65	50	75	50
VI	40	40	50	75	60
VII	50	75	60	--	60
VIII*	--	--	--	--	--
IX	80	80	80	--	75
X	50	--	30	-	60

*Only one facility. Source: Foster D. Snell, Inc. industry Interviews.

shows the current estimated utilization as compared to process capacity of the facilities nationally. The highest facility utilization is in Region IX for all processes, with the lowest in Region I.

Future treatment and disposal capacity of the hazardous waste management industry is dependent upon expansion plans, capital expenditures necessary for regulatory compliance, and elimination of environmentally inadequate disposal options as required under the Resource Conservatory and Recovery Act of 1976.

SITE SELECTION

Assuming that the need for some facilities is established, the decision maker is faced with the issue of approving and/or participating in the selection of specific sites for such facilities. Site selection should be viewed as a phased decision process. The first phase, site screening, should include the establishment of a minimum set of criteria (by the State) that must be met in order for the prospective site to be considered as a candidate for further investigation by the owner. Site screening is the process of identifying and evaluating a parcel of land for its suitability as a hazardous or chemical waste land disposal treatment or storage site. Specific site-screening criteria should cover characteristics the site must possess naturally or which can be achieved through modification. Geologic, hydrogeologic, topographical, climatic, ecological, and cultural aspects must first be examined before any sites are considered for potential construction of a hazardous waste management facility. Economic feasibility (cost benefit) and public acceptance of the site may ultimately decide the fate of a proposed site. The screening criteria based upon the above parameters should ideally be set up to be judged by the owner of the site on a simple acceptable or nonacceptable basis. Either the site meets the set of criteria or it doesn't.

Site screening can be used by the private sector as an effective means of eliminating unacceptable sites, for the construction of a hazardous waste facility (treatment, storage, disposal), based upon minimum criteria identified by the State.

A useful tool for the evaluation of site screening criteria is a "decision tree"–a flow chart of "yes-no" decision points (Figure 4). The desirable quality of an individual site parameter is stated at each decision point In total, the "tree" constitutes a minimal set of environmental parameters important to maintaining the environmental quality of a given site.

Presented is an example of a "decision tree" and general criteria for a hazardous waste disposal site (Figure 4) The State decision maker should develop specific site screening criteria for hazardous waste disposal treatment and storage facilities. The criteria for treatment and storage should address many of the same parameters considered for the disposal facility. By no means should the "tree" be interpreted as necessarily representing the complete universe of parameters, or the order in which they must be evaluated. Other criteria established by the State such as soil types, waste types to be handled, engineering, cost/benefit analysis, legal issues, economic constraints, etc., may affect the site review and selection process.

A naturally secure disposal site would be any site whose set of environmental conditions satisfied the parameters of the "tree" with no site modifications required.

Geological

Hazardous waste management facilities should not be located in areas where the geology of the site presents an unstable environment. Sites exhibiting historical seismic activity, karst landforms, landslide potential, soil slump or solifluction, subsidence, volcanic or hot spring activities, etc., should be carefully examined before the site is selected. In many locations, these areas cannot be avoided. Therefore, site modification will be necessary.

Hydrogeologic

Location of a hazardous waste management facility above a useful aquifer may necessitate site modification to prevent leachate from reaching the water table. This may include some form of leachate collection coupled with a final capping of the site after completion. It is important, therefore, to be aware of the location of all useable aquifers along with all perched water tables.

The groundwater within the saturated zone may be an important water resource for drinking, agriculture or industry; therefore, it is important to consider its potential for use. Groundwater availability may be estimated from the saturated zone's productivity (pumpability). Productivity evaluations should be based on local conditions, including the availability of good quality groundwater resources and anticipated demand for water from aquifer(s) in question. Saturated zone discharge points, including perched water tables, should be identified and mapped at the site. If there are potential water supply points between the site and the discharge points or if the perched water table discharges outside the drainage area defined by

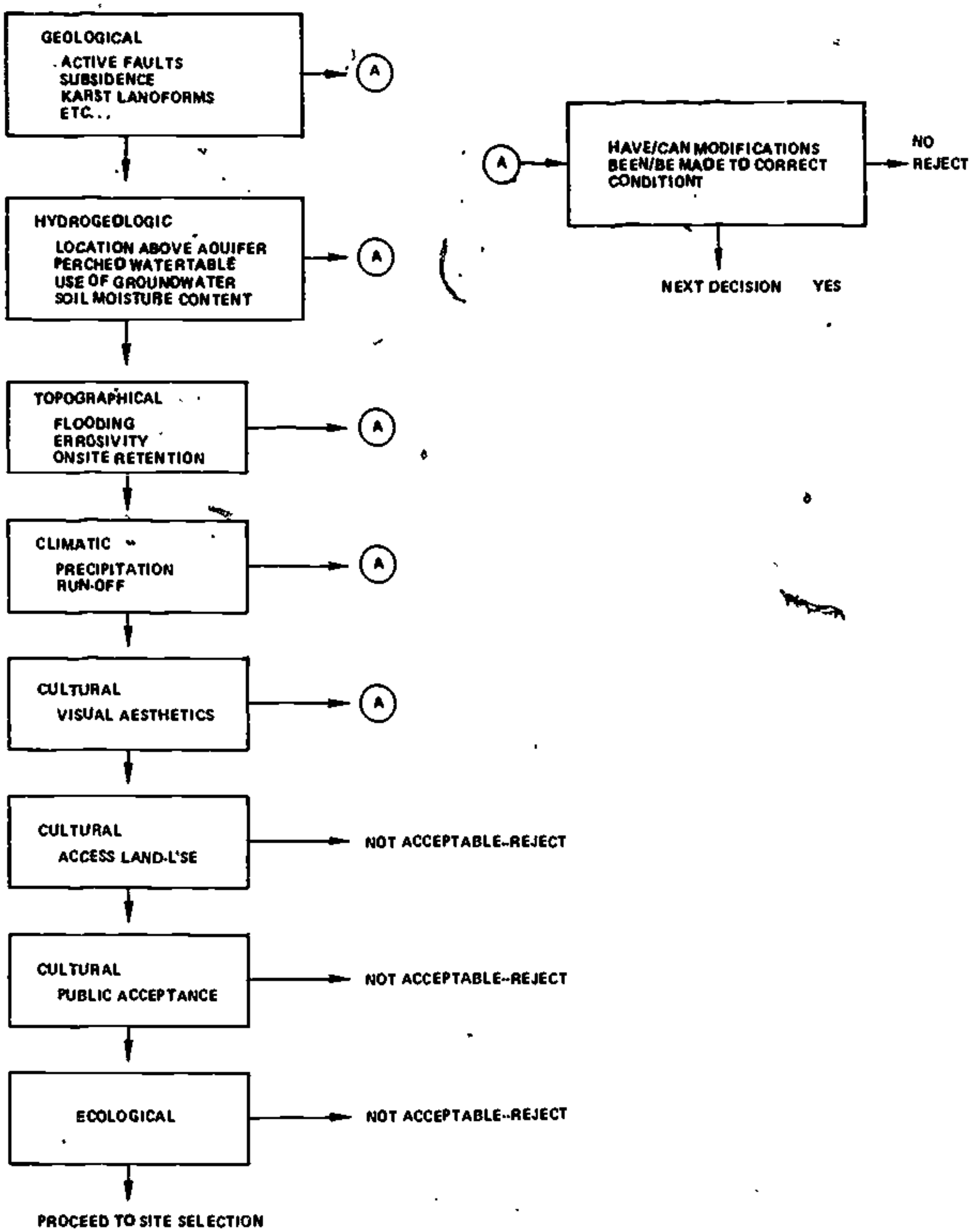

Figure 4. Decision Tree

the site, measures should be taken to prevent contamination of surface and groundwater from the leachate. One such measure is the use of a double liner arrangement with a leachate collection system between the liners.

In addition to groundwater, the inherent soil-moisture content will influence site selection. Field capacity is the amount of soil moisture held in the unsaturated zone against the normal downward pull of gravity. Field capacity is expressed as either moisture content per unit of soil weight, or as inches of water per foot of soil. Procedures for making field capacity determinations are described in the "Handbook of Soil Survey Investigations Field Procedures,"* published by the U.S. Soil Conservation Service.

Field capacity measurements should be used as *indicators* of the unsaturated zone's moisture-conducting potential because of its positive correlation with other soil parameters (such as texture), that retard the rate of soil-moisture movement. If wastes containing free moisture are permitted to be disposed at the site, it is important that the unsaturated zone contain enough available storage capacity to accommodate this free moisture.

If the field capacity is not sufficient to hold all of the moisture associated with the waste, it is still possible that the physical and chemical properties of the soil may be capable of attenuating pollution materials via ion exchange or reducing transport to the aquifer below. If the available storage capacity is sufficient in itself, it may not be necessary to go to the expense and trouble of determining soil attenuation. If the field capacity is not sufficient, however, and there exists insufficient attenuative properties to preclude potential contamination, then the use of engineered modifications (liners, leachate collection, etc.) will be necessary to reduce or eliminate leaching from the site.

Topographical

The main topographic constraints that may render a site undesirable for hazardous waste treatment, storage, or disposal are susceptibility to flooding, erosivity, and offsite drainage runoff.

*Soil Conservation Service. Handbook of Soil Survey Investigation Field Procedures, U.S. Department of Agriculture. Government Printing Office, Washington, D.C.

The site should not be located in a flood plain, shoreland, wetland or any other area subject to inundation. If no such area is available, trade-offs will have to be made. Erosion and sedimentation, considered to be a nonpoint source of pollution, should be containable within the site's boundary. Areas with highly erodible slopes pose a problem to site operations and should therefore be avoided. The site should also contain sufficient area for the construction of a runoff-holding pond to retain surface and subsurface runoff which may contain soil as well as hazardous substances in solution. Several EPA publications provide useful information and are available from the U.S. Government Printing Office.* Data necessary to make the soil loss calculations are readily available from the U.S. Soil Conservation Service.

Climatic

The primary climatic features which may adversely impact on a site are the amount of precipitation and incidence of severe storms. Surplus precipitation will cause surface runoff and water infiltration through the soil. Leachate, as a result of infiltration, will be transported downward only as far as the water is able to penetrate. If precipitation exceeds evapotranspiration for any length of time, there is the potential that the leachate will reach the groundwater. This, however, depends upon local soil and hydrogeologic conditions.

Because seasonal recharge may occur during a period in the site's annual climatic cycle when precipitation is excessive, the annual ratio of precipitation to evapotranspiration is not the only indicator of groundwater infiltration potential that should be examined. More accurate indicators of infiltration potential include weekly and monthly comparisons of evapotranspiration and precipitation rates. Soil permeability and the water-holding capacity of the soil will also influence the amount of leachate infiltration. This will vary from soil to soil and

*Methods for identifying and evaluating the nature and extent of nonpoint sources of pollutants (EPA 430/9-73-014).

Processes, procedures, and methods to control pollution resulting from all construction activity (EPA 430/9-73-007).

Comparative costs of erosion and sediment control construction activities (EPA 430/9-73-016).

therefore should be determined by soil analysis of the potential site.

Runoff, that residual of rainfall that does not infiltrate into the soil, depends on such factors as the intensity and duration of the precipitation; the soil-moisture content; vegetation cover; permeability of the soil; and the slope of the site. Hazardous constituents that may have percolated up to the surface of the site could be carried off in the runoff. Therefore, the runoff from a 100-year storm or annual spring thaw, whichever is the greater, should be containable by the site's natural topography. If not, berms, dikes, and other runoff control measures should be constructed to modify the site. (Runoff may be estimated by applying the coefficients used to design surface water drainage systems.)*

Minimum criteria for the above parameters should be established by the State decision maker and applied to the site by the prospective owner. If the minimum standards are not achieved at the site, it should either be rejected or undergo site modification. For the ecological and cultural parameters, the option of site modification does not exist–the site is either acceptable, or it is not.

Ecological

Since it is difficult to assess the limitations of an ecosystem without initiating an exhaustive and time-consuming study, it is recommended that site selection avoid areas which are undeveloped, including wetlands and marshes, grazed and ungrazed grassland, grazed or ungrazed forest and woodland, and ecosystems which are in a delicate balance. Whether a site is a habitat for rare and endangered species or used seasonally by migratory wildlife are also factors to be determined before selection of the final site.

Cultural

Cultural site features are those elements that are a direct result of human activities which modify and effect the site's desirability for hazardous waste disposal–access, land-use, and aesthetics.

Adequate access to the site should minimize both the transportation costs and the risk of accident or property damage. Distance from the waste source and route congestion and suitability for bulk cargo vehicles are elements that must be considered for site selection by the prospective owner of the site.

Land areas zoned for nonresidential uses and areas with adequate buffer zones should be considered as possible locations for the siting of a hazardous waste management facility. Heavy and light industry as well as unproductive agricultural lands are preferable land-use zones–residential, commercial and recreational zones, on the other hand are not recommended disposal sites. Whether zoned or unzoned, the proposed site should ideally contain sufficient land area to provide a concentric ring of unoccupied space as a buffer zone between active storage, treatment, and disposal areas, and the nearest area of human activity.

Visual aesthetics are best measured by the unaided eye. Line-of-sight observations from commercial business, residential or recreational areas should be screened from the facility's activities. Vegetation, topography, distance, and artificial barriers are all potential means of modifying the site to achieve the desired effect.

After all of the data are collected and analyzed, the prospective owner will have to evaluate each parameter and decide what trade-offs will be necessary for final site selection. Each parameter will have to be assigned a "level of importance" to the community and compared to the other site-selection elements. According to the location of the site and specific site characteristics, each parameter may be assigned different values. For example, in California the location of geologic faults will greatly influence the siting of a hazardous waste facility, whereas in Florida, seismic activity need not be considered. Trade-offs will then have to be made for final site selection. In the final decision process, a specific decision maker may be able to trade-off access to paved roads, for example, against the acreage of the site which would have to be set aside for a water run-off catchment basin.

Public Acceptance

No matter in how much detail the above parameters are examined for the selection of a hazardous waste management facility site, public acceptance or rejection may ultimately decide its fate. One of the most difficult problems faced by the decision maker (or the applicant) is that of gaining public approval from a community for the construction of a waste management facility.

*Chow, Vente. Handbook and Applied Hydrology–A Compendium of Water Resources Technology. McGraw-Hill Book Co., New York, 1964. 14180.

The first step toward the formation of favorable public attitudes is for the prospective owner to design and present to the community a comprehensive plan for an environmentally safe, economically viable, and aesthetically pleasing facility.

The comprehensive plan should include data on: the population (industry) to be served; land availability and suitability; economic resources; zoning and environmental regulations; and transportation networks. The comprehensive plan should also cover management of the facility, manpower requirements of the facility, financial needs, and implementation of the plan.

The prospective owner must decide at what point the public should become involved in the selection of the site, and type of facility to be built. Public participation in the planning stages may be a time-consuming process; however, for the success of the project, the public should be informed as early as possible that a hazardous waste management facility is being planned.

Even if every possible consideration were taken by the planning body to provide an economically and environmentally sound hazardous waste management facility, there would still be no guarantee that the project will be welcomed with open arms by the community. Many times citizens look on hazardous waste management facilities with distrust. This is particularly true for sanitary landfills. The term "sanitary landfill" normally has an unfavorable connotation for many people. Often this type of facility is associated with the unsightly, foul smelling, open "dumps" that are still in use today.

An information and education program can help to alleviate this problem by enabling the public to take an active role in both the planning and operating stages of the new facility. Furthermore, an information program can increase public awareness of the environmental benefits of a well-planned and well-constructed facility, as well as the environmental cost of unmanaged hazardous waste.

There are many ways in which to conduct a public information/education program. Use of media, public participation, citizen advisory committees, and door to door canvassing are only a few methods commonly employed to gain support

The planner should begin the public information program by explaining why a particular type of facility is needed and the logic of its proposed location. Emphasis should be placed upon the benefits that will be realized from the facility both economically and environmentally. It is important for public awareness that the information go to all of the various interest groups that should be involved with the project. Political leaders, public officials, environmental groups, as well as public interest groups and industry should be notified. Adjacent property owners, although often not organized as a group, probably have the most to lose from a poorly conceived facility. Therefore, they should also be made aware of and have an opportunity to input to the decision-making process.

Increasingly, a situation exists where community groups have opposed and successfully blocked the construction of various private and public facilities. For this reason, it may be necessary for the prospective owner to provide these groups with some form of "additonal benefit" to serve as an incentive and thereby increase the realized benefits.

Additional benefits to the community may involve, for example, site restoration to facilitate a park or recreation area. It must be kept in mind that if "additional benefits" are to be successful in winning public acceptance, the facility should be environmentally and economically acceptable.

OPERATION OF FACILITIES

Once the facility is sited and constructed, proper operation is necessary to protect and prevent adverse impacts of the facility on the public health or to the environment.

Proper facility operation, on a day-to-day basis, includes proper handling of the waste, access to laboratory facilities for waste analysis, treatment and/or disposal; safety at the site; monitoring to assure protection of the environment; operator training; and financial responsibility of the owner.

The State decision maker should allow disposal of hazardous waste only at permitted, approved facilities. The criteria used for the permitting should allow the State to close facilities that are not being operated in an environmentally acceptable manner or which are exceeding the established criteria.

Proper Handling Waste Compatability

Proper handling of the waste to include treatment and disposal is needed in order to prevent environmental damage. Without proper handling, there is a danger for fire, explosion, and gas generation that can arise from the haphazard mixing of wastes which are not compatible. While empirical data exist concerning the consequences of reactions between pure substances under laboratory conditions, very little work has been done in the field of waste combination reactions. Very seldom are wastes pure substances. They are usually sludges, emulsions, suspensions or slurries containing many different components. In a landfill, these mixtures will not react in the same manner that the pure substances comprising them react in the laboratory. This is due to differences in concentration, rates of mixing, heat capacities of the surroundings, and the presence of other components in large or trace amounts which might accelerate or decelerate the reaction.

It is evident from existing data that the largest dangers inherent from incompatible reactions involve strong acids or bases. Large deviations of the pH of a waste from neutrality will also interfere with soil attenuation, and can solubilize and release heavy metals and other contaminants that might otherwise be bound. For these reasons, it is desirable that acids and bases be neutralized to within a pH range of 4.5 to 9 before being mixed with other wastes (possibly acidic and basic wastes could be mixed in a controlled manner to achieve pH neutrality). Even within this restricted pH range, acids should be segregated from acid-soluble sulfide and cyanide salts.

Wastes that are particularly toxic, including beryllium, asbestos and all pesticide wastes, should be segregated from highly flammable wastes, since fires provide a ready vector for these wastes to enter the immediate environment.

Also, wastes that react violently with water, or react with water to give off a noxious or toxic gas (wastes containing phosphorous trichloride, phosphorous pentachloride, thionylchloride, and elemental sodium, potassium, or magesium) must be encapsulated in a moisture-proof container before land filling.

With the above inclusions, an example of a compatibility matrix is depicted in Figures 5 and 6.* If it is

AMINES & ALKANOL AMINES	1					
HALOGENATED CMPDS PEROXIDES & ETHERS	X	2				
ALDEHYDES & KETONES	X		3			
MONOMERS & POLYMERIZABLE ESTERS		X		4		
ALKYLENE OXIDES, NITRILES & ACID ANHYDRIDES	X				5	
OXIDIZING AGENTS	X	X	X		X	6

X DENOTES INCOMPATIBILITY

DO NOT FORM THE FOLLOWING COMBINATIONS.	
LEAD OXIDE WITH:	SODIUM ARSENITE SODIUM CACODYLATE SODIUM CHLORIDE
SODIUM ARSENITE WITH:	LEAD OXIDE GOTHION 2,4D DEMETON

Figure 5

ACIDS	1							
CAUSTICS	X	2						
AMINES & ALKANOL AMINES	X		3					
HALOGENATED CMPDS PEROXIDES & ETHERS	X	X	X	4				
ALDEHYDES & KETONES	X	X	X		5			
MONOMERS & POLYMERIZABLE ESTERS	X	X		X		6		
ALKYLENE OXIDES NITRILES & ACID ANHYDRIDES	X	X					7	
OXIDIZING AGENTS	X	X	X	X	X		X	8

Figure 6

not feasible to neutralize acid wastes and/or caustics to within the prescribed pH range, then the matrix in Figure 6 should be used. The successful use of any compatibility system depends upon the labeling of wastes to conform with the generic names used in the system. These matrices will be modified and updated as further information concerning waste compatibility becomes available.

Facility operators should be aware of the problems with mixing of incompatable wastes and, if at all possible, guard against such practices. If consistent mishandling occurs at a facility, the State can opt to revoke the operation permit.

Training

Training of waste management facility personnel in safety, first aid, and facility operation is another important aspect of overall facility management. All site personnel should undergo some sort of training either in a classroom environment or on the job site. The type and degree of the training will vary with the responsibilities of the site personnel.

Site Personnel

A hazardous waste facility should have a manager, a supervisor, and a technical advisor. The manager should be responsible for the overall management of the hazardous waste facility, knowledgeable about site operations and equipment design, and able to give specific waste handling instructions and safety precautions to the supervisor and equipment operators on a continuing basis in consultation with the technical advisor. The supervisor will direct the everyday waste treatment/disposal activities and ensure that proper waste handling procedures are followed and safety regulations are enforced. Other site personnel, heavy equipment operators and laborers, will be under the direct supervision of the supervisor. The technical advisor should be available to answer questions relating to waste compatibility and the hazards of chemical toxicity, flammability, reactivity, etc. The three positions, supervisor, manager, and technical advisor fill the anticipated needs at an average hazardous waste management facility, however, the operational needs of the facility may be filled by fewer than the three people, since one person may be able to perform more than one of these functions.

Training Needs

The need for training and safety requirements peculiar to the hazardous waste management industry has been debated. In a recent series of public meetings held by EPA in December 1975, several industry representatives questioned the need for safety and training requirements beyond those regulations the Occupational Safety and Health Administration (OSHA) already have in effect for products of comparable hazard within the chemical industry.

Many in the hazardous waste management-service industry believe that the most important safety precaution is the proper characterization and identification of hazardous waste. Therefore, it is very important that the facility supervisor be able to recognize the hazards associated with each of the chemical wastes managed at the site. Training of the management personnel should focus on operational procedures of the facility, special handling procedures for the hazardous waste, occupational safety, first aid, and industrial wastes.

Employee safety is an important aspect of proper facility operations as well. OSHA standards for safety in the workplace should be enforced, and any violations recorded in the event of permit review. State environmental officials may need to highlight for State or Federal occupational health agencies the unique problems involved at waste management facilities.

It would seem desirable that supervisor/management personnel have either a degree in chemistry or chemical engineering or have a strong background in the subject matter. All site employees should be given training on facility operations by the plant management. In addition, site employees should be required to attend a basic safety course. Areas of instruction should include accident prevention, occupational safety, first aid, and hazardous waste handling procedures. A basic safety course currently offered by the National Safety Council is entitled, "Safety in Chemical Operations." Because each facility may have unique operations and handling requirements, it will be necessary for the management personnel to provide additional training unique to the site involved.

*Unpublished Paper Viviani, Don., A Rationale for a Waste Compatibility Matrix. U.S. EPA Hazardous Waste Management Division.

Monitoring

In order to protect against pollution of surface and groundwater, the site should have monitoring equipment. Samples should be taken of the surface and groundwater to determine if the facility is polluting the water. In the event pollution is detected, corrective steps can be taken. Also, monitoring of the air quality and noise levels at the site should be undertaken. Chapter VIII deals with some of the sampling and analysis facets of this issue in detail.

Fiscal Responsibility of Owners - Insurance

The owners and operators of any waste management facility have a responsibility to the public to operate in a manner which will not adversely affect the environment or the public health. Within the broad realm of this responsibility is the financial responsibility of the owner to acquire financial protection against liability. The amount of financial protection required by the waste management facility should be the amount of liability insurance available from private sources. It is assumed that the private insurance industry will be able to provide adequate liability coverage. A hazardous waste management facility ideally should be required to obtain coverage over all aspects of operating a hazardous waste facility including transportation, contamination incidents, and other risk activities associated with long term consequences, even after closure of a facility and/or a change in ownership. The protection should extend to any persons who may be legally liable for a hazardous waste incident.

The policy should cover liability for bodily injury and property damage, and should contain a single aggregate limit of liability for all losses and loss expenses for bodily injury and property damage arising during the policy period.

The service firm, as a condition for seeking insurance, would be required to meet all State or EPA standards associated with the operation of a hazardous waste facility. By the same token, a permit application must contain the names and addresses of the applicant's current or proposed insurance carriers, including copies of insurance policies in effect.

Closure of Facilities

The final step in the control of hazardous waste facilities is proper closure of the hazardous waste management facility. Because hazardous waste constituents may enter the environment after the day-to-day maintenance of the facility has ceased, the owners of the facility must plan for site closure and long term surveillance, and the State must consider future uses of the land. The funding requirements of the plan must be estimated, and a means derived to acquire the necessary funds.

Landfills for hazardous waste disposal will ultimately reach capacity and must be closed; but the potential for harmful occurrences would still remain. Regardless of the kind of firm originally or currently owning such a facility (whether public or private), liability for damages is an important fact or burden that someone will have to bear. The possibility certainly exists that the owner and operator of a closed hazardous waste facility still under his ownership could be held liable for long term damages. The problem is more complex when ownership has changed. In order to provide protection in the event of future occurrences after closures, the liability insurance requirement might include coverage for long term damage regardless of whether ownership is retained or not.

The advantages of this system are as follows: (1) it is easy to implement and involves minimal cost to the government; (2) the private sector (insurance carriers) operates the liability insurance mechanism; (3) it is self-enforcing, that is, if a company cannot afford the insurance, it does not qualify for a permit; and (4) it provides current and future liability protection against hazardous waste occurrences.

The disadvantages of this system are as follows: (1) the insurance cost may be very expensive and lead to an uneven cost burden within the private sector; (2) the cost may force firms out of business; (3) firms may be unwilling to buy insurance after they close or sell a facility; (4) the insurance coverage from the private sector may not be adequate to protect the public health and the environment; and (5) adequate amounts of insurance per facility and per incident are unknown.

PLANNING LONG TERM CARE

The owners of a hazardous waste management facility need to plan for long term care which should address decontamination of equipment and structures prior to sale, removal and disposal of remaining hazardous materials, modification to disposal areas to render the site secure; and expected resource commitments or requirements. In addition, a long term care plan (for disposal areas only) should be developed and implemented after closure of the site. It should include monitoring, sampling, analysis of groundwater and surface waters in the vicinity of the site, maintenance of the site (that is, cap maintenance or replacement), containing operations to prevent leachate from reaching the groundwater and surface waters, and identification of officials responsible for implementation of the plan.

Sufficient funding will be necessary to implement the above plan. Provision for the financing of long term care of waste sites can be generally secured via a posted bond, a perpetual care fee, or a combination of both mechanisms. A mutual trust fund may also be used. These mechanisms are explained in the following discussion.

Bonding

One method of ensuring long term site care is to require deposit of a cash bond or maintenance of a surety bond by the waste disposal site operator. The bond should be of sufficient size to assure sufficient funds for proper site closing and site monitoring, surveillance, and maintenance for a number of years. The appropriate bonding level varies with site characteristics (size, geology, hydrology, etc.), the particular hazardous materials destined for disposal, and the degree of waste treatment prior to disposal. The likelihood of offsite damages which is related to such factors as proximity to population centers could be considered as well when choosing an appropriate bonding level, although it has not previously been a factor.

A surety bond which is a certain level of insurance maintained for the purpose of securing adherence to certain procedures or regulations, would probably be less burdensome to the site operator than a cash bond of an equivalent amount. The premium paid for a surety bond would presumably be less than the cost of a loan needed for deposit of a cash bond.

In the case of a cash bond, adequate provision for perpetual site care is assured if the annual real rate of return (that is, the return on the principal over and above the rate of inflation) offsets the cost of site upkeep. A portion of the bond could be used to correct major site deficiencies or to offset damages caused by leachate runoff or migration. Sufficient funds would have to remain on deposit to provide for annual site upkeep subsequent to such expenditures. If a change in site operators occurs before site closure, then the former site operator should be allowed to withdraw the bond's principal and the new operator required to deposit an equivalent amount.

Perpetual Care Fee

An alternative to the required bond deposit is assessment of a perpetual care fee on each user of the waste facility. The user surcharge would be fixed on a volumetric basis. Site operators should not allow this fee to vary with the type of incoming waste. The aggregate fees are deposited in an account, and when a level sufficient to maintain long term care of the site has been reached (including accrued interest), the fee may be discontinued. (Of course, the fee may be calculated such that the desired fund level will not be reached until the site is full.) The major drawback to this method of financing long term site care is that the operator can cease site operations without having accumulated a fund large enough to assure adequate site closure and perpetual care.

Bonding/Fee Combination

Either a cash or surety bond can be combined with a perpetual care fee to provide for perpetual site care. A cash bond deposited with the State could be withdrawn when an equivalent amount accumulated through aggregate perpetual care fees had been deposited by the site operator. Alternatively, a surety bond, equal to the difference between the apparent required sinking fund and the expected size of the sinking funds for that year (that is, the cumulative perpetual care fees plus the accrued interest), could be required of the site operator. The apparent required sinking fund would be a site-specific reserve sufficient to provide funds for routine maintenance, surveillance, and monitoring costs, as well as contingency funds in the event of major site repair. In essence, this method of assuring long term site care would require the site operator to purchase declining term insurance to protect the State against early close-out of site operations.

Mutual Trust Fund

Rather than accumulate a perpetual care fund for each disposal site, a mutual trust fund could be developed for all sites within a given jurisdiction, for example, within a State. This proposal could be funded by any of the foregoing mechanisms. The trust fund would provide a larger reserve to cover unexpected site repairs or damage claims. Also, due to the pooling of the risk of major site repair, the contingency reserve required of each site operator would be less than that needed if a separate sinking fund were maintained for each site. Private operators might not be as careful in site construction and maintenance if they were not directly liable for these costs, however. The enforcement agency would have to provide the incentive for continued site care.

FUTURE LAND USE OF CLOSED FACILITIES

The State should require that the use of a site for a hazardous waste management facility be recorded on the deed to the property. This information is necessary to prevent future improper uses of the land. After use as a land disposal facility, the site should not be an area zoned for commercial or residential construction. Construction of any structure on the site should be limited to only those areas where waste was not disposed of. The use of the site for a recreational area or park may be the best use for the land. However, the location of the facility in a highly industrial area may limit the appeal of such a recreational facility. In the planning stages of the hazardous waste management facility, the State decision makers should decide if future land use restrictions will be necessary in the context of what uses of the land can serve.

Chapter 8

WASTE SAMPLING AND ANALYSIS METHODS AND LEACHATE ANALYSIS METHODS

This chapter surveys the presently known methods needed to sample and analyze the wastes placed in landfills and to sample and analyze any leachate that may come out of the land disposal sites. Both types of sampling and analysis are required in fulfilling a comprehensive hazardous waste management plan: 1) to ultimately determine the proper disposal methods for the waste and 2) to determine (from the leachate) whether a disposal site is operating properly as far as health and environmental effects are concerned.

WASTE SAMPLING METHODS

The cornerstone of any viable waste management system is the procedure used to retrieve those samples that are analyzed to determine how the waste should be managed. Unless the sample taken is representative of the waste material as an aggregate, the information extracted from the sample will be misleading. The need for standardized sampling procedures is obvious, but unfortunately, most discussions of waste sampling merely discuss the problems involved in a general manner, without giving specifics on how to deal with these problems, or descriptions of particular sampling procedures.

There are methods presently being employed, however, for sampling waste products and also for sampling materials with consistencies similar to waste products that can be adapted for use in waste sampling. These methods are of primarily two kinds: those that can be used for fluids and those that can be used for granular nonfluid materials. Examples of the former include the California Department of Health's Coliwasa sampler and the oil thief for nonviscous fluids [see American Society for Testing Materials (ASTM) Standard D270-23]. Examples of the latter include soil augers (see ASTM Standard D452-19) and grain sampling triers.

There is still a need, however, for validated, standardized step-by-step waste sampling protocols. Several organizations are presently working on developing such protocols. It is unlikely that a single waste sampling protocol will emerge from these concurrent efforts, since different waste types may well require different procedures. At this point, it is apparent that the methods evolved will contain the following elements:

- A method of obtaining either a continuous vertical sample or many different point samples on the vertical axis.
- Specifications as to when a stream is to be tested (that is, beginning of process, after process, randomly, etc.).
- Separate procedures for different physical characterizations of the waste (and possibly a procedure for determining that characterization or state).
- Methods of sample preservation.
- Protocal to avoid cross-contamination by residues left in the sampler.

Very few specific sampling protocols have been developed.

WASTE ANALYSIS METHODS

The analysis of waste materials is complicated by the following factors. The composition of waste constituents often ranges over a wide variety of chemical types and over many orders of magnitude of concentration. The presence of other constituents in a sample under analysis can introduce interference.

Since wastes often contain many of these other constituents, it is very difficult to compensate for their presence in the interpretation of the analytical data. Also, most wastes are not in a physical form or state that is amenable to analysis. For a standard analytical methodology to be prescribed, the wastes must be in some sort of "standard state." For this reason, significant amounts of pretreatment are often required before analysis can begin. The following is a discussion of how various organizations are addressing the problem of waste analysis.

The United States Environmental Protection Agency does have recommended procedures for waste analysis; these are contained in the "Manual of Methods for Chemical Analysis of Water and Wastes" (Reference 1). It is recognized that these methods are not applicable to the analysis of all waste streams, and the Agency is researching analytical methods for wastes.

The Federal Republic of Germany has a handbook entitled "German Standard Procedures for Analysis of Water, Effluent, and Sludge" (Reference 2) which addresses the problem of waste analysis. A short summary of those sections pertinent to waste analysis are presented here:

- *Determination of Water Content and Dry Residues.* This is a procedure for preparing a dry residue of the waste by evaporation (including the removal of most water of crystallization from wastes with high inorganic content).
- *Determination of Loss on Ignition of Dry Residue.* The method described is a measure of organic content. The method is an ashing procedure (run at 550°C) and has some interference from water of crystallization, magnesium carbonate releasing carbon dioxide, and organics which volatilize slowly at this temperature.
- *Determination of Hydrogen Ion Concentration (pH Value).* The method described employs a pH meter, and describes sample preparation and handling as well as meter calibration, and possible interferences (that is, fats and oils). In this treatment, it is recommended that the test be run as soon after sampling as possible to prevent gas exchange (pH can, to a large extent, be a function of carbon dioxide concentration).

Not yet contained in the German Standard Method are standard analytical procedures for free cyanide or total mercury. These are available in preprint and are summarized as follows:

- *Determination of Total Cyanides.* Detection by the German Standard Method, D13, Part 1 (total cyanides) *7th* Serial, Verlog Chemie GmbH, Weinheim/Bergstor).

This method detects most CN groups including metal cyanides, and various cyanocomplexes, such as with iron. (The cobaltcyanide complex is only partly decomposed by the method and, therefore, not totally detected.) The method is applicable for cyanide concentrations up to 100 mg/liter. Both a volumetric and a photometric method are described. The photometric method is more sensitive, but also is more susceptible to interference from reducing agents.

A rapid field-test method for cyanide analysis in wastewater is described by J. Bertlisg (Haus der Technik - Vortragsveroffentlichung No. 283). This method can be used in samples containing from 1 to 100 mg/liter of easily liberated cyanides. In this method, hydrogen cyanide is liberated by mixing the waste with acidic solution. Detection is by visual colorimetric means. The liberated HCN is seen in a standardized test tube (Hg Cl2/methylred). Interference is caused by free chlorine; this, however, can be overcome by using a reducing agent such as sodium arsenite beforehand.

The 'Analytical Chemistry' Working Group of the Caucus on Waste Disposal of the Lander (LAG) has proposed analytical techniques for the determination of cyanides in water samples, and it is working on techniques for the determination of heavy metals in solid wastes.

- *Detection of Mercury.* In order to determine mercury content, organically bound mercury must be transformed into inorganic mercury. In this procedure, intense UV radiation in an acidic, oxidizing medium, is used to accomplish this transformation. This method is suitable for all types of wastewaters, and for mercury concentrations from .05 to 10 g/liter. The method of detection is atomic absorption, utilizing a hollow cathode lamp as a radiation source.

Another important aspect of waste sample pretreatment is elutriation of the waste followed by analysis of the elutriate for various chemical species. The "leaching" of a waste by the various waters with which it comes into contact is one of the primary vectors of pollution from land disposal. Therefore, this type of waste sample pretreatment is very appealing, since the elutriation process can be thought of as a leaching process. Some leaching or elutriation tests attempt to mimic natural leaching processes, while others simply attempt to indicate whether there is a "potential" for leaching for a particular waste and do not attempt to recreate in the elutriation solvent physical parameters identical to the natural leachate.

The Federal Republic of Germany has such a pretreatment procedure. It does not attempt to reproduce the exact parameters of natural leachate, but only serves to determine if various chemical species may dissolve when the waste is in contact with water.

The following is a general outline of the procedure. The waste is separated into a liquid and solid phase by centrifugation or filtration. The filter residue (or solid phase) is mixed in a 1:10 ratio with distilled water and vigorously shaken or stirred for 24 hours. As the agitation is proceeding, electrical conductivity measurements may be taken to determine whether solubility equilibrium has been reached. This mixture is then filtered and standard water analysis methods are used on both the original liquid filtered off and the filtrate from the elutriation process.

Also, performance of multiple elutriations may be desirable both to simulate natural processes and to distinguish between the following situations:

- Wastes containing contaminant species with such a high solubility or which occur in such minute quantities that they are leached quantitatively in the course of the initial elutriation.
- Wastes containing species with such low solubility, or in such a large quantity that they become dissolved only partially in the initial dilution.
- Wastes with contaminants which show changes in behavior, when they come into contact with the leachate.

It is important to distinguish between these various waste types for operational management purposes. The technique of multiple elutriation involves repetitive dehydration and filtration followed by elutriation with fresh solvent. Each resultant elutriate is analyzed separately.

Finally, the solubility of contaminants in a waste under conditions of various pH's may be of interest. Wastes may come into contact with waters of pH's other than neutrality due to dissolved CO_2, actions of other wastes, the presence of biological byproducts of waste degradation, etc. Depending on the interest of the experimenter, the elutriate test may be run using .1 N hydrochloric acid, .1 N sodium hydroxide, or water saturated with carbon dioxide substituted for distilled water.

There is at present no official Federal elutriation method for wastes. The State of Texas, however, has recommended the following elutriate test, promulgated by the State Water Quality Board.

Solid Waste Evaluation Leachate Test

1. A 250 gm. representative sample of the "dry" material should be taken according to the Association of Official Analytical Chemists or the American Society of Testing and Materials Standard methods and placed in a 1500 ml Erlenmeyer flask.
2. One liter of deionized or distilled water should be added to the flask and the material stirred mechanically at a low speed for 5 minutes.
3. Stopper the flask and allow to stand for 7 days.
4. Filter the supernatant solution through a 45 micron glass filter.
5. The filtered leachate from step 2 should be subjected to a quantitative analysis for those component or ionic species determined to be present in the analysis of the waste itself.

Note: Triplicate samples of the waste should be leached in order to obtain a representative leachate.

The U.S. Environmental Protection Agency is presently doing research on the development of a standard elutriate (leachate) test, as are other organizations such as American Society for Testing

Materials (ASTM) and American Petroleum Institute (API).

Summary

Extensive separation is often required before wastes can be analyzed, and the interpretation of the analytical data is often ambiguous. Unless the analyst has some fairly good idea as to what organics are present in the waste, presently available methods are too expensive and time consuming to be of use in routine waste analysis.

Elutriate tests presently being used are not comparable to natural leaching action. Natural leachate solubilizes waste components because of many physical parameters of the leachate including pH, dielectric constant, organic content (which can act as chelating agents, buffering agents, etc.), temperature, redox potential, and others. Also, standard infiltration and centrifugation methods must be developed. Leachate analysis can suffer from different interferences and matrix effects (due to high organic content, turbidity, etc.) than those of wastewater and waste analysis.

LEACHATE ANALYSIS METHODS

The leachate resulting from the land disposal of wastes can contaminate ground and surface water, causing environmental damage and a hazard to health. It is frequently necessary to analyze this leachate for various hazardous contaminants. Unfortunately, the chemical analysis of leachate is not as straightforward as the analysis of most aqueous samples with which the analytical chemist is familiar. These leachates contain a large variety of constituents whose concentrations vary over a wide range. These factors cause interference, and necessitate extensive pretreatment procedures, making the interpretation of the analytical data ambiguous. This interpretation can be further muddied by the significant chemical and biological changes that may occur within the leachate during sampling, transportation, and storage. For these reasons and others, it is difficult to develop standard procedures for leachate analysis. The procedures cited here are not infallible, but are presently being used in leachate analysis, and in some cases have been endorsed by particular organizations.

The analytical procedures discussed will be for those contaminant species for which drinking water standards exist (Table 11) and for purposes of this discussion, have been separated into two classes, the metallic and the nonmetallic species.

Metallic Species

The two most widely utilized methods for heavy metal determinations are colorimetric spectrophotometry and atomic absorption spectrophotometry (A.A.).

In A.A., a metal atom is volatilized (usually by means of a flame). A beam of monochromatic (single wavelength) electromagnetic radiation is passed through this gaseous sample. The radiation is specific for a transition of the metal from the ground state to an excited state. Since most of the atoms will be in the ground state, much of this energy will be absorbed, hence the name atomic absorption. The beam continues on to a photoreceptor. The amount of absorbance is used as an index of metal concentration.

Like A.A., colorimetry is an absorption technique. The observance of the species depends upon its ability to coordinate with some highly conjugated organic molecule (for example, diphenyl carbazide) so that it has a molecular orbital transition (as opposed to an atomic orbital transition for A.A.) in the visible range. A beam of visible radiation is passed through the sample (the chromatics being controlled and changed by a filter, grating or prism) and the amount of absorbance is recorded. Since we are dealing with visible radiation, visual colorimetry is possible. In this technique, known standard solutions are prepared and the unknown solution is visually matched to see which standard it most closely resembles [with respect to color (shade)]. This visual method is a less precise, less reproducible method than the instrumental. It requires that many standards be accurately made and remade, since many have a finite lifetime. The results are often qualitative and depend on the experience and expertise of the operator. The advantages are that it is considerably cheaper than any instrumental method and can be done in the field, if no extensive sample workup is necessary.

Colorimetry, in general, requires more sample pretreatment than A.A. The advantage conferred by the ability in colorimetry to perform multiple species scanning without changing the radiation source (as is required in A.A.) does not compensate for the strong interferences to which colorimetric methods are subject. This is especially valid given the often

TABLE 11

METHODS FOR ANALYSIS OF LEACHATE FOR SUBSTANCES COVERED BY DRINKING WATER STANDARDS

Metallic Species	Atomic Absorption	Instrumental Photospectro-scopy	Visual Color-imetry	Polar-graphic	Wet Analysis
Arsenic	Yes (A)	Yes (A, B)	No	No	No
Barium	Yes (A, B)	No	No	No	No
Cadmium	Yes (A, B)	Yes (A, B)	No	Yes (B)	No
Chromium	Yes (A, B)	Yes (A, B)	Yes (B)	No	No
Lead	Yes (A, B)	Yes (A, B, C)	No	Yes (B)	No
Mercury	Yes (A, B)	No	No	No	No
Selenium	Yes (A)	Yes (B)	No	No	No
Silver	Yes (A, B)	Yes (A, C)	Yes (C)	No	No

Non-Metallic Species	Gas Chromato-graphy	Instrumental Spectrophotometry	Wet Analysis	Visual Spectro-photometry
Aldrin	Yes (A, B)	No	No	No
DDT	Yes (A, B)	No	No	No
Dieldrin	Yes (A, B)	No	No	No
Cyanide	No	Yes (A, B)	Yes (A, B)	No
Nitrate (as N)	No	Yes (A, B)	No	Yes (B)

(A) EPA Method of Choice
(B) Standard Methods Recommended
(C) Standard Methods Tentative

complex nature of the leachate matrix.

Procedures. The methods endorsed by EPA for heavy metal determination in "Methods for Chemical Analysis of Water and Wastes" (Reference 1) and the methods endorsed by "Standard Methods for the Examination of Water and Wastewater" (Reference 2) are outlined in Table 11.

A.A. Analysis. There are several types of A.A. spectrophotometers that are commercially available, with different options for radiation source and sample volitalization technique. The two types of radiation sources available are the hollow cathode lamp, and the electrodeless discharge lamp (EDL). EPA recommends the single element hollow cathode lamp (Reference 1). This is the most widely used radiation source and the most familiar to analysts. The electrodeless discharge lamp is more expensive, however, its use may be indicated for selenium and arsenic determination. The EDL's are both brighter than the corresponding hollow lamps and more long lived for these elements.

The sample atomizer may well be the most important component of the A.A. spectrophotometer, especially in leachate analysis, given its potential for high organics content. There are two types of sample atomizers commercially available: flame, and furnace (and other flameless). Flame A.A., as the name suggests, produces this vapor by means of a graphite cylinder that is heated by an electric current.

The most widely used and best documented method is flame A.A. This technique is the least expensive of the three. The method works well for all the contaminants of interest except selenium and arsenic. There is spectral interference by the flame gases for the major resonance lines of these elements. Furnace A.A. does not produce this interference and has been used successfully for the detection of selenium and arsenic (arsenic and selenium can also be generated by use of the gaseous hydride method (References 1 and 2)). There are several types of each of these general methods. Flame A.A., for example can be either total combustion or premixed, and each of these types has advantages and disadvantages.

A related instrumental method is emission spectroscopy. This relies on atomic emissions rather than absorption for the detection of metal ions. There are commercially available plasma emissions spectrophotometers that analyze for up to 20 elements simultaneously. This instrument operates in the following manner: The liquid sample is sprayed into a very hot ionized argon gas (plasma) which causes the sample to break down into elements. In the 8000-K heat, the elements emit light. The wavelength of light always appears at the same location of the spectrum. Photomultiplier tubes, which detect light and convert it to electricity, are placed at the locations along the spectrum where light will be produced when any of the elements being sought are present. A computer can identify the element from the concentration from the intensity of the light. In designing the instrument, one wavelength that would be unlikely to be produced to any great extent by other elements samples was chosen for each element. The small interferences that do exist are taken into account in a computer program before the results are printed out.

Plasma R.F. is a relatively new technique and the results using this technique by different investigators seem inconsistent. Also the equipment necessary is at least an order of magnitude more expensive than what is necessary for A.A. Plasma emission and the two A.A techniques are compared in Table 12. (This comparison merely comments on the general tendencies of the methods. Each type within the method may exhibit the advantages or disadvantages cited to a greater or lesser degree depending on the equipment and procedures used.)

Specific procedures for the determination of the metallic species in Table 11 (both colorimetric and atomic absorption) can be found in References 1 and 2. It must be stressed, however, that these procedures were not specifically developed for the analysis of leachate, but for the analysis of wastewater, and that the complexity of leachate composition often introduces interferences and error into these methods. EPA has recently published a "Compilation of Methodology Used for Measuring Pollution Parameters of Sanitary Landfill Leachate" (Reference 3) which evaluates these methods as they are applied to leachate analysis. This reference points out some of the difficulties which may arise and how to address these problems.

A final analytical method (for selenium) is recommended in the seminar proceeding reports of "Procedures for the Analysis of Landfill Leachates" sponsored by the Canadian Environmental Protection Service and is found in Reference 4.

Nonmetallic Species

Due to the complexity of organic and other nonmetallic species, analysis for these species is much more complicated. The instrumental methods presently available for this type of analysis are: chromatography (thin-layer, column, and gas liquid), and colorimetric (spectrophometric and filter photometric). There are also wet analysis methods available. Table 11 illustrates what methods are available for each species.

All the methods except chromatography have been discussed in the previous section on the analysis of metals. Chromatography is a general technique for separating or concentrating one or more components from a physical mixture. It consists of two phases, a moving phase and a stationary phase. The moving phase contains the species of interest along with other species and a solvent (either liquid or gaseous). The species in the moving phase are dissolved or absorbed into the stationary phase (which is usually a solid support with a liquid absorbed on it). The species that are more soluble (in the liquid of the stationary phase) spend more time in the stationary phase and hence become more displaced than the less soluble species which spend more time in the moving phase. This displacement is the basis for separation and ultimately detection of the various species. This technique can be an instrumental gas liquid chromatography (glc) or a wet technique (column or thin layer), but all three have their basis in the above physical principle.

Methods and procedures for the determination of the nonmetallic species in Table 11 can be found in References 1 and 2. Again Reference 3 can be used as an invaluable aid since it takes these standard methods for wastewater and evaluates their utility for leachate analysis.

In the proceeding report of the "Procedures for the Analysis of Landfill Leachate" (Reference 5), the following alternative method and observations were

TABLE 12
COMPARISON OF ALTERNATIVE METHODS FOR ANALYSIS

Flame		Flameless (Furnace)		Plasma	
Advantages	Disadvantages	Advantages	Disadvantages	Advantages	Disadvantages
· Least expensive	· Not recommended for As or Se.	· Better than flame for atomization when matrix is complex.	· Technically not as well documented as flame.	· Can operate on multichannels, up to 23 elements can be analyzed at once.	· Technically these are the least well known and documentation is scant.
· Best documented	· Small percentage of atomic vapor concentration available.	· Better able to dissociate metal oxides than flame.	· Must use standard addition technique. (Standard addition technique is also recommended for flame A.A.)	· Thermal energy available is the largest: 10,000 Kcal, so that all oxides are dissociated.	· Most complex and expensive.
· Most chemists are familiar with procedures.	· Longer memory of previous samples (esp. in pre-mix type).	· Can be used for As or Se. · Little or no ionization effect.	· Sample injection is in ul. range, so that final reliability of data may be limited by errors inherent in reproducing these small volumes. · All laboratory apparatus must be ultra clean. · Takes longer than flameless.		· Application is limited to those metals which do not readily atomize.

reported as being used in leachate analysis of the indicated species.

Cyanide - analyzed as in Reference 6.

Nitrates as N - The cadmium reduction methods in References 1 and 2 are recommended. The samples generally require pretreatment to remove turbidity, and the cadmium column may have a short life if oil and grease are not removed from the sample.

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Chapter 9

STATE PROGRAMS FOR HAZARDOUS WASTE MANAGEMENT

This chapter describes the recommended goals of a State hazardous waste management program, and discusses the elements which would make such a program effective and the phases of developing a State program.

GOALS

The major goals of a State hazardous waste management program may be summarized in the following way: cognizance, control; capability; alternatives; and *prevention*.

- *Cognizance*-The State should assure itself that it has cognizance over the quantities, sources, types, destinations, and disposition of hazardous wastes within its borders. This includes wastes which are generated within the State and which never leave, but it should also include wastes which are imported into or exported from a State to other States. This cognizance is a necessary precondition to understanding the nature and dimensions of the hazardous waste problem in any State, and to planning the solutions to it.

  The State can assure that it has cognizance over hazardous waste through two devices: conducting a survey to establish baseline data; and, instituting reporting and monitoring systems that allow the State to remain current at all times. Conversely, the State cannot expect to manage hazardous waste adequately without basic information on what wastes are being generated and where they are going.
- *Control*-The State should establish control over hazardous wastes for the entire life cycle of those wastes. EPA has long advocated "cradle-to-grave" control, which means that the State should control the storage and transportation of hazardous wastes, as well as their treatment and disposal. EPA does not advocate the "control" of generation, nor does it require generator permitting; the State can best assure "cradle-to-grave" control by requiring sufficient generator reporting to give the State cognizance over the existence of hazardous wastes, thus allowing the State to monitor those activities it does control (storage, transportation, treatment, and disposal).
- *Capability*-The State should seek the capability to provide technical assistance to those requesting it, and to monitor and enforce its regulatory program. This may be expressed primarily as personnel resources, but must be seen as more than establishing a large staff. The mix of skills must allow the State to deal with problems of chemistry, engineering, geology, and hydrology, to name only four areas.
- *Alternatives*–A major goal should be to offer alternatives to those practices the State determines to be inadequate or unacceptable. The provision of alternatives includes an opportunity for the private sector to respond to a State's new regulatory climate, which presumably will be more favorable to those seeking to provide the service of hazardous waste treatment and disposal. The concept of alternatives also includes a determination by the State as to which existing facilities are adequate for hazardous wastes. This would allow the

State to prevent hazardous wastes from being landfilled at one location, while at the same time identifying an area where the wastes could be taken. The State may otherwise find itself preventing the use of the only available treatment or disposal practices, sites, or facilities.

- *Prevention*–Prevention of damage to the public health or environment should be the central goal of any State hazardous waste management program, as it is for the Federal program.

ELEMENTS OF AN EFFECTIVE STATE HAZARDOUS WASTE MANAGEMENT PROGRAM

An effective State program ought to have the following elements:

- Legislative Authority
- Adequate Resources
- Published Criteria and Standards
- Established Permit Mechanisms
- Transportation Manifest System
- Surveillance and Enforcement Functions

Each of these is an essential element in an effective State hazardous waste management program. An effective program will probably involve functions and responsibilities beyond those listed above, but the omission of any of them would severely hinder the State program.

Legislative Authority

Many States will find their existing authorities inadequate for establishing a hazardous waste management program, and will have to seek new legislation for this purpose. EPA does not require new legislation in order for the State program to be authorized. EPA's expectation is rather that the State have (or seek) legislation which authorizes the implementation, administration, and enforcement of an effective program. This should include authority to issue permits for storage, treatment, and disposal, to require a transportation manifest system, to require the keeping of records and the submitting of reports, to conduct inspections and take samples, to establish criteria and standards for storage, treatment, and disposal, and to institute enforcement proceedings against violators.

Some States that have this type of legislation for water or air pollution control may be able to use those other authorities for managing land disposal. The existence of sufficient authorities in other areas of environmental management does not, however, guarantee that those authorities are applicable to hazardous waste management on the land.

State legislation should not exclude those who treat or dispose of their own wastes at the site of generation ("onsite disposal"). This is a potentially large loophole, and one of which the States should be aware. Failure to include onsite hazardous waste management activities would leave a significant portion of the problem unregulated.

Adequate Resources

A State program cannot be considered effective where the State does not commit sufficient resources to administer and enforce an otherwise approvable program. States must base the judgment as to the effectiveness of their programs upon an assessment of the actual performance to be expected, a judgment largely dependent upon the resources a State invests. The term 'resources' includes both personnel and dollars. The former would be assessed in terms of numbers of people assigned to specific tasks, as well as in terms of the mix of skills and the usefulness of that mix for the administration and enforcement of a hazardous waste management program.

The other category of resources (dollars) includes considerations such as the adequacy of laboratory analysis facilities (or services), the availability of data processing facilities (or services), and the availability of appropriate surveillance and monitoring equipment.

Published Criteria and Standards

An effective State program should have adopted and published criteria and standards for the storage, treatment, and disposal of hazardous wastes, for the transportation of hazardous wastes, and for the non-process aspects of generation of hazardous wastes (e.g., reporting, recordkeeping). EPA neither recommends nor expects that each State will invest significant amounts of its own time or resources in repeating the developmental work performed by EPA or other State agencies. Each State should review the Federal standards, and those of authorized State programs, with an eye toward adopting similar or identical criteria and standards for themselves. States will necessarily alter certain criteria and standards adopted by other jurisdictions to account for unique circumstances or conditions, but EPA encourages States to seek the greatest possible agreement of each State's standards with those of the Federal program, and with those of authorized State programs.

Established Permit Mechanisms

No State program should be considered "effective" unless it has the capability to issue and enforce permits for the storage, treatment, and disposal of hazardous wastes. The permit function is central to the administration and implementation of the Act. Consequently, an effective State program should include the administrative framework to identify and notify those who must apply for permits; to process applications for permits; to monitor renewal and expiration of permits; and to monitor compliance with the terms and conditions of permits.

Surveillance and Enforcement

The State should demonstrate both the willingness and the ability to assure that the program it has developed is being implemented. This requires the State to make inspections and to take samples from those who are managing hazardous wastes, and to require that prescribed practices for reporting, record-keeping, and labeling (to name only three) are being followed. It further requires that those who are violating the law be prosecuted, and that the State be able to suspend or revoke permits, and impose fines which are sufficient to deter other would-be violators. Consequently, a State program which did not include surveillance and enforcement provisions should not be considered "effective."

Manifest System

Section 3002(5) of the RCRA directs that EPA require the use of a manifest to assure that hazardous wastes which leave the site of generation are taken only to permitted storage, treatment, or disposal sites. This requirement is based upon the experience or expectations of several States which believe the manifest to be an essential element in managing hazardous wastes, a belief which EPA shares. The State will not be able to effectively control hazardous wastes by regulating only the treatment and disposal sites. The "cradle-to-grave" concept implies knowledge of the existence and movement of hazardous wastes throughout their life cycle.

An effective State program will necessarily include, therefore, a manifest system. The form used, and specific information required, should be consistent and compatible with the manifest developed for the Federal program, and with those in use in other authorized State programs.

PROGRAM DEVELOPMENT PHASES

The State should expect to go through two distinct phases in developing an effective hazardous waste management program: These may be called "Development and Implementation" and "Operational" phases. The first phase can require from 1 to 3 years, while the second phase encompasses everything thereafter.

During the "Development and Implementation" phase, the State should develop procedures; develop and promulgate standards, criteria, and guidelines; obtain staff members, and emphasize training of both the regulatory staff and of the regulated community (in the sense that the regulated community should be made familiar with the requirements of the new program).

The "Operational" phase will see the State beginning its emphasis on enforcement, surveillance, and monitoring activities. During this phase, the State should allocate about 75 percent of its personnel resources to the above activities; the remaining 25 percent will be used to continue the developmental tasks, and for administration and management. This is in contrast with the initial phase, in which about 10 percent of the available resources may be expected to go to administration and management, with the remaining 90 percent going to development of the program.

A second contrast between the two phases is in the importance of field work. The State should give field investigation and surveillance activities a lower priority than in-house tasks during the developmental stages of the program, but should reverse this ordering of priorities in the operational phase.

Appendix A

MODEL STATE HAZARDOUS WASTE MANAGEMENT ACT WITH ANNOTATION

Recent Federal and State environmental management legislation has addressed the quality of our air, our water, and our oceans. One result of this legislation has been to curtail the disposal of potentially hazardous materials into these media, thereby improving the quality of our air, water, and marine resources. But there has been a second result: potentially hazardous wastes continue to be generated which can no longer go to other media, so they are placed on or into the land. The 375 million tons of industrial wastes generated in the United States in 1974 included about 30 million tons of potentially hazardous wastes.

New Federal legislation, the Resource Conservation and Recovery Act (RCRA) (P.L. 94-580), controls the disposition of potentially hazardous wastes on land. Congress made clear that Federal and State partnership is intended for the implementation of this new pollution control program. Regulatory provisions of the new Act are scheduled to take effect in October 1978. States should begin to develop their own control programs now.

An essential element in any State hazardous waste management program is the enabling legislation. In some cases, existing legislation authorizes parts of what would constitute the State's program; in other cases, existing legislation may be reinterpreted in such a way as to cover some of the threats posed by the mismanagement of potentially hazardous wastes. Most States, however, will find that an effective program requires new legislation explicitly delineating the obligations and responsibilities of those who generate, store, transport, treat, or dispose of these wastes; but even here, States should consider the possibility of supplementing existing solid waste legislation with the appropriate hazardous waste management authority. Whether or not the State develops a separate hazardous waste management act, the State must obtain adequate legislative authority to develop and implement its program.

This document includes a text and annotation. The latter is intended to explain the reasons for including certain phrases or ideas, or for choosing one or another among various options, and to highlight potential difficulties in interpretation or implementation of the text. Further, this document is intended to show the reader the kind of legislative authority the State may find useful in developing an effective hazardous waste management program. Readers should not construe this Model Act as showing what EPA will consider to be an "equivalent" State program, or as setting out the criteria against which applications for authorization under Section 3006 of RCRA will be judged; the Model Act is not so intended.

MODEL STATE HAZARDOUS WASTE MANAGEMENT ACT

SHORT TITLE

Section 1

This Act may be cited as the Hazardous Waste Management Act of 19

FINDING OF NECESSITY AND DECLARATION OF PURPOSE

Section 2

(A) The legislature of this State finds:

(1) that continuing technological progress, increases in the amounts of manufacture, and the abatement of air and water pollution have resulted in ever-increasing quantities of hazardous wastes;

(2) that the public health and safety, and the environment are threatened where hazardous wastes are not managed in an environmentally sound manner;

(3) *that the knowledge and technology necessary for alleviating adverse health, environmental, and aesthetic impacts resulting from current hazardous waste management and disposal practices are generally available at costs within the financial capability of those who generate such wastes, but that such knowledge and technology are not widely used; and*

(4) *that the problem of managing hazardous wastes has become a matter of State-wide concern.*

(B) *Therefore, it is hereby declared that the purposes of this Act are:*

(1) *to protect the public health and safety, the health of living organisms and the environment, from the effects of the improper, inadequate, or unsound management of hazardous wastes;*

(2) *to establish a program of regulation over the storage, transportation, treatment, and disposal of hazardous wastes; and*

(3) *to assure the safe and adequate management of hazardous wastes within this State.*

DEFINITIONS

Section 3

When used in this act:

(A) *The term, Department, means the Department of this State charged with the administration and enforcement of this Act.*

(B) *The term, Disposal, means the discharge, deposit, injection, dumping, spilling, leaking or placing of any hazardous waste into or on any land or water so that such hazardous waste or any constituent thereof may enter the environment or be emitted into the air, or discharged into any waters, including groundwaters.*

(C) *The term, Generation, means the act or process of producing waste materials.*

(D) *The term, Hazardous Waste, means any waste or combination of wastes of a solid, liquid, contained gaseous, or semisolid form which because of its quantity, concentration, or physical, chemical, or infectious characteristics, in the judgment of the Department may (1) cause, or significantly contribute to, an increase in mortality or an increase in serious irreversible or incapacitating reversible illness; or (2) pose a substantial present or potential hazard to human health or the environment*

DEFINITIONS

Section 3

The definitions have been worded so as to be consistent with the new Federal solid waste legislation.

(B) "Disposal"–This definition is taken from the RCRA, (P.L. 94-580). The definitions of disposal and storage taken together mean that the traditional landfill can be construed as disposal if there is any leaching or other discharge; a non-leaching landfill, however, would be considered storage (albeit very long term). The rationale for this is partly to increase awareness that one has not done away with hazardous constituents by simply putting them into the ground. Where there is no discharge or emission, the hazardous waste has been retained in one place and requires monitoring and/or care–hence "storage."

(D) "Hazardous Waste"–This definition is consistent with that in RCRA, (P.L. 94-580). EPA recommends that enabling legislation contain a generic definition, and that it not contain specific criteria, lists, or wastes. The definition should instead give generic examples of hazardous wastes, such as ". . . including, but not limited to, toxic, flammable, etc. . . . ." The listing of *when improperly treated, stored, transported, disposed of, or otherwise managed. Such wastes include, but are not limited to, those which are toxins, corrosives, flammable materials, irritants, strong sensitizers, or materials that generate pressure through decomposition, heat, or other means.*

(E) *The term, Hazardous Waste Management, means the systematic control of the collection, source separation, storage, transportation, processing, treatment, recovery, and disposal of hazardous waste.*

(F) *The term, Manifest, means the form used for identifying the quantity, composition, origin, routing, and destination of hazardous waste during its transport.*

(G) *The term, Person, means any individual, trust, firm, joint stock company, corporation (including a government corporation), partnership, association, State, municipality, commission, political subdivision of a State, or any interstate body.*

(H) *The term, Storage, means the containment of hazardous wastes, either on a temporary basis or for a period of years, in such a manner as not to constitute disposal of such hazardous wastes.*

(I) *The term, Transport, means the movement of wastes from the point of generation to any intermediate points, and finally to the point of ultimate storage or disposal.*

(J) *The term, Treatment, means any method, technique, or process, including neutralization, designed to change the physical, chemical, or biological character or composition of any hazardous waste, so as to neutralize such waste or so as to render such waste nonhazardous, safer for transport, amenable to recovery, amenable to storage, or reduced in volume.*

(K) *The term, Treatment Facility, means a location at which waste is subjected to treatment and may include a facility where waste has been generated.*

POWERS AND DUTIES OF THE DEPARTMENT

Section 4

(A) *Within one year after the effective date of this Act, the Department shall conduct and publish a study of hazardous waste management in this State, which shall include, but not be limited to - -*

(1) *a description of the sources of hazardous waste generation within the State, including the types*

examples shows to the Department, the courts, industry, and the public, what the legislature intends the term, hazardous, to mean.

(H) "Storage"– This definition is similar to that in RCRA. If the State does not use the concepts of storage and disposal as they are used in RCRA (and in this paper), any substitute definition of storage must limit the duration for which a waste may be stored. One reason for this limitation is that indefinite storage, or storage for a long period of years, may otherwise become a way for generators to avoid the controls which the State exercises over disposal. A second reason is to avoid the enforcement problem of the possessor's intent. Where the State defines storage or disposal to include the concept of "intending to reuse or recover," or "intending to hold for future use," the State invites the difficulties attendant to proving intent. Third, the longer one stores a hazardous waste, the more closely one approaches the environmental effects and consequences of disposal. For all these reasons, where the more traditional definition of storage is used, it should include a phrase such as, "Storage in excess of [one year, for example] shall be considered disposal for the purpose of this Act."

(K) "Treatment Facility"–This definition explicitly includes onsite hazardous waste management. The law thus recognizes that the environmental threat is no less from those wastes managed at the site of generation than from those wastes managed anywhere else. It is for this reason that the State's regulation of hazardous waste treatment or disposal facilities must include regulating those who manage their own wastes at the site of generation.

POWERS AND DUTIES OF THE DEPARTMENT

Section 4

Subsection (A) directs the Department to conduct and and publish a study of hazardous waste management within the State. Inclusion of this requirement is intended partly to assist the Department in gathering information it needs, but which it may not have explicit authority to elicit under existing statutes.

and quantities of such wastes; and

(2) *a description of current hazardous waste management practices and costs, including treatment and disposal, within the State.*

(B) *Within 6 months after the publication of the study required by Section 4(A) of this Act, the Department shall develop and publish a plan for the safe and effective management of hazardous wastes within this State. Such plan shall include, but not be limited to - -*

(1) *identification of those locations within the State which are suitable for the establishment or disposal facilities or sites; and*

(2) *identification of those locations within the State that are not suitable for the establishment of hazardous waste treatment or disposal facilities or sites.*

(C) *Within 2 years after the publication of the study required by Section 4(A) of this Act, the Department shall, after adequate notice and at least one public hearing on the record, adopt, and may revise as appropriate - -*

(1) *criteria for the determination of whether any waste or combination of wastes is hazardous for the purposes of this Act;*

(2) *rules and regulations for the storage, treatment, and disposal of hazardous wastes;*

(3) *rules and regulations for the transportation, containerization, and labeling of hazardous wastes, which shall be consistent with those issued by the United States Department of Transportation;*

(4) *rules and regulations specifying the terms and conditions under which the Department shall issue, modify, suspend, revoke, or deny such permits as may be required by this Act;*

(5) *rules and regulations establishing standards and procedures for the safe operation and maintenance of hazardous waste treatment or disposal facilities or sites;*

(6) *a listing of those wastes or combinations of wastes which are not compatible, and which may not be stored or disposed of together;*

(7) *procedures and requirements for the reporting of the generation, storage, transportation, treatment, or disposal of hazardous wastes pursuant to Section 8 of this Act;*

The subsection specifies that the study must address the costs of current hazardous waste management practices. This allows the State to assign likely costs to its regulatory decisions, making possible an analysis of the economic consequences of many of the Hazardous Waste Management Act's provisions. This process is analogous to the Federal government's "Economic Impact Analysis" process for its own actions.

Subsection (B) requires the Department to identify locations suitable for hazardous waste treatment or disposal sites. This phrasing is not intended to preclude engineered sites. The Department should seek those locations which have been favored by geology, climate, and other relevant factors, and which offer natural protection to the environment; EPA recognizes, however, that there is a need for facilities in States, and sections of States, which have no suitable natural sites, and that this need can only be met through artificial devices which protect the environment. Where the soil does not meet acceptable standards of impermeability, for example, artificial liners may be substituted. This means that the Department should include those areas where a site is needed, but in which a site would have to be engineered to protect the environment.

Subsection (B) additionally requires the State to identify those parts of the State which are *not* suitable for the location of hazardous waste treatment or disposal sites. This decision, as well as the above decision that sites *should* be located in certain areas, must be based on a number of factors besides geology and hydrology. EPA encourages the kind of determination which results in certain areas being designated as "critical" or "sensitive" for ecological or other reasons, and in which the State would allow the location of hazardous waste treatment or disposal facilities with great reluctance and under especially high standards of design, construction, and operation. An example of such a "critical area" might be a major aquifer.

Subsection (C) (3) requires that the State rules and regulations for the transport of hazardous wastes be "consistent" with those of the U.S. Department of Transportation (DOT). This does not mean that States must adopt the DOT rules by reference or unchanged; however, where the State chooses to establish any rule or regulation for transport that is different from (including stricter than) DOT's, it will

(8) *rules and regulations establishing standards and procedures for the certification of supervisory personnel at hazardous waste treatment or disposal facilities or sites as required under Section 6(A) (3) (a) of this Act; and*

(9) *procedures and requirements for the use of a manifest during the transport of hazardous wastes.*

(D) *In complying with this Section, the Department shall consider the variations within this State in climate, geology, population density, and such other factors as may be relevant to the management of hazardous wastes.*

be incumbent upon the State to avoid conflict with the latter.

Subsections (C) (5) and (C) (6) are important for occupational health and safety, as well as for environmental protection. EPA has documented cases where an individual disposing of hazardous wastes has been injured or killed because of handling unmarked containers without the caution one would use were the containers prominently labeled to show their potential danger. Similarly, EPA has documented cases where the disposal of incompatible wastes (such as acids being disposed of with cyanide wastes) has resulted in injury or death. Subsections (C) (5) and (C) (6) are an important part of the State's effort to assure that those who handle hazardous wastes are fully informed as to the nature of the hazard, and as to the safest method of handling those wastes.

Section (C) includes a requirement for a "public hearing on the record." Readers should be aware that the use of this phrase will, in many States, trigger the use of an "Administrative Practices Act" or equivalent. This entails the advantages and disadvantages of a formal proceeding, including the keeping of a transcript, and so on.

Subsection (D) gives the Department an opportunity to recognize the differing regions within the State. Nevertheless, the Department must establish certain minimum standards above which the environment will be protected; it is in the process of determining how far above this minimum the State sets specific requirements that Subsection (D) comes into play.

PERMITS

Section 5

(A) *Beginning 6 months after promulgation of the regulations required under Section 4(C) of this Act, no person shall construct, substantially alter, or operate any hazardous waste treatment or disposal facility or site, nor shall any person store, transport, treat, or dispose of any hazardous waste without first obtaining a permit from the Department for such facility, site, or activity.*

(B) *Permits issued under this Section shall be issued under such terms and conditions as the Department may prescribe under the authority of Section 4 of this Act, and under such terms and conditions as the [appropriate State agency] may prescribe for the transportation of hazardous wastes under Section 7 of this Act.*

PERMITS

Section 5

The word "permit" has been used throughout this document to stand for the process by which the State can insure cognizance of, as well as control over, various activities. The provisions and requirements of each permit system should be explicitly stated in the regulations which implement the State Hazardous Waste Management Act; consequently, the reader should be aware that certain uses of the word "permit" here may refer to a license or registration concept, and need not imply the detailed criteria and compliance schedules attendant to the kind of permit issued under the Federal Water Pollution Control Act Amendments of 1972 (P.L. 92-500).

Subsection (A) requires a permit to construct, "substantially alter," or operate any hazardous waste

(C) *Permits shall be issued for a period not to exceed 5 years, and may be renewed at the option of the issuing agency.*

(D) *Any permit issued under this Section may be revoked by the issuing agency at any time when the permittee fails to comply with the terms and conditions of the permit, PROVIDED, no permit shall be revoked until the Department has provided the affected party with the opportunity for an adequate hearing, and with written notice of the intent of the Department to revoke the permit and the reasons for such revocation.*

(E) *Where the application for or compliance with any permit required under this Section would, in the judgment of the Department, cause undue or unreasonable hardship to any person, the Department may issue a variance from the requirements of this Section. In no case shall the duration of any such variance exceed one year; renewals or extensions may be given only after opportunity for public comment on each such renewal or extension.*

(F) *Beginning 6 months after promulgation of the regulations required under Section 4(C) of this Act, any person undertaking one of the activities for which a permit is required under this Section or under Section 7 of this Act, or violating any term or condition under which a permit has been issued pursuant to this Section or pursuant to Section 7 of this Act, shall be subject to the enforcement procedures of Section 11 of this Act.*

treatment or disposal facility. This poses at least two issues for the State to address: defining "substantially alter;" and, deciding whether construction and operation entail two separate permits.

The phrase "substantially alter" is intended to allow the State latitude in deciding what kinds or degrees of alteration change the environmental impact of a site enough as to make reassessment necessary. Neither the State nor the site operator wants to repeat the permit application and evaluation process each time there is a change to the site, no matter how trivial or irrelevant that change may be. Therefore, the State regulations should describe the circumstances under which an existing site would be required to apply for a revised or amended permit. The Model Legislation is purposely vague on the issue of separate versus combined permits for construction and operation. Some States issue a permit to construct, but require the permittee to apply for an entirely separate permit after construction to operate the site. Other States issue a single permit for the construction and subsequent operation of a site. The State should be explicit in describing which of these systems it is using.

Subsection (A) requires a permit to "store" hazardous wastes. As stated above, this use of the word "permit" is not intended to parallel the use of the word in the Federal Water Pollution Control Act, or even in other parts of this Model Legislation. The provision is nevertheless an important one. It is intended to control the environmental abuse from "storage" which is really "disposal," and which has the same (degrading) environmental result as improper disposal. Consequently, the State might require a permit from those who store hazardous materials in large, open areas (pits, ponds, lagoons) for some period sufficient to threaten the environment. The State should also use this provision to control the creation of large piles of tailings or mining residuals above the surface, as there are cases of such residuals remaining long after the generator has gone out of business or otherwise left the scene. Conversely, the State might not require permits of those who store small quantities in closed tanks awaiting shipment, or those holding residuals for short periods awaiting use or reuse.

The State should use the permits it does issue for storage as a source of information, so that the State is aware of, and can track, wastes through their life cycle, and as a way of preventing such abuses that might otherwise follow from the misnamed "storage" of hazardous wastes described here.

Subsection (A) explicitly applies also to generators that treat or dispose of their own wastes. This frees the State from having to allege that someone treating his own wastes at the site of generation is operating a treatment or disposal site; this Subsection renders such an issue moot, since anyone treating or disposing of hazardous wastes (including his own wastes, and including on his own property) may be required to use proper management practices.

Subsections (A) and (B) require permits for the transportation of hazardous wastes; as elsewhere in this document, however, the word "permit" is not intended to imply the kind of detailed criteria and compliance schedules attendant to permits under the Federal Water Pollution Control Act. (A number of States have elected to regulate the transporters of hazardous wastes, several through the use of a "trip ticket" or "manifest" system. These systems are described in the annotation for Section 7.)

Subsection (B) includes the phrase "appropriate State agency," a phrase which appears throughout the Model Law where the subject is the transport of hazardous wastes. Institutional arrangements and responsibilities for the transport of hazardous wastes vary widely from one State to another, making it impossible to generalize in a document such as this. The reader should distinguish, however, between the economic aspects of regulation (usually assigned to the State Public Utilities Commission or equivalent agency) and other aspects such as transportation safety (often assigned to the State Highway Patrol or equivalent agency). The Model Law addresses only the latter function; where the economic and safety aspects are divided between two agencies, all transport responsibilities specified in the Model Law would logically be assigned to the latter agency.

Subsection (C) suggests a term of 5 years for all permits. This figure is presented for example only and is admittedly arbitrary. The State should issue permits for a sufficient term so that investors will commit necessary funds, but not for a period which is so long as to obligate the State to continue an unsatisfactory situation any longer than it must.

Subsection (E) provides for variances. The State may choose to issue variances for durations other than

HAZARDOUS WASTE TREATMENT/DISPOSAL FACILITIES AND SITES

Section 6

(A) *No permit shall be issued to any hazardous waste treatment or disposal facility or site unless that facility or site meets such terms and conditions as the Department may direct. Terms and conditions shall include, but not be limited to - -*

(1) *Evidence of liability insurance in such amount as the Department may determine to be necessary for the protection of the public health and safety and protection of the environment;*

(2) *Evidence of financial responsibility in such form and amount as the Department may determine to be necessary to insure that, upon abandonment, cessation, or interruption of the operation of the facility or site, all appropriate measures are taken to prevent present and future damage to the public health and safety and to the environment;*

(3) *Evidence that the personnel employed at the hazardous waste treatment or disposal facility or site have met such qualifications as to education and training as the Department may determine to be necessary to assure the safe and adequate operation of the facility or site:*

(a) *Persons charged with the direct supervision of the operation of any facility or*

12 months; the figure used in this Model Legislation is for example only.

The State should also decide whether variances may be renewed, and, if so, how many such variances may be given to one applicant or permittee. This decision must take into account the environmental effects of variances, since continued noncompliance with minimum standards creates no less a problem for being sanctioned by the authority of a variance. Balancing this is the realization that many factors may militate against immediate closure of a permittee who can be brought into compliance within a finite period if allowed to continue to operate. The Model Law includes a requirement that the public be allowed to comment on any renewal or extension of a variance. This is intended to make explicit the State's authority to continue variances, but also its responsibility to demonstrate to the public the reasons for so doing.

HAZARDOUS WASTE TREATMENT/DISPOSAL FACILITIES AND SITES

Section 6

This Section includes several subjects which could be addressed separately in hazardous waste legislation. These include: funding or other provisions for long term care of sites; insurance requirements; training requirements for operating and supervising personnel at sites; and, a possible method for financing the State regulatory program. The State should be certain that the first three areas above are addressed somewhere in the authorizing legislation, if not in the section describing the duties and responsibilities of treatment/disposal site operators. The initial paragraph in Subsection (A) is intentionally broad in order to give the State wide latitude in determining those requirements necessary to the safe operation and environmentally-sound design of treatment/disposal sites. The State should use its regulations to detail the terms and conditions required of all permit holders. Terms and conditions will vary (as they should) between permit holders, depending upon geology, hydrology, geography, and many other factors, and the Regulations should recognize this by stating that the Department may require such other terms and conditions as are necessary to meet the purposes of the authorizing legislation. General terms and conditions will include such things as a specific monitoring and sampling system approved by the State, and evidence of financial responsibility in such form and amount as the *site shall be certified by the Department according to the regulations required under Section 4(C) (B) of this Act and after a review of the types, properties, and volume of hazardous wastes to be treated or disposed of at the facility or site.*

(b) The Department may require the recertification of supervisory personnel where there is any significant change in the types or properties of hazardous wastes being treated or disposed of at the facility or site.

(B) The Department is authorized to establish a schedule of fees to be paid to the Department by hazardous waste treatment or disposal facilities or sites.

Department deems necessary.

Subsection (A) (2) does not suggest the specific type of financial responsibility to be required. There are two separate concerns involved in "long term care": The first is the expense of continued monitoring and maintenance of the site after cessation of operations; the second is the potential expense of environmental damage occurring (or being discovered) after cessation. The first concern is relatively inexpensive and can be estimated in advance. The State can, therefore, require an amount equal to X dollars a year for Y years. For example, the State might require a bond of $10,000 based upon monitoring and maintenance costs of $1,000 each year for 10 years. This would assure the integrity of fences, signs, monitoring wells, and so on, for whatever period the State determines appropriate.

The second concern is considerably more difficult to quantify. The type of damage which could occur, the cost of correcting that damage (if it can be corrected), and the gestation time between closing a site and the discovery of any damage are all relative unknowns. States have devised different responses to these unknowns in order to protect their citizens. One approach has been to require that any site licensed for hazardous waste disposal or treatment be deeded to the State, in effect making all sites public land. States which have done this believe that the State will ultimately be responsible for correcting any environmental damage caused by hazardous waste treatment or disposal sites anyway, making it prudent that such sites be on public land from the start. EPA does not necessarily endorse this concept, as there are many facets to the issue of public versus private disposal or treatment facilities, not all of which favor public ownership. Most States have instead required some form of bonding. The chief drawback to this approach is the difficulty in determining an adequate amount for such a bond. A third alternative is some type of trust fund or revolving account which would receive money from currently operating sites, to be used to correct damage caused by any treatment or disposal site, even if closed long ago. The specific course chosen is less important than the fact that the State have legislative authority to address the problem of potential environmental damage from hazardous waste treatment or disposal sites and to institute some type of protection for the public before that damage occurs.

Subsection (B) describes a system that would make the State regulatory program self-supporting, which is similar to the system used in California. The logic of such a system is that the "polluter pay," and Subsection (B) offers one way by which the generators of hazardous wastes might be charged for the costs of a State program to assure adequate treatment and disposal of those wastes. If the State does choose to establish a special fund for hazardous waste management, or any similar area, the legislature will have to amend the State revenue code; legislation such as a State hazardous waste management act is not the proper vehicle for this.

Whether or not the State establishes any new fund, thought should be given to some type of mechanism which will allow the hazardous waste management system to be self-sustaining. The State may elect a variant of this system, such as returning a surcharge from treatment/disposal sites to the General Fund while allocating the same amount to its regulatory program through the usual appropriations process. In this case, the State would avoid establishing any special accounts within the General Fund.

TRANSPORTATION OF HAZARDOUS WASTES

Section 7

(A) *Following adequate public notice, and not less than one public hearing on the record, the [appropriate State agency], in consultation with Department, shall issue rules and regulations for the transportation of hazardous wastes. Such rules and regulations shall be consistent with applicable rules and regulations issued by the United States Department of Transportation, and consistent with any rules, regulations, and standards issued pursuant to Section 4 of this Act. The [appropriate State agency] shall comply with this Section within 3 years after the effective date of this Act.*

(B) *The provisions of this Section shall apply equally to those persons transporting hazardous wastes generated by others and to those transporting hazardous wastes they have generated themselves, or combinations thereof.*

TRANSPORTATION OF HAZARDOUS WASTES

Section 7

Many States have recognized the importance of transportation in the "cradle-to-grave" life cycle of hazardous waste management, and several have initiated hazardous waste hauler permit or control systems as their first step in managing these wastes. The Congress has also recognized the importance of transport control in managing hazardous wastes, as demonstrated by the inclusion of a manifest system in the Resource Conservation and Recovery Act of 1976.

The Model Law directs the "appropriate State agency," rather than the environmental management agency, to issue rules, regulations, and permits for the transport of hazardous wastes. The wide variation in institutional arrangements and responsibilities for the transport of hazardous wastes make it impossible to specify the "appropriate" agency for each State in this document. The reader should distinguish, however, between the economic aspects of regulation (usually assigned to the State Public Utilities Commission, or equivalent agency), and other aspects such as transportation safety (often assigned to the State Highway Patrol, or equivalent agency). The Model Law addresses only the latter aspects.

Environmental agencies in a few States have been charged with the responsibility for control of hazardous waste haulers. Where a legislature chooses to do this, Subsection (A) should read: ". . . the Department shall issue rules and regulations for the transportation of such wastes."*

Note that P.L. 93-633 provides as follows:

> Sec. 112. (a) General.—Except as provided in subsection (b) of this section, any requirement of a State or political subdivision thereof, which is inconsistent with any requirement set forth in this title, or in a regulation issued under this title, is preempted.
>
> (b) State Laws.—Any requirement, of a State or political subdivision thereof, which is not consistent with any requirement set forth in this title, or in a regulation issued under this title, is not preempted if, upon the application of an appropriate State agency, the Secretary determines, in accordance with procedures to be prescribed by regulation, that such requirement (1) affords an equal or greater level of protection to the public than is afforded by the requirements of this title or of regulations issued under this title and (2) does not unreasonably burden commerce. Such requirement shall not be preempted to the extent specified in such determination by the Secretary for so long as such State or political subdivision thereof continues to administer and enforce effectively such requirement.
>
> (c) Other Federal Laws.—The provisions of this title shall not apply to pipelines which are subject to regulation under the Natural Gas Pipeline Safety Act of 1968 (40 U.S.C. 1671 et seq.) or to pipelines which are subject to regulation under chapter 39 of title 18, United States Code.

EPA and DOT are presently consulting upon implementation by regulation of Sec. 112 as hereinabove set forth and relevant requirements of RCRA of 1976.

The State can achieve several ends through regulation of the transportation of hazardous wastes:

(1) The State must be aware of the whole life cycle of hazardous waste, from "cradle-to-grave." Were the State to regulate only the treatment and disposal sites, there would be no way of knowing which wastes should have been delivered to such sites but were not. Neither would the State know where those wastes had gone. A system which requires the hauler to report where he onloaded and where he offloaded wastes allows the State to be sure that wastes really went into the sites that the State directs.

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*EPA has published a guide to assist the States in implementing the kind of transportation control systems authorized under this Section. "State Program Implementation Guide: Hazardous Waste Transportation Control," EPA/530/SW-512.

Transportation control is an effective substitute for generator reporting. There may be political or other obstacles which prevent the State from requiring that generators report the fact that they have produced hazardous wastes. These obstacles probably will not interfere with a system requiring generators to tell transporters what they are consigning, which effectively makes the information available to the State.

(2) Another use of transportation control is to insure that hazardous wastes actually reach the treatment or disposal sites to which they are directed by the State. Several States have developed "manifest" systems to this end. (The use here of the word "manifest" is intended to represent the several systems already in effect. These systems usually use the words "manifest" or "trip-ticket" to distinguish such documents from the shipping papers used in ordinary commerce, such as bills-of-lading.)

The two basic variants of the manifest system use either the single-part or the multi-part document. In the single-part variant, the generator is required to give the manifest to the hauler, who, in turn, surrenders it to the treatment or disposal site operator. Each party fills in his part of the document, so that the final product includes certifications as to the origin, composition, quantity, disposition, and handlers of each load of wastes. The State may then require the treatment or disposal site operator to submit reports on the manifests received, and to maintain copies of them for specified periods of time so that the Department may inspect them. The hauler is required to have the manifest in nis possession while he has the wastes, and must be prepared to show it to authorized persons. The generator, through filling out his portion, makes a full disclosure to the hauler as to what it is that he is consigning, and may be subject to such penalties as obtain for perjury, where he is not truthful. The multi-part system [illegible] in that each party submits his copy of the manifest directly to the Department as he finishes it. The State can then compare the forms which are submitted, identifying shipments sent to specific sites which have not acknowledged their receipt. The State can then determine whether the wastes were disposed of at some other (possibly unacceptable) site, or whether the reporting system has malfunctioned. Either of these variations on the manifest system meets the first purpose of controlling the movement of hazardous wastes from generation to treatment or disposal. The single-part system is simpler, and generates less paper; the cost to the regulatory agency is that there is no separate submittal from the generator to match with the form that arrives (or fails to arrive) from the treatment/disposal site. Conversely, the cost to the State in using the multi-part system is a large increase in the amount of paper to be monitored. In many States this would require automatic data processing equipment, with the attendant increase in costs and personnel.

(3) The manifest system serves an important function in expediting emergency response actions. Both variations of the manifest system described above require the hauler to have a copy of the manifest system in his possession when he has the wastes. A properly designed and accurately completed manifest tells emergency response personnel what the material is, the dangers it presents, and the proper procedures to follow to mitigate damages. Equally important, the State ensures that the hauler is fully aware of what he is carrying by requiring full disclosure from the generator at the time of consignment.

Existing DOT regulations require only that the material be marked as "flammable," "toxic," or whatever the appropriate hazard may be. The waste hauler, treatment/disposal site personnel, and emergency-response personnel all need a fuller description of the material being carried. This is especially true because of hazardous wastes: there may be combination and mixtures of any number of different substances, possibly posing several different

RECORDS; REPORTS; MONITORING

Section 8

(A). The Department shall adopt, and revise as appropriate, rules which prescribe:

(1) the establishment and maintenance of such records;

(2) the making of such reports;

(3) the taking of such samples, and the performing of such tests or analyses;

(4) the installing, calibrating, using, and maintaining of such monitoring equipment or methods; and

(5) the providing of such other information as may be necessary to achieve the purposes of this Act.

(B) Six months after promulgation of the regulations required under Section 4(C) (7) of this Act, it shall be unlawful for any person to generate, store, transport, treat, or dispose of hazardous wastes in this State without reporting such activity to the Department according to the procedures described in said regulations.

types of threats.

(4) The manifest system is useful to the State in compiling information on the quantity and disposition of hazardous wastes within the State. Because it is, in effect, a self-reporting system for generators (generators must disclose information to the hauler which is later submitted to the State), the State can monitor the aggregate generation and treatment or disposal of hazardous wastes throughout the State. Any manifest system must be mandatory, including a prohibition against the hauler accepting any wastes without a properly executed form.

Subsection (B) includes explicit coverage of those hauling hazardous wastes "... they have generated themselves." This is an important provision and the State should be certain that any regulations of hazardous waste haulers include this or a similar phrase. Some States regulated; this can be a significant loophole. Wastes are no less hazardous, and the need for State cognizance [illegible] different, for the fact that the hauler and the generator are the same person. The existence of this loophole may leave a large segment of the hazardous waste problem unregulated.

RECORDS, REPORTS, MONITORING

Section 8

This Section allows the State to require submittal of the information it needs to assure "cradle-to-grave" control over hazardous wastes. This is a crucial element in the State hazardous waste management program, as the State must be aware of the kinds and quantities of hazardous wastes for which it is responsible, the origins and destinations of these wastes, and the integrity of the treatment or disposal method used. The State can do these things most effectively through rules or regulations describing what is needed.

Section 8 explicitly covers all main participants in hazardous-waste management. The State can only assure sound management if it is aware of all potentially hazardous wastes in the State, including those which remain at the site of generation.

Subsection (E) is especially important to generating industries. Those States which have begun their own hazardous waste management programs have encountered concern from generators that trade secrets, or other proprietary information, could be deduced from their wastes, or

(C) Six months after promulgation of the rules required under Section 8(A) of this Act, it shall be unlawful for any person to generate, store, transport, treat, or dispose of hazardous wastes within this State without complying with the procedures described in said rules.

(D) Any person violating any requirement authorized by this Section shall be subject to the enforcement provisions of Section 11 of this Act.

(E) Information obtained by the Department under this Section shall be available to the public, unless the Department certifies such information to be proprietary. The Department may make such certification where any person shows, to the satisfaction of the Department, that the information, or parts thereof, if made public, would divulge methods, processes, or activities entitled to protection as trade secrets. Nothing in this Subsection shall be construed as limiting the disclosure of information by the Department to any officer, employee, or authorized representative of the State concerned with effecting this Act.

from reports to the State concerning their wastes. The State should recognize and accommodate this concern in establishing its program. However, the State should retain the prerogative of determing that the release of information would not be harmful if the claim of trade secret is not valid. The Model Legislation includes the requirement that persons seeking protection of information demonstrate "... to the satisfaction of the Department ..." that the information is indeed a "trade secret."

INSPECTIONS; RIGHT OF ENTRY

Section 9

For the purposes of developing or enforcing any rule or regulation authorized by this Act, any duly authorized representative or employee of the Department may, upon presentation of appropriate credentials, at any reasonable time - -

(A) enter any place where hazardous wastes are generated, stored, treated, or disposed of,

(B) inspect and obtain samples of any waste, including samples from any vehicle in which wastes are being transported, as well as samples of any containers or labels; and

(C) inspect and copy any records, reports, information, or test results relating to the purposes of this Act.

INSPECTIONS: RIGHT OF ENTRY

Section 9

This Section parallels a common provision of existing State and Federal environmental statutes. Subsection (B) is of special importance to States regulating land disposal and treatment of hazardous wastes. Industrial wastes have traditionally been mobile, and the State cannot effectively regulate the management of these wastes without authority to monitor their movements. The State must be able to inspect waste-carrying vehicles to ensure that they are hauling what they say they are, and that Federal and State safety provisions have been met.

IMMINENT HAZARD

Section 10

(A) Notwithstanding any other provision of this Act, the Department, upon receipt of information that the storage, transportation, treatment, or disposal of any waste may present an imminent and substantial hazard to the health of persons or to the environment, may take such action as it determines to be necessary to protect the health of such per-

IMMINENT HAZARD

Section 10

The purpose of this Section is to allow the Department to act immediately where the potential for environmental damage may be realized before the completion of normal administrative or judicial remedies. The corollary to this is that the Department would use this Section to prevent or minimize such damage only in situations where immediate action was essential.

sons or the environment. The action the Department may take includes, but is not limited to --

(1) issuing an order directing the operator of the treatment or disposal facility or site, or the custodian of the waste, which constitutes such hazard, to take such steps as are necessary to prevent the act or eliminate the practice which constitutes such hazard, which may include permanent or temporary cessation of operation of a facility or site; and

(2) requesting that the Attorney General or appropriate District Attorney commence an action enjoining such acts or practices, and granting a permanent or temporary injuction, restraining order, or other order upon a showing by the Department that a person has engaged in such acts or practices.

(B) In any civil action brought pursuant to this Section in which a temporary restraining order, preliminary injunction, or permanent injunction is sought, it shall not be necessary to allege or prove at any stage of the proceeding that irreparable damage will occur should the temporary restraining order, preliminary injunction, or permanent injunction not be issued; or that the remedy at law is inadequate, and the temporary restraining order, preliminary injunction, or permanent injunction shall issue without such allegations and without such proof.

The Section provides considerable flexibility. Where the Department chooses, it may issue an administrative order, but the Section also allows the Department to seek a court order if it prefers.

Subsection (B) includes the phrasing ". . . it shall not be necessary to allege or prove . . . that irreparable damage will occur . . . or that the remedy at law is inadequate . . . " for the Department to take immediate action under this Section. Such a waiver is a useful element in any imminent hazard provision the State includes in its hazardous waste management legislation. Its purpose is to prevent lengthy legal delays over the correctness of the Department's judgment that a threat is immediate, and delays caused by affected persons forcing the Department to exhaust such other (slower) legal remedies as may be available to the Department. This phrasing may be of special interest in those States where the courts have been reluctant to consider limited environmental damage to be "irreparable."

ENFORCEMENT

Section 11

(A) Whenever the Department finds that any person is in violation of any permit, rule, regulation, standard, or requirement under this Act, the Department may issue an order requiring such person to comply with such permit, rule, regulation, standard, or requirement, or the Department may request that the Attorney General of this State bring a civil action for injunctive relief in [the appropriate] court; or, the Department may request that the Attorney General of this State bring a civil enforcement action under Subsection 11(C) of this Act.

(B) Any person who knowingly violates any order issued by the Department pursuant to this Section shall be liable for a fine not to exceed $25,000 per

ENFORCEMENT

Section 11

Section 11 provides the mechanism by which the Department can enforce the permits, rules, regulations, standards, and requirements promulgated under the authority of this Act.

The Department has three options under the Recommended Legislation's enforcement provisions:

(1) the Department can issue an order to the violator instructing him to comply with whatever rule (or regulation, etc.) he is violating;

(2) the Department can ask that an action be brought for a penalty against a violator; or

(3) the Department can obtain an injunction against a violator.

day of violation, imprisonment for not to exceed one year, or both.

(C) Any person who violates any permit, rule, regulation, standard, or requirement pursuant to Sections 4, 5, 6, 7, or 8 of this Act shall be liable for a fine of not to exceed $25,000 per day of violation.

(D) Each day of noncompliance with any order issued by the Department pursuant to this Section, or of noncompliance with any permit, rule, regulation, standard, or requirement pursuant to Section 4, 5, 6, 7, or 8 of this Act shall constitute a separate violation of this Act.

(E) An order issued under this Section shall be delivered by personal service and shall be served on the person designated by the laws of this State as appropriate to receive service of process.

INTERSTATE COOPERATION

Section 12

The legislature of this State encourages cooperative activities by the Department with other States for the improved management of hazardous wastes, for improved, and so far as is practicable, uniform State laws relating to the management of hazardous wastes; and compacts between this and other States for the improved management of hazardous wastes.

REPEALER

Section 13

The following laws of this State are hereby repealed on the effective date of this Act:

These options provide the Department with wide latitude in enforcing the rules and regulations promulgated under the Act. The Department may choose to simply issue an order preventing an act or the continuation of a practice which violates applicable regulations, where the act or practice does not pose an imminent threat of extreme hazard. Section 11(B) then allows the Department to invoke criminal penalties where such an order has been knowingly violated.

Where damage has already occurred, and where that damage appears to warrant compensation, the Department may choose to seek civil penalties.

Last, the Department may choose to seek injunctive relief for those situations where the potential hazard of an act or practice appears to make that appropriate.

Subsections 11(C) and 11(D) specify the Sections of this Act which, if violated, can result in the imposition of penalties. Failure to specify those Sections which carry such sanctions may result in problems of "due process," as persons subject to the Act must be given clear notice of the sanctions which may result from a violation. The State legislation should clearly identify those provisions which carry penalties.

Subsection 11(E) is similarly important for reasons of due process: the violator must receive "effective notice" that he has violated an order which may result in criminal sanctions.

INTERSTATE COOPERATION

Section 12

Interstate cooperation is especially important in the management of hazardous wastes. While air pollution moves as the climate dictates, and water pollution as geography and geology dictate, residuals destined for the land move at human whim. Wastes going to the land can and are transported by all manner of vehicle to sites in any direction as far away from the point of generation as economics allows. Many large industrial centers are at or near the boundary of a neighboring State, with the movement of wastes from generation in one State to treatment or disposal in another State being part of longstanding residuals management practices as a result.

The Congress has recognized this in the Resource Conservation and Recovery Act of 1976, Section 1005 of which encourages certain interstate compacts. Where States do not establish formal agreements, they may

SEVERABILITY

Section 14

If any provision of this Act, or the application of any provision of this Act to any person or circumstances, is held invalid, the application of such provision to other persons or circumstances, and the remainder of this Act, shall not be affected thereby.

EFFECTIVE DATE

Section 15

This Act shall take effect on

find it useful to at least recognize publicly that interstate cooperation is especially important in managing hazardous wastes by including phrasing similar to that in Section 12 of the Model Law in their own Hazardous Waste Management Acts.

Appendix B

INFORMATION SOURCES FOR DISPOSING OF SMALL BATCHES OF HAZARDOUS WASTES

Mismanagement of industrial waste and indiscriminate disposal of certain business and commercial wastes and household items have already resulted in numerous documented cases of air contamination, land and water pollution, property damage, and injuries and death of humans and animals. Small batches of hazardous wastes are generated as discarded household items (for example, battery acid or small pesticide cans), or as chemical wastes from small business and manufacturing establishments, and from commercial, university, and high school laboratories.

The objective of this guide is to outline information sources on waste handling and disposal, and to present available methods and options to advise the waste holder on the disposal of small batches of hazardous wastes.

It also provides a step-by-step procedure on what to look for, who to ask, and what steps to take if you suspect you have hazardous waste or material that must be disposed of. It will enable you to answer the following crucial questions concerning the disposal of hazardous wastes:

- What are they?
- How do I identify them?
- How do I properly dispose of them?

IDENTIFYING HAZARDOUS WASTE

A hazardous waste is a waste that poses a threat to life and property. It can contaminate the environment by virtue of being toxic, radioactive, explosive, or flammable, as well as nonbiodegradable and bioaccumulative. When a hazardous chemical used in the workplace or the lab is contaminated, or no longer useful, the material is a potential threat if disposal is not carried out properly.

The fundamental fact about these hazardous wastes is that they are a menace to human health and the environment. They can poison, burn, maim, blind, and kill people and other living organisms immediately when inhaled, swallowed, or brought in contact with the skin, or they may wreak their havoc slowly over time, affecting the nervous system, causing cancers, or spawning birth defects. Some are nondegradable and persist in nature indefinitely. Some may accumulate in living things. Some may work their way into the food chain.

Hazardous wastes are found in a wide variety of solid, liquid, or gaseous forms. They may be packaged in small jars, bags, drums, cylinders, cans, or aerosol containers. Table B-1 provides a partial list of commonly encountered sources of hazardous waste.

According to the Resource Conservation and Recovery Act of 1976, EPA must formally define a hazardous waste by Spring 1978. Meanwhile, several Federal regulations already deal with the hazardous properties of chemicals, and the transportation of these chemicals, or certain commercial products that contain hazardous components. Several States do maintain lists or criteria for hazardous wastes which makes those agencies an excellent source of information for determining what is hazardous.

All pesticides are regulated under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), as amended, and disposal must be in accordance

TABLE B-1

COMMONLY ENCOUNTERED HAZARDOUS MATERIALS AND PRODUCTS FOUND IN SMALL BATCHES OF WASTE

TYPICAL WASTE SOURCES	HAZARDOUS MATERIALS
1. ACIDS	
Pickling Liquor Battery Acid Acidic Chemical Cleaners Spent Acid Plating Operations Laboratory Glassware Acid Baths Glass Etching Solutions	Chromic-sulfuric acid mixture, hydrobromic acid, hydrochloric acid, hydrofluoric acid, nitric acid, perchloric acid, sulfuric acid
2. ALKALIES	
Miscellaneous Caustic Products Alkaline Battery Fluid Caustic Wastewater Cleaning Solutions Lye	Ammonia, lime (calcium oxide), potassium hydroxide, sodium hydroxide, sodium silicate
3. ORGANICS *(Mainly Non-Halogenated)*	
Capacitor Fluids Chemical Cleaners and Solvents Chemical Toilet Wastes Electrical Transformer Fluids Furniture and Wood Polishes Laboratory Chemicals Paint Removers Silver Cleaning Agents Shoe Polish	Aromatic compounds, organic amides, organic mercaptans, organonitriles, nitrobenzene, phosgene, thioureas
4. HALOGENATED ORGANICS	
Cleaning Solvents Laboratory Chemicals Paint and Varnish Removers Dry Cleaning Solutions Capacitors and Transformers Containing PCB	Carbon tetrachloride, chloroform, methylene chloride, polychlorinated biphenyls (PCB)
5. INORGANICS	
Catalysts Chemical Toilet Wastes Laboratory Chemical Wastes Paint Sludge Plating Solutions Fluorescent Lamps Germicidal and "Disinfectant" Solutions Paints Fluxes Aluminum Cleaning Agents	Ammonium fluoride, ammonium silicofluoride, antimony salts, arsenic salts, asbestos products and fibers, beryllium compounds, barium salts, borane compounds, cadmium salts, chromium salts, cyanide compounds, inorganic halides (potassium bromide, sodium iodide), lead compounds, mercury salts, selenium salts, sodium silicofluoride, vanadium compounds, zinc chloride

TABLE B-1

COMMONLY ENCOUNTERED HAZARDOUS MATERIALS AND PRODUCTS FOUND IN SMALL BATCHES OF WASTE (CONTINUED)

TYPICAL WASTE SOURCES	HAZARDOUS MATERIALS
6. EXPLOSIVES	
Illegal Explosive "Firecrackers" Laboratory Wastes Obsolete Explosives Track Torpedoes Blasting Caps Detonators Commercial Pyrotechnics for Private Use	Ammonium nitrate, ammonium nitrate-fuel oil mixtures (ANFO), dynamite, mercury fulminate, nitroglycerin, 2,4,6-trinitrotoluene (TNT), water-gel explosives
7. PESTICIDES	
Waste Pesticides House and Garden Discarded Pesticide Cans Waste Water from Cleaning of Pesticide Containers Containers and Pesticide Application Equipment	Chlorinated hydrocarbon pesticides, organophosphate pesticides, phosphorothioate pesticides, organic carbamates, organic thiocarbamates
8. GASES	
Welding Gases Laboratory Gas Cylinders Local Anesthetic "Aerosol" Cans Medical Oxygen Cylinders	Acetylene, ammonia, carbon monoxide, chlorine, ethyl chloride, hydrogen, hydrogen sulfide, methyl chloride, nitrogen dioxide, oxygen, other gases under high pressure
9. BANNED PRODUCTS	
Banned Pesticides Banned Hair Sprays Banned Aerosol Bathroom Cleaners Waste Lead-Base Paints	Aerosol products containing vinyl chloride as propellant, aldrin products, lead-based paints containing 0.5 percent lead or greater

with label directions or with regulations and procedures published pursuant to Section 19 of the Act (see Appendix C). Published guidelines provide for the disposal of single containers of household pesticide products that are securely wrapped in several layers of paper in regular municipal solid waste disposal facilities.

INFORMATION SOURCES

Detailed information on the hazardous characteristics of laboratory chemicals and on the most commonly used commercial and household products can be obtained from the manufacturers/suppliers, from open literature, and by contacting appropriate governmental agencies.

Most chemicals used in the laboratories, or products used in the household or in small commercial and business establishments carry warning labels as to the hazards involved, if they contain hazardous substances or if they may be hazardous under certain conditions of use. Thus, if the original label still remains on the container, it should be read very carefully as a first step toward waste identification (and for safe handling and disposal). If the name of the manufacturer or distributor of a product is known, this source can be contacted for information on hazardous characteristics of the product and on proper handling and disposal procedures.

There are five reference manuals, available in many public libraries and in most chemical laboratories, that can be consulted on properties, uses, and hazardous characteristics of laboratory chemicals and many consumer products (Table B 2). Generally, descriptions of the material's hazardous nature will be in terms of its toxicity, flammability, reactivity, explosiveness, or corrosive nature. The reference manuals noted describe the hazardous nature of the material in these terms, and some may give a relative rating of its danger. Some of these references also tell whether or not these materials are potentially carcinogenic (cancer-causing).

Federal agencies can also be contacted for assistance in the identification of hazardous material. A list and brief description of these agencies are presented in Appendix F.

DISPOSING OF HAZARDOUS WASTE

Some pertinent reference materials on treatment and disposal are given in Table B-3. These references identify treatment methods that have been used by universities and industrial trade organizations (for example, the Manufacturing Chemists Association). The treatment and disposal methods given in these references generally have not been evaluated by EPA for their effectiveness and should be carried out only by qualified personnel.

SELECTING THE PROPER DISPOSAL OPTION

Depending on the nature of the waste, the specific location where the waste is generated, and the applicable local ordinances and State regulations on waste disposal, small batches of hazardous wastes can be disposed of in a number of ways including, in order of preference:

- Recycling or returning to supplier
- Transporting to a hazardous waste management facility
- Using available laboratory equipment for treatment/disposal
- Disposing of material in appropriate municipal incinerators with permission of local and State agencies (only if the previous three options are not available)
- Disposing of material in "appropriate" landfills with permission of local and State agencies (and only as a last resort)

REUSE/RECYLE

The first disposal option selected should be to return the material either to the supplier or manufacturer or to the approved chemical trader, broker, or reclaimer who can reuse or recycle the waste for some useful end product. Lists of local laboratory supply houses can be found in the "yellow pages" of the telephone directory or in certain publications such as the American Chemical Society Publication 1975-76 LABGUIDE.

DISPOSAL IN HAZARDOUS WASTE MANAGEMENT FACILITIES

Throughout the United States there are over 100 centralized facilities for processing and/or disposal of hazardous wastes. Although a large number of these facilities are owned and operated by private waste-disposal service companies, there are also some which are operated by municipalities and county agencies (for example, County Department of Public Works in several California counties). Some facilities, especially

TABLE B-2

REFERENCE MANUALS ON HAZARDOUS PROPERTIES OF LABORATORY CHEMICALS AND COMMERCIAL/INDUSTRIAL PRODUCTS

REFERENCE	CONTENTS
Gleason, Marion N., et al. *Clinical toxicology of commercial products, acute poisoning.* 3d ed. Baltimore, The Williams & Wilkins Co., 1969. various pagings.	Contains alphabetical compilation of 3,000 major chemical substances (ingredients) found in widely used commercial products, and gives toxicity information and a toxicity rating for each ingredient. In addition, the manual contains a trade name index for 17,000 products, identifies the manufacturers and lists the ingredients for each product and identifies the toxic components.
Stecher, P.G., et al. *The Merck index, an encyclopedia of chemicals and drugs.* 8th ed. Rahway, N.J., Merck & Co., Inc., 1968. 1713 p.	Describes 10,000 individual substances, provides data on their toxic effects on humans and test animals, and lists common uses for selected entries. In addition, the index lists poison control centers and first aid procedures. A cross-index of chemical names and formulas is also given.
Sax, N.I., et al. *Dangerous properties of industrial materials.* New York, Reinhold Publishing Corporation, 1957. 1467 p.	Lists 9,000 general chemicals and products; gives descriptions of physical properties and toxicity, explosion, fire, and radiation hazard ratings. For each chemical, pertinent data are provided on personal hygiene, ventilation, disaster control, shipping regulations, and storage/handling procedures.
Weast, R.C. *Handbook of chemistry and physics.* 56th ed. Cleveland, CRC Press, 1975-1976. various pagings.	Identifies physical and chemical properties of most organic and inorganic chemicals. The handbook gives toxicity of select chemicals, and general information on chemical hazards, fire precautions and first aid.
Christensen, H.E., Luginbyhl, T.T., and B.S. Carroll. *Registry of toxic effects of chemical substances; 1975 edition.* Washington, U.S. Government Printing Office, June 1975. 1296 p.	Identifies toxicity (to man, animals, and aquatic life) of most known organic and inorganic chemicals and identifies carcinogenic, teratogenic, and mutagenic nature, if any.

those operated by public agencies, handle a variety of wastes including small batches of hazardous material. At these facilities, a certain area within the disposal site is set aside for handling hazardous wastes. A number of waste disposal companies also provide waste hauling service to their customers. Others that do not provide hauling service usually request their regular major clients to use only the services of registered waste haulers to bring wastes to the disposal site. Unlike most regular refuse disposal sites which are open 8 to 10 hours a day, 5 to 6 days per week, some hazardous waste disposal sites have a very restricted business-hour schedule, with a few accepting wastes only by prior appointment. Nearly all facilities require the waste generators to provide some data on the general characteristics of their wastes and their hazardous constituents. Such data are needed to assure safe waste handling and disposal.

TABLE B-3

SELECTED LIST OF PERTINENT PUBLICATIONS ON TREATMENT AND DISPOSAL OF SMALL BATCHES OF HAZARDOUS WASTES

REFERENCE	CONTENTS
Laboratory waste disposal manual. Washington, Manufacturing Chemists Association, May 1970. 176 p.	The manual stresses safe procedures for on-site waste disposal from small laboratories, especially those in small communities not possessing sophisticated equipment. Gives detailed waste disposal procedures for 25 classes of chemicals (covering 1,121 individual chemicals) in common use in laboratories and related facilities. Also provides several recommended methods for the recovery of certain spilled chemicals. Data on physical properties and hazardous properties of the chemicals are also provided.
How to dispose of hazardous household wastes. Sacramento, California State Water Resources Control Board. (In preparation.)	Lists 10 types of hazardous wastes most commonly found around the home, and gives a brief description of the options available for the disposal of these materials including direct disposal to the land, use of municipal sewage treatment systems, use of special collection pits at gasoline stations, etc. The booklet also provides hints for handling hazardous wastes.
Steere, Norman V., ed. *CRC handbook of laboratory safety.* Cleveland, The Chemical Rubber Co., [1971]. 854 p.	Gives procedures for the disposal of hazardous wastes and presents chemical, biological, radiation, fire, and other hazards associated with several thousand chemicals. The handbook also contains general laboratory safety procedures.
Shih, C.C., and D.F. Dal Porto (TRW Systems and Energy). *Handbook for pesticide disposal by common chemical methods.* Washington, U.S. Environmental Protection Agency. (In preparation.)	Contains step-by-step chemical degradation/detoxification and disposal procedures for 20 major pesticides which are representative of the several hundred pesticides currently in use. The handbook also contains an extensive review of the pertinent literature on various reported chemical methods for the degradation and/or detoxification of the selected pesticides.
Lawless, E.W., T.L. Ferguson, and A.F. Meiners (Midwest Research Institute). *Guidelines for the disposal of small quantities of unused pesticides.* Publication No. EPA 670/2-75-057. Washington, U.S. Government Printing Office, June 1975. 331 p. (Also distributed by National Technical Information Service, Springfield, Va., as PB-244 557.)	Provides 14 detailed methods for the treatment and disposal of 550 pesticides and discusses treatment of small spills of pesticides and methods for the disposal of empty pesticide containers. The manual contains reference charts of pesticide properties pertinent to disposal, and a cross index of chemical names, common names, and trade names. The manual is intended to be used by regulatory authorities in advising the layman on the disposal of pesticide wastes

In areas where hazardous waste disposal facilities are readily accessible, small batches of hazardous wastes should definitely be taken to such sites for disposal. These sites, which are generally operated by professionals with training and expertise in waste management, utilize disposal methods which assure minimum environmental damage. These facilities also operate under permits from one or more governmental agencies and are regularly inspected by the regulatory agencies to assure compliance with the conditions of their permits and all applicable regulations.

EPA has published a list of such facilities (EPA/530/SW-146) called "Hazardous Waste Management Facilities in the United States," which is available through EPA, Office of Solid Waste.

"IN-HOUSE" TREATMENT/DISPOSAL

After it has been determined that the recycle/reuse disposal option is not available and that the services of a commercial hazardous waste disposal facility are also unavailable, the generator of a small batch of hazardous waste may investigate "in-house" treatment possibilities for "on-premises" or "offsite" disposal. Under appropriate conditions, and if regulations permit, small batches of certain hazardous waste can be disposed of "on-premises" after the waste is rendered harmless or less hazardous (that is, detoxified, neutralized, or encapsulated, e.g., in cement) by proper treatment. In some cases, the treated waste may be suitable for disposal in sanitary landfills or municipal incinerators. Certain hazardous wastes, such as explosives, for example, should not be handled "in-house."

HAZARDOUS WASTE DISPOSAL IN MUNICIPAL INCINERATORS

Small batches of certain combustible hazardous wastes can be incinerated in municipal incinerators if it is determined that the disposal will not result in (a) explosion or emission of products which can be damaging to the equipment or injurious to operating personnel, and (b) generation of pollutants which cannot be adequately controlled by the existing emission control equipment and procedures. Municipal solid waste incinerators generally are not appropriate for incineration of pesticides other than casual household containers. For regulations concerning destruction of hazardous wastes in municipal incinerators, the local agency responsible for operation or regulation of the incineration facility should be contacted. In general, information on waste quantities and characteristics would be required in order to determine whether a hazardous waste can be safely handled in a municipal incinerator. For all hazardous waste disposal in municipal incinerators, obtain approval from the local and State agencies responsible for solid or hazardous waste disposal.

HAZARDOUS WASTE DISPOSAL IN SANITARY LANDFILLS

Specific regulations on disposal of hazardous wastes to sanitary landfills vary from locality to locality and from State to State. As examples, some States, such as Illinois, allow disposal of small amounts of hazardous chemical wastes in certain sanitary landfills, whereas other States, such as Florida, prohibit any land disposal of hazardous wastes unless they have been "detoxified" prior to disposal. Generally, single containers of household pesticides can be wrapped in several layers of paper and discarded in the regular municipal solid waste collection system. Local and State agencies responsible for the operation or regulation of a sanitary landfill should be contacted for regulations on waste disposal before any hazardous waste is taken to the sanitary landfill for disposal. For all hazardous waste disposal in landfills, obtain approval from the local agency responsible for solid or hazardous waste disposal.

Appendix C

INFORMATION ON DISPOSAL OF PESTICIDES AND PESTICIDE CONTAINERS

As State hazardous waste problems may include disposal of pesticides or pesticide containers, some background on current recommendations and information sources is useful. Pesticides are regulated by EPA under the Federal Insecticide, Fungicide, and Rodenticide Act, as amended. Section 19(a) of this Act requires EPA to establish recommended procedures and regulations to control the disposal and storage of pesticides, and pesticide containers, and accept for safe disposal those pesticides canceled under Section 6(c). Thus far, EPA has published two declarations on this subject.

On May 1, 1974, "Recommended Procedures for Disposal and Storage of Pesticides and Pesticide Containers" 39 *FR* 15236 was promulgated. This publication provides guidance on the subjects of disposal and storage (Subparts C and D) to the public, but they are only regulatory for Federal agencies or where Federal funds or property are involved. This document also provides regulations relating to the acceptance by EPA of suspended and canceled pesticides (Subpart B).

Subpart C separates pesticides into three specific categories for purposes of disposal—organic, organometallic, and inorganic, with appropriate recommended disposal procedures for each group. It also cautions against the use of certain disposal procedures which pose threats to the environment. Pesticide container disposal is addressed in a similar fashion. Finally, criteria and recommended procedures for storage of pesticides and containers are outlined.

Subpart D relates to pesticide-derived wastes; if such wastes are part of an industrial waste stream, then the Federal Water Pollution Control Act or Safe Drinking Water Act permits may apply; otherwise, such waste should be handled as specified under Subpart C.

To provide control of the worst acts of pesticide disposal, regulations were proposed on October 15, 1974, 39 *FR* 36867 to prevent water dumping and ocean dumping except by permit, and open dumping, open burning, well injection, and storage which could lead to contamination of food or feed. These regulations would amend the previously issued recommended procedures and prohibit those procedures not recommended (165.7). These regulations are expected to be promulgated in 1977.

The state-of-the-art on pesticide disposal and storage is not well developed. Criteria for pesticide incineration, disposal in landfills, rinse solution disposal, chemical degradation methods, photodegradation, and storage have not been completed; grants and contracts to answer these questions are planned and in progress. The Solid Waste Management Representative in the EPA Regional Offices is the best source of information on current regulations and status of the developing pesticide disposal technology.

Included in this Appendix are several publications addressing pesticide disposal and storage issues. These publications deal with information sources, disposal of pesticides, including dilute solutions, current pesticide disposal research, the reconditioning of pesticide containers, etc., and should be consulted for details:

- Regulations for Acceptance and Recommended Procedures for Disposal and Storage of Pesticides and Pesticide Containers, 39 FR 15236, May 1, 1974

- Proposed Regulations for Prohibition of Certain Acts Regarding Disposal and Storage of Pesticides and Pesticide Containers, 39 *FR* 36867, October 15, 1974.

REFERENCES

Day, H. R. Disposal of dilute pesticide solutions. Environmental Protection Publication SW-519. [Washington], U.S. Environmental Protection Agency, June 1976. 18 p.

Day, H. Pesticide disposal information sources; a guide for EPA personnel. [Washington], U.S. Environmental Protection Agency, 1976. 11 p., app. [Prepublication copy.]

Ghassemi, M., and S. Quinlivan [TRW Systems Group]. A study of selected landfills designed as pesticide disposal sites. Environmental Protection Publication SW-114c. U.S. Environmental Protection Agency, Nov. 1975. 143 p. (Distributed by National Technical Information Service, Springfield, Va., as PB-250 717.)

Munnecke, D., H. R. Day, and H. W. Trask. Review of pesticide disposal research. Environmental Protection Publication SW-527. [Washington], U.S. Environmental Protection Agency, 1976. 76 p.

Shih, C. C., and D. F. Dal Porto [TRW Systems Group]. Handbook for pesticide disposal by common chemical methods. Environmental Protection Publication SW-112c. U.S. Environmental Protection Agency, Dec. 1975. 103 p. (Distributed by National Technical Information Service, Springfield, Va., as PB-252 864.)

Staton, W. S., and J. G. Lamperton [Oregon State University, Environmental Sciences Center]. Pesticide container processing in commercial reconditioning facilities. Environmental Protection Publication SW-88d. [Washington], U.S. Environmental Protection Agency, Nov. 1976. 21 p.

[Versar, Incorporated.] A study of pesticide disposal in a sewage sludge incinerator. Environmental Protection Publication SW-116c. U.S. Environmental Protection Agency, 1975. 186 p. (Prepublication issue; to be distributed by National Technical Information Service, Springfield, Va.)

federal register

Appendix D

THURSDAY, APRIL 1, 1976

PART V:

ENVIRONMENTAL PROTECTION AGENCY

POLYCHLORINATED BIPHENYL-CONTAINING WASTES

Disposal Procedures

Errata:

1. p. 14134, 1st column, 4th ¶, 8th line: insert to read "The possible adverse effects on animals (including man)..."
2. p. 14135, middle column, 4th ¶, 5th line: should read "checking to assure that the materials are being properly handled, treated, transported..."
3. p. 14136, 1st column, 1st ¶, 2nd line: should read "burial" instead of "bureau"...

ENVIRONMENTAL PROTECTION AGENCY

[FRL 514-4]

PCB-CONTAINING WASTES (INDUSTRIAL FACILITIES)

Recommended Procedures for Disposal

On December 22, 1975, the Administrator of the Environmental Protection Agency announced an action plan of regulatory and administrative actions to help ensure that polychlorinated biphenyls currently in service do not enter the environment. One portion of that program includes investigation and recommendation of appropriate disposal procedures for *industrial users* of this family of chemicals or products containing them. The Agency is also evaluating the consumer waste disposal problem and may issue further guidance on that subject at a later time.

Purpose.—Pursuant to Section 204(b)(1) of the Solid Waste Disposal Act, as amended, the Administrator may issue advisory guidance and recommendations related to the disposal of waste materials These recommended procedures do not have standard-setting or regulatory status, but represent the best information available on preferable disposal options for PCB-containing waste materials. The Agency plans to conduct studies to determine other options for treatment and disposal of PCB-containing wastes (including incineration of capacitors containing PCB liquids) during calendar year 1976 (In addition to Agency activities, the American National Standards Institute is in the process of revising ANSI C107.1-1974, its guidelines for disposal of askarels containing PCBs.) As significant new information becomes available from these and other sources, this FEDERAL REGISTER issuance will be revised.

The purpose of this issuance is to provide guidance for the disposal of PCB-containing wastes This guidance is addressed primarily to *industrial users* of PCBs, particularly those manufacturing and/or using capacitors and transformers containing PCBs, although the recommended procedures are appropriate to all PCB-containing wastes

General Background. — Polychlorinated biphenyls (PCBs) are chlorinated aromatic organic compounds which give rise to concern because of their chronic toxicity, their pervasiveness and persistence in the environment, and their tendency to accumulate in food chains (including man), resulting from the bioaccumulation of PCBs in the food chain, cause the present and continuing concern over the disposition of PCBs to the environment. PCBs have been used both in closed systems, especially as sealed dielectric fluids in transformers and capacitors, and consumptive (or "open") applications, where the PCBs are used in and consumed and discarded with a product.

In the past, consumptive or "open" uses of PCBs have included: impregnators of cotton and asbestos for braided insulation of electrical wiring; plasticizers in wire and cable coatings; plasticizers of vinyl chloride polymer films; components of high-pressure hydraulic fluids; specialized lubricants and gasket sealers, heat transfer agents; and machine tool cutting oils. Former "open" applications also include, formulation into some epoxy paints; protective coatings for wood, metal, and concrete; adhesives; and in carbonless reproducing paper.

Today domestically produced PCBs are supplied only to "closed" applications in the electrical power distribution industry PCBs used as dielectric fluids in transformers and capacitors are referred to generally as askarels.

Capacitor applications include power factoe correction of both high and low voltage power, ballasting in fluorescent lamps, and motors in air conditioners and industrial applications Transformer use of PCBs is primarily in those areas where the non-flammability is the major consideration (largely those applications in proximity to humans). These include transportation applications (electric trains, rapid transit systems) and power supply transformers in commercial and public buildings

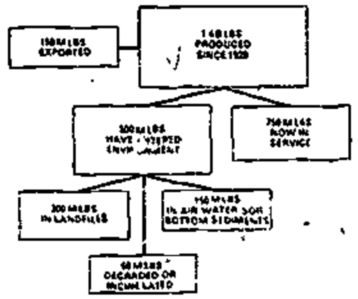
The sole producer of PCBs in the United States is the Monsanto Company, under the trade name of Aroclor Some domestic manufacturers either modify Aroclor or have Monsanto prepare special formulations for them These have been marketed and used by manufacturers in their products under various trade names Additional quantities of PCBs are imported, both as a raw material and as a substance incorporated into manufactured parts or products Appendix A provides a listing of the trade names used by domestic and foreign manufacturers on their products containing PCBs.

Cumulative sales in the U S. since the introduction of PCBs in 1929 are estimated to be 1 5 billion pounds An estimated 750 million pounds of the PCBs produced are still in service It is estimated that less than half the PCBs ever produced have entered the environment, of this amount, only about 10 percent (50 million pounds) are estimated to have degraded or been incinerated. 300 million pounds are estimated to be in landfills at this time This distribution of PCBs is illustrated on Figure 1 The recommendations of this publication are directed only at the PCBs presently in service (or which will enter service as a result of future production)

In 1970 Monsanto voluntarily restricted domestic sales of PCBs to use in transformers and capacitors (closed systems) As a result, current domestic production of PCBs is down about 50 percent from the peak years before 1970, but still amounts to about 40 million pounds per year (1974) Imports of PCB liquids currently amount to about 0 4 million pounds per year.

FIGURE 1

PCB HISTORY IN THE U S



Most capacitors (using PCBs) produced in the past two years use Aroclor 1016, while transformer applications continue to use Aroclor 1242 and 1254.

Technical Background.—Polychlorinated biphenyls are a class of synthetic compounds which have no known counterpart in the natural environment PCBs are manufactured by the chlorination of biphenyl with anhydrous chlorine using iron filings or ferric chloride as a catalyst. The most important physical properties of PCBs are low vapor pressures, low water solubility, and high dielectric constants They are miscible with most organic solvents.

The chemical properties that make PCBs desirable industrial materials are their excellent thermal stability, their strong resistance to both acidic and basic hydrolysis, and their general inertness They are quite resistant to oxidation Unfortunately, some of the characteristics (stability, nondegradability) which make PCBs so valuable in industrial applications also make them highly persistent in the environment.

Theoretically 210 PCB compounds can be prepared, but less than 100 homologs and isomers are likely to occur in commerical products. PCB compounds contain from 12 to 68 percent chlorine The typical commercial product is a mixture of several homologs

Monsanto, the sole U S producer of PCBs, has adopted a four-digit designation for its Aroclors The first two digits indicate the type of material biphenyl, triphenyl, or mixture of the two The last two digits represent the approximate chlorine content by percentage weight (Aroclor 1016, with approximately 41 percent chlorine, is an exception to this nomenclature system) Biphenyls with higher chlorine content are non-flammable and have extremely low volatilities

The chemical stability, low volatility, high dielectric constant, and compatibility with other chlorinated hydrocarbons have resulted in many and varied industrial applications for the PCBs

The ready solubility of PCBs in nonpolar solvents explains why they are easily absorbed into fatty tissue and into the liver. Fatty tissue acts as a nonpolar solvent, and PCBs are retained, rather than excreted Their resistance to oxidation or other types of chemical degradation explains their persistence and accumulation in animal tissue

The chemical inertness and resistance to metabolism of PCBs account for their low acute toxicity. Chronic toxic effects vary in different animal species; they include skin, liver and kidney lesions in rabbits as well as chloracne and hepatotoxic effects in man.

The low solubility of PCBs in water probably limits the rate at which they are dispersed by water systems. PCBs discharged into a river or lake will accumulate in the sediment in relatively high concentrations. Plants and animals can concentrate PCBs above their level in water alone. Some fish species taken from Lake Michigan in 1970 and 1971 have exhibited PCB concentrations greater than 5 ppm. Shrimp and oysters exposed to 10 ppb of Aroclor 1254 have shown bioaccumulations from 130- to 3300-fold; bioaccumulations in some species of 40,000 to 75,000 have been experienced.

PCBs are not intended to get into the environment—but they do because their unique chemical properties prevent them from being destroyed by usual waste treatment methods. Thus, they inadvertently escape and become widely dispersed. Environmental transport models for PCBs have not been developed. Conclusions regarding their behavior, particularly their distribution and transport in the environment, are based largely upon the results of DDT research. Recent data indicates that aerial transport may play a major role in the worldwide dissemination of PCBs, although dumping and river runoff may contribute more importantly to local contamination of fish, wildlife, and drinking water sources. Degradation characteristics of PCBs are not well understood. Some dibenzofurans, which are extremely toxic, may be degradation products of PCBs.

Disposal of PCB-Containing Wastes.—The persistence of PCBs necessitates extremely careful attention to final disposition of PCBs and PCB-containing materials. First, the use of PCBs should be reduced. Manufacturers or users should use more environmentally acceptable substitute materials whenever possible. However, spills, damaged goods, and housekeeping materials will require disposal. All absorbents and other clean-up materials should be carefully selected with disposal implications in mind.

Reclamation of PCBs is usually feasible only with relatively uncontaminated liquids and should be carried out only if there is virtually no chance of PCB losses to the environment. Recycling is advisable only as long as adequate substitutes for PCBs are not available. Monsanto maintains a toll-free telephone number (800 325-3850) for the public for advice on scrap PCBs. If liquids cannot be reused these liquids should be disposed of by high temperature incineration.

Recycling of transformer fluids is accomplished by several companies. The tank and inside copper of the transformer is reclaimed; the PCB liquids, if they cannot be reused, should be incinerated.

PCBs can be leached from solid manufacturing wastes with a suitable solvent, e.g., trichloroethylene or acetone. The decontaminated waste can then be disposed. The solution containing PCBs may be separated by distillation into PCB which may be reclaimed and the solvent which may be used again. The distillation technique is also applicable to remove PCBs from contaminated liquids. This technique of leaching and reclamation is especially useful after accidental spills of liquid PCBs. Spills could be absorbed on dry sand, ash, sawdust, or commercial absorbent, and then processed as above.

As noted on Figure 1 there are approximately 750 million pounds of PCBs incorporated into products currently in service. These products will ultimately require disposal. If a capacitor or transformer has a label identifying one of the trade names shown in Appendix A, it should be handled as a PCB and the options listed below followed. If the contents are unknown but the manufacturer is one of those listed in Appendix A, an inquiry should elicit information on the contents of the equipment or product.

Effective safeguards should be employed in the handling and transport of the PCB-containing wastes. These include the use of protective clothing, closed containers for transportation, and adequate labeling to alert personnel to hazards from routine disposal as well as emergency response in the event of a spill or accident.

Anyone responsible for the disposal of PCBs should select high-quality firms for the transport and disposal of their PCB-containing wastes. Also, spot-check to assure transported and disposed is recommended. The generator of the waste should take responsibility for proper waste management.

Recommended options for the disposal of PCB-containing wastes (in priority order) are:

Incineration
Controlled land disposal

Incineration.—The proper incineration of waste PCB must involve a suitable balance among temperature in the incinerator, dwell time in the firing chamber and oxygen availability. Also, a suitable scrubber should be provided on the exhaust stack to remove the hydrochloric acid mist that is formed. Exhaust gases ~~should be~~ monitored to assure compliance with air regulations.

Recommended requirements are: (1) 2-second dwell time at 1100 C (2000 F) and 3 percent excess oxygen in the stack, or (2) 1½ second dwell time at 1500 C (2700 F) and 2 percent excess oxygen in the stack gas.[1] Open hearth and other incinerators used for municipal refuse incineration are not normally suitable; the relatively low operating temperature of such equipment would only volatilize the PCBs and pollute the atmosphere. In addition, instrumentation and handling equipment are usually not sufficient for managing hazardous materials. Therefore PCB-containing waste should not be sent to such municipal incinerators for disposal.

The above recommendations are suitable for liquids. Incineration of solid wastes containing PCBs has not been demonstrated. However, such destruction does appear feasible. For example, a rotary kiln furnace, with an afterburner and scrubbing system, could probably safely incinerate solid wastes containing PCBs. Likewise, other smaller, high temperature incinerators with sufficient residence times may be satisfactory for the smaller waste generator.

As a service, Monsanto will incinerate (for a fee) any returned liquids in their high temperature incinerator. A technical description of the Monsanto incinerator is provided in Appendix B.

EPA publication, *Hazardous Waste Management Facilities* (EPA 530/SW-146) provides information on some incineration facilities. Use of these facilities for incineration of PCB-containing waste should be checked with EPA Regional and State representatives to assure that the facilities have adequate environmental controls to meet Federal/State/local regulations.

Land Disposal.—Wastes containing PCBs should not be disposed of with other mixed wastes in a sanitary landfill (See EPA Guidelines on Thermal Processing and Land Disposal of Solid Waste, Federal Register, August 14, 1974). Characteristics of transport of PCBs through the soil are not definitively established. The interaction with other decomposing wastes is not well understood. Some landfills may contain or accept wastes which could cause the release of PCBs. The ubiquity and persistence of PCBs indicate that their disposal should be carefully controlled until additional data are developed. While these data are being gathered, PCBs (when disposed to the land) should only be placed in a secure chemical waste landfill.

In general terms, a chemical waste landfill provides complete long-term protection for the quality of surface and subsurface waters from hazardous waste deposited therein, and against hazards to public health and the environment. Such sites should be located or engineered to avoid direct hydraulic continuity with surface and subsurface waters. Generated leachates should be contained, and subsurface flow into the disposal area eliminated. Monitoring wells should be established, and a sampling and analysis program conducted. Additional characteristics of a chemical waste landfill are described in EPA publication, *Landfill Disposal of Hazardous Wastes: A Review of Literature and Known Approaches* (EPA/530/SW-165).[2]

[1] These values are from ANSI C107.1-1974 Guidelines for Handling and Disposal of Capacitor and Transformer Grade Askarels Containing Polychlorinated Biphenyls, American National Standards Institute.

[2] Documents referenced here may be obtained from Solid Waste Information, U.S. Environmental Protection Agency, Cincinnati, Ohio 45268.

Encapsulation of wastes in cement prior to bureau in a sanitary landfill has been used for small quantities of solids or sludges. This is usually done by casting the waste in concrete inside a drum prior to deposition in the landfill.

Only those specific sites which have been State approved for PCB wastes should be used. The EPA publication, *Hazardous Waste Management Facilities* (EPA/530/SW-146), provides some information to potential disposers. these data when used in consultation with State solid waste management officials can assist in a disposal action

Dated March 26, 1976

ROGER STRELOW,
Assistant Administrator for Air and Waste Management

APPENDIX A

LISTING OF NAMES USED FOR PCB'S BY MANUFACTURERS

Name	Manufacturer
Aroclor	Monsanto
Asbestol	American Corp
Askarel	(¹)
Chlorextol	Allis Chalmers
Diaclor	Sangamo Electric
Dykanol	Cornell Dubilier
Elemex	McGraw Edison
Hyvol	Aerovox
Inerteen	Westinghouse Electric
No-Flamol	Wagner Electric
Pyranol	General Electric
Saf-T-Kuhl	Kuhlman Electric
Clophen	Bayer (Germany)
DK	Caffaro (Italy)
Fenclor	Caffaro (Italy)
Kanechlor	Mitsubishi (Japan)
Phenoclor	Prodelec (France)
Pyralene	Prodelec (France)
Santotherm	Mitsubishi (Japan)

¹ Generic name used for insulating liquids in capacitors and transformers, may contain PCBs

APPENDIX B—DESCRIPTION OF MONSANTO INCINERATION FACILITY

SAUGET, ILLINOIS

Background—The Krummrich Plant is one of Monsanto's large chemical manufacturing plants. The product line includes sulfuric acid, benzene, chlorine, polychlorinated biphenyls, several rubber compounds, and various chemical intermediates. The plant is located immediately south of East St Louis, Ill near the Mississippi River Since June 1971, Monsanto has operated a liquid injection incinerator to dispose of in-house liquid wastes and contaminated PCBs from customers.

Waste Characteristics—The large majority of the wastes burned are PCB derivatives The sources of these wastes are process still bottoms and contaminated transformer oils The heating value of the materials is about 9000 BTU/lb Other in-house high BTU liquid wastes are also incinerated. Phosphorous compounds cannot be burned due to the formation of particulates (P_2O_5) which foul the injection system The system is not equipped to handle suspended solids Four 20,000 gallon tanks are available for storage. The wastes are typically stored for several days before incineration to allow undissolved solids to settle After the settling period, the wastes are pumped directly from the tanks to the liquid combustor

Incinerator Description—The incinerator is a liquid injection type housed in a horizontal cylinder 20 ft. long and 9.5 ft. in diameter High pressure steam is used to atomize the waste liquid and inject it into the liquid combustor The feed rate measures 2 gal/min An additional gun which burns natural gas is also positioned inside the plenum The natural gas serves as an auxiliary fuel to supplement the heating value of the waste if necessary. The operating temperature varies from 2000 to 2200 F If the temperature is too high, water can be sprayed into the chamber to act as a heat sink The cylinder is protected from the heat by a lining of refractory brick High alumina brick is used in the plenum chamber A blower supplies 25% excess air forcing the fumes from the plenum and through an oxidizer. The residence time inside the oxidizer is 2-3 seconds

The unit is operated 24 hours/day requiring 2 men/shift. Initial capital costs were $750,000 The disposal cost has averaged 10¢/lb.

Air Pollution Control—The fumes exit the oxidizer and enter a water quench column The main purpose of the quench is to reduce the temperature of the hot fumes Particulates are removed next in a high energy venturi scrubber. Finally, the emissions are cleaned in a packed bed (polypropylene packing) at the base of the stack. The 40 ft stack is equipped with a demister.

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[FR Doc 76-9420 Filed 3-31-76;8:45 am]

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Appendix E

WEDNESDAY, JUNE 9, 1976

PART I:

ENVIRONMENTAL PROTECTION AGENCY

VINYL CHLORIDE

Recommended Procedures for Disposal of Aerosol Can

VINYL CHLORIDE

Recommended Procedures for Disposal of Aerosol Cans

Background. On January 22, 1975, the Environmental Protection Agency in the FEDERAL REGISTER canceled certain indoor aerosol pesticide products which contain vinyl chloride as a propellant (40 FR 3494). Following that action, the Office of Solid Waste Management Programs (OSWMP) of EPA developed internal guidance for the use of its Regional Offices should they be requested to provide disposal advice to affected parties.

On September 5, 1975, and again on February 6, 1976, the Consumer Product Safety Commission (CPSC) reaffirmed in the FEDERAL REGISTER its regulation declaring *any* self-pressurized products intended or suitable for household use that contain vinyl chloride monomer as an ingredient or in the propellant to be "banned hazardous substances". That action included certain repurchase requirements for manufacturers and had obvious disposal implications. In fact, CPSC in the September 5, 1975, FEDERAL REGISTER notice requested appropriate industry officials to conduct their repurchase and disposal actions in accordance with EPA guidelines (40 FR 41170). It was also noted "* * * that 'many States and municipalities have adopted codes for the disposal of hazardous wastes * * * [which, in many instances] are in conformity with EPA guidelines and will insure the proper disposal of the products involved." No seizure actions have been initiated to date, but the CPSC, if necessary, "will recommend to the Courts disposal methods consistent with EPA guidelines."[1]

Purpose. Pursuant to section 204(b)(1) of the Solid Waste Disposal Act, as amended, the Administrator may issue guidance and recommendations to State and local government, industry, organizations, and individuals, related to the disposal of waste materials.

The purpose of this publication is to provide guidance for the disposal of vinyl chloride-containing aerosol cans. This guidance is addressed primarily to holders[1] of large quantities of vinyl chloride-containing aerosol cans, although the recommended procedures are appropriate to disposal of any such wastes. These recommended procedures represent the best information available on preferable disposal options for vinyl chloride-containing aerosol cans.

When the problem of disposal surfaced, little was known about the chemical interactions of vinyl chloride monomer (VCM) with the environment. While the chemical and physical properties of VCM as they generally relate to its manufacture and use are known, there is limited information on how VCM reacts in a land disposal site environment. However, comparison of the known properties of VCM to those of other gases has been attempted in order to provide a base for recommended procedures for the disposal of VCM-containing aerosols. The following recommendations acknowledge recommended procedures for pesticide disposal as well as procedures for disposal of heavy-metal containing materials.

Technical background. Vinyl chloride monomer (VCM) is a chlorinated alkene hydrocarbon with a density of twice that of air. Since VCM boils at −13.37 C, it is a gas at normal atmospheric temperature and pressure. Vinyl chloride is highly flammable having a flash point of −78 C. The explosive limits are from 4 to 22 percent VCM in air by volume.

VCM is soluble in organic solvents, but not very soluble in water. The quantity of VCM that dissolves in water depends on the partial pressure of the gas above the solution. If the partial pressure of the gas above the water is reduced, VCM will escape into the gas phase and be released to the ambient air. Chemical reactions, which can occur because of water impurities, might tend to inhibit escape of vinyl chloride. Certain salts have the ability to combine with VCM: for example, soluble silver and copper salts increase the solubility of VCM in water by forming complex dissolved salts.

VCM makes up about 20 percent by volume (equivalent to about 16 percent of the net weight) of the propellant in most of the canceled pesticide aerosols. The pesticides involved are mainly pyrethrins, lindane, and malathion. In hair sprays, deodorants, paints, etc., however, VCM may constitute as much as 40 to 45 percent by volume of the contents. Other propellants are chlorofluorocarbons 11

[1] The CPSC estimated in its September 5, 1975, *Federal Register* notice that an estimated 3.3 million cans of vinyl chloride aerosols were in existence. Of these, approximately one million were in the hands of manufacturers, wholesalers, and retailers. The remaining 2.3 million cans were in the possession of the consumer.

and 12 (e.g. Freon). Although EPA has no data on the ingredients of non-pesticide aerosols, hairsprays, for example, would be expected to consist mainly of organics, while paints may contain heavy metals such as cadmium, lead, chromium, or mercury.

Disposal of VCM-containing aerosol cans. Final disposal of VCM-containing aerosol cans should be undertaken using methods listed in order of preferred priority:

1. High temperature incineration (except for products containing heavy metals)
2. Burial in a State-approved chemical (or hazardous) waste landfill
3. Burial in a separate area of a State-approved sanitary landfill.

It should be noted that chemical treatment to recover the active materials may be technically feasible, but would require special handling techniques to remove the contents from the cans. Since this process is very costly, its feasibility depends largely upon the value of the recovered materials.

Incineration. Incineration should be used when possible for final destruction of the materials. This method is limited to heavy duty rotary-kiln or other incinerators that (1) can handle aerosol cans without damage, (2) operate at a temperature of 1000 C with two seconds dwell time, and (3) are equipped with appropriate pollution controls to meet State or local air pollution control requirements. Incineration should not be used where the product contains more than trace quantities of heavy metals such as lead, mercury, cadmium and chromium.

High temperature incineration of pesticides, VCM, and the other propellants and solvents or carriers found in aerosol units can effectively be carried out at 1000 C with a dwell time in the combustion zone of two seconds. Although VCM probably is destroyed at a lower temperature (one source indicated 700 C was sufficient), preparations containing pesticides may not be completely combusted. Additionally, the hair sprays, deodorants, etc. contain unknown resins which may require higher temperatures for complete destruction.

Since the cans explode and produce shrapnel at high temperatures, only heavy duty rotary-kiln or equivalent units should be considered if more than about 12 cans are to be disposed of at one time. Incinerator feed mechanisms should be adjusted to prevent injury or damage from blow-back which may occur when several aerosol units (such as one case) are introduced simultaneously.

A pollution control system will be required to remove potential air contaminants. Most of these aerosols contain chlorofluorocarbon propellants as well as VCM, and, therefore, generate both hydrogen chloride (HCl) and hydrogen fluoride (HF).

EPA publication, Hazardous Waste Management Facilities (EPA/530/SW-146.2),[3] provides information on some incineration facilities. Use of these facilities for incineration of VCM-containing aerosol cans should be checked with EPA Regional and State representatives to assure that the facility has adequate environmental controls to meet Federal/State/local regulations.

Chemical Waste Landfills. In some areas there are public or commercial landfills that have been approved by State agencies to accept industrial hazardous wastes. Such sites are located, engineered, or constructed to avoid hydraulic continuity with either surface or ground water. Disposal of VCM aerosols in these facilities does, however, require extraordinary care above that given to other toxic or hazardous wastes (such as sludges), because the gases that could be released upon rupture of the unit are highly volatile and flammable as well as toxic.

Further details on the recommended site criteria and operating procedures for landfilling are given in the following section. Specifically, however, in the case of VCM disposal in a chemical waste landfill, special bottom liners would not be needed although all other criteria and procedures should be followed.

State-approved Sanitary Landfills. Sanitary landfills for disposal of aerosols containing VC, should only be considered if an adequate incinerator or chemical waste landfill is not available. Even then, special conditions should be observed to assure proper disposal. Such a landfill should be located and operated in an appropriate manner and be inspected and approved by State and local agencies.

The following procedures discuss the landfilling aspects of disposal of aerosols containing VCM and are only concerned with the propellant. The active ingredients in the aerosol can could dictate more stringent disposal requirements due to their potential hazard to the environment. However, the quantities of active ingredient contained are usually small (1 percent of the net weight or less). Most of the pesticide chemicals involved are insoluble in water and biodegradable. Thus, they may not move from the burial site in ground water or percolating water, but would be biodegraded to their basic constituents in place. Other products, however, may contain soluble materials capable of polluting groundwaters. Procedures discussed in the next section will limit groundwater degradation potential.

Little is known of the soil degradation of VCM gas. However, the polar molecules suggest that the gas will be loosely held in place by soil organic matter, and by the clay fraction of the soil. Soil moisture also impedes the dispersion of gases in soils; however, the best medium to contain gases would have a moisture content approaching 50 percent of field capacity. Such soils also normally contain a large, varied population of microorganisms including several species that might attack the organic compounds found in aerosols.

Recommended Procedures for Landfilling. State-approved sanitary landfills that are located, designed, and operated in accordance with EPA's "Guidelines for the Land Disposal of Solid Wastes" (40 CFR Part 241) published August 14, 1974, in the *Federal Register* (39 FR 29328) are acceptable, provided that the following special criteria and procedures are utilized:

(1) Advance notice is given to the appropriate State agency;

(2) A facility is chosen which has groundwater monitoring facilities or such facilities are provided prior to disposal of the cans. Quarterly monitoring for heavy metals or other potential pollutants should be carried out;

(3) The burial site is specifically recorded in the property records;

(4) A separate, clearly marked area is set aside so that the bottom of the trench (in which the aerosol cans are to be placed) is at least one foot above the 60-year high water table.

(5) A trench with minimum depth of 10 feet is dug

(6) A high-density polyethylene film (20 to 30 mil) (or equivalent material) is properly installed at the bottom of the trench

(7) One foot of topsoil covers the film (see note).

(8) A single layer of cases or randomly distributed cans do not exceed 12 inches in depth and 3 feet in width

(9) One foot of topsoil covers the cans (see note).

(10) Six feet of cover material is compacted over the topsoil (see note);

(11) A high-density polyethylene film liner (20 to 30 mil) is laid over the compacted cover;

(12) One foot of final cover is compacted, and

(13) The following safety precautions are observed during disposal:

No smoking or open flames, since VCM is a flammable gas.

No direct compaction of cans is undertaken since rupture will expose workers to hazardous or toxic vapors.

Each day's accumulation is covered with at least one foot of topsoil and 6 feet of cover and compacted.

NOTE.—Organic matter, clay, and moisture contents of soils will provide additional protection by interfering with the movement of chlorinated hydrocarbon pesticides and VCM to the surface or to the water table. The topsoil and cover material should contain less than the optimum moisture content for compaction, in order to provide more pore space for the absorption of gases. The final cover should be mounded to approximately six inches above grade in the center to promote runoff and reduce infiltration.

Dated: June 4, 1976.

ROGER STRELOW,
Assistant Administrator for Air and Waste Management.

[FR Doc.76-16647 Filed 6-8-76;8:45 am]

[3] Referenced document may be obtained from Solid Waste Information, U.S. Environmental Protection Agency, Cincinnati, Ohio 45268.

Appendix F

FEDERAL AGENCIES

The activities in hazardous waste management at the Federal level are concentrated in the EPA, Office of Solid Waste (OSW). Within OSW, the Hazardous Waste Management Division (HWMD) is primarily involved in: (a) building a data base in the hazardous waste management area, particularly in connection with public health and environmental damage assessment, quantification of hazardous waste generation, and definition of applicable treatment and disposal technology; (b) development of guidelines and standards for hazardous waste management; and (c) program implementation involving assistance to States in development of hazardous waste management programs. HWMD has sponsored numerous studies on hazardous waste management and has an extensive data file on pertinent literature publications and documents.

The EPA has ten Regional Offices. Each Regional Office has a solid waste management representative to whom inquiries should be directed. Figure F-1 contains a map locating the regional offices and their coverage; Table F-1 lists addresses and telephone numbers for the Regional Solid Waste Management representatives, Air and Hazardous Materials Division, and the Regional Administrator.

In addition to the Office of Solid Waste, a number of other EPA offices have certain programs and responsibilities related to identification, handling, and regulation of hazardous substances. A listing of the most pertinent of these agencies is shown in Table F-2. Major Federal agencies other than the EPA, which are concerned with various environmental aspects of hazardous materials, are listed in Table F-3 along with a brief description of their responsibilities.

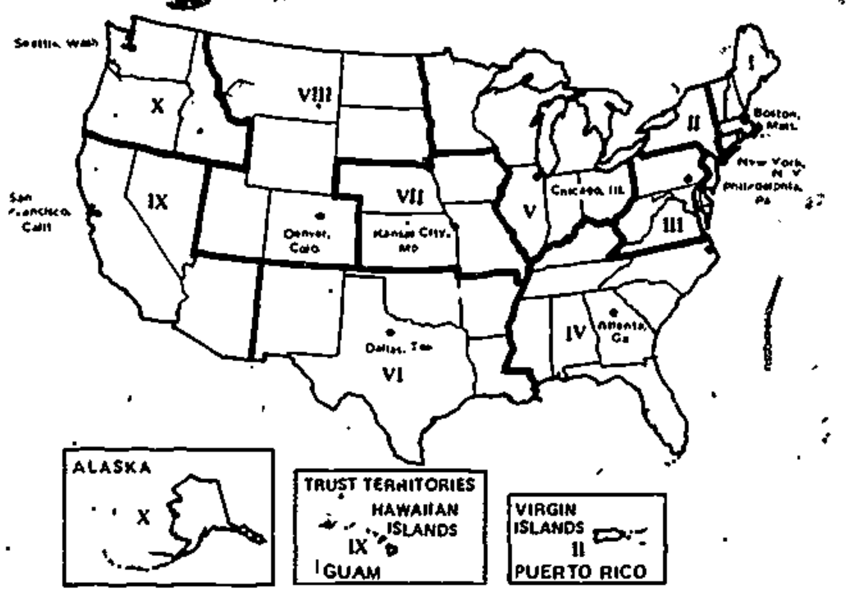

Figure F-1. United States Environmental Protection Agency, regional offices.

TABLE F-1
ENVIRONMENTAL PROTECTION AGENCY REGIONAL OFFICE

Region	SWM Representative Address as: Solid Waste Management Rep. EPA Region No. Street. City, State. Zip	Air & Hazardous Materials Division Address as: Director Air & Hazardous Materials Division EPA Region No. Street City, State, Zip	Regional Administrator Address as: Regional Administrator EPA Region No. Street City, State, Zip	Address
I	(617) 223-5775	(617) 223-5186	(617) 223-7210	John F. Kennedy Building Boston, Massachusetts 02203
II	(212) 264-0503/4/5	(212) 264-2301	(212) 264-2525	Federal Office Building 26 Federal Plaza New York, N. Y. 10007
III	(215) 597-8116	(215) 597-8131	(215) 597-9814	Curtis Building 6th and Walnut Street Philadelphia, Pennsylvania 19106
IV	(404) 881-3116	(404) 881-3454	(404) 881-4727	345 Courtland Street, N. Atlanta, Georgia 30308
V	(312) 353-2197	(312) 353-2212	(312) 353-2000	230 South Dearborn Street Chicago, Illinois 60604
VI	(214) 749-7601	(214) 749-1121	(214) 749-1962	1201 Elm Street - First Int'l Bldg. Dallas, Texas 75270
VII	(816) 374-3307	(816) 374-3307	(816) 374-5493	1735 Baltimore Avenue Kansas City, Missouri 64108
VIII	(303) 837-2221	(303) 837-3895	(303) 837-3895	1860 Lincoln Street Denver, Colorado 80203
IX	(415) 556-4606/7	(415) 556-0217	(415) 556-2320	100 California Street San Francisco, California 94111
X	(206) 442-1260	(206) 442-1236	(206) 442-5810	1200 6th Avenue Seattle, Washington 98101

TABLE F-2

EPA OFFICES CONCERNED WITH ENVIRONMENTAL ASPECTS OF HAZARDOUS MATERIALS

OFFICE	PERTINENT RESPONSIBILITIES
Hazardous Waste Management Division Office of Solid Waste Management Programs U.S. Environmental Protection Agency Waterside Mall, Room 2111 401 M. Street, S.W. Washington, D.C. 20460 (202) 755-9185	The office quantifies hazardous waste generation and defines applicable treatment and disposal technology, develops guidelines and standards; directs technical assistance to Regions, States, organizations and private individuals on treatment and disposal of hazardous wastes.
Division of Water and Hazardous Materials Office of Water Program Operations U.S. Environmental Protection Agency Waterside Mall East, Room 1113C 401 M. Street, S.W. Washington, D.C 20460 (202) 426-3971	The office provides information on the government's role in the safe handling of hazardous materials. It also establishes regulations for the prevention, control and clean up of oil and hazardous material discharges to water.
Pesticides Registration Division Office of Pesticides Programs U.S. Environmental Protection Agency Waterside Mall East, Room E539A 401 M. Street, S.W. Washington, D.C. 20460 (202) 755-8036	Areas of interest include pesticide toxicology, pesticide residue tolerances, pesticide analytical standards, and pesticide chemical methodology. The office also answers letters of inquiry about the status of pesticide uses under the provisions of the Federal Insecticide, Fungicide, and Rodenticide Act.
Office of Radiation Programs U.S. Environmental Protection Agency 401 M. Street, S.E., E. Tower, Room 611 Washington, D.C. 20460 (202) 755-4894	The office publishes *Radiation Data and Reports* (monthly). Other services are provided to Federal and State agencies, scientific organizations and industry.
Air Pollution Technical Information Center (APTIC) Office of Air and Waste Management U.S. Environmental Protection Agency Research Triangle Park, North Carolina 27711 (919) 688-8146	APTIC collects basic data on the chemical, physical and biological effects of varying air quality, and other information on the prevention and control of air pollution. Citations, abstracts, and extracts from the literature file are provided. APTIC prepares state-of-the-art reviews and publishes *Air Pollution Abstracts*.
Office of Toxic Substances U.S. Environmental Protection Agency 401 M. Street, S.W. Washington, D.C. 20460	Areas of interest include toxic chemicals. The office collects basic data on such chemicals and also answers inquiries.

TABLE F-3

SELECTED FEDERAL AGENCIES (OTHER THAN EPA) CONCERNED WITH VARIOUS ASPECTS OF HAZARDOUS WASTE MANAGEMENT*

AGENCY	PERTINENT RESPONSIBILITIES
Food and Drug Administration U.S. Department of Health, Education and Welfare 5401 Westbord Avenue Bethesda, Maryland 20016 (301) 496-7691	The FDA acts to recall consumer products which have been determined to be hazardous, and publishes recall reports on such products. This agency also investigates, sets standards, and enforces regulations on safety of food, drug, and cosmetic items. FDA has offices in most major cities.
Medical Library Bureau of Drugs, BD-45 Food and Drug Administration 5600 Fishers Lane Rockville, Maryland 20852 (301) 443-3182	Areas of interest include adverse effects of drugs, cosmetics, household chemicals, and feed and food additives; packaging and containers for above items; natural occurrence of food toxicants; contaminants of foods, drugs, and cosmetics. The library also has books, periodicals, microfilm, audio equipment, extensive card indices on toxicants and their adverse effects. The library also answers inquiries and provides references.
U.S. Consumer Product Safety Commission Washington, D.C. 20207 (800) 638-2666 (*toll free*) (800) 492-2937 (*Maryland residents only*)	This agency publishes periodic fact sheets which provide information on dangerous consumer products (exclusive of food, drug, and cosmetic items). It answers inquiries and compiles data on reported product hazards and product-related injuries.
Office of Hazardous Materials U.S. Department of Transportation 400 Sixth Street, S.W. Washington, D.C. 20590 (202) 426-0656	This office establishes regulations on the transportation of hazardous materials via public carriers and provides information and advice on regulations and procedures for safe handling, transportation, and clean up of spills of hazardous chemicals. The agency has 14 district offices across the country.
Mail Classification Division U.S. Postal Service Washington, D.C. 20260 (202) 961-7405	This office establishes standards for what can be sent through the mail and how it should be packaged.
Environmental Mutagen Information Center Environmental Information System Office Oak Ridge National Laboratory P.O. Box X Oak Ridge, Tennessee 37830 (615) 483-8611 Ext. 3-7998	Maintains a data base of chemical mutagenesis information. Evaluates and analyzes data and makes them available to researchers. Publishes state-of-the-art reviews, critical reviews, and a newsletter.
Division of Technical Services National Institute for Occupational Safety and Health U.S. Department of Health, Education, and Welfare 5600 Fishers Lane Rockville, Maryland 20852 (302) 443-2140	The division answers inquiries and provides consulting services on questions related to industrial safety, medicine, hygiene, toxicology, working conditions, and sanitation.

*Based in part on the information contained in the following reference which should be consulted for additional listings. Selected Information Resources on Hazardous Materials, National Referral Center, Science and Technology Division, Library of Congress, Washington, D.C.

*U.S. GOVERNMENT PRINTING OFFICE : 1977 0-720-313/4001