TSCA LANDFILL INSPECTION

GUIDANCE MANUAL

MARCH, 1990

U.S. ENVIRONMENTAL PROTECTION AGENCY
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The Pesticides and Toxic Substances Branch of the U.S. Environmental Protection Agency, Region V, was tasked by the Office of Pesticides and Toxic Substances to take the lead in the development of this "TSCA Landfill Inspection Guidance Manual." It has been developed in consultation with U.S. Environmental Protection Agency headquarters and the Regional TSCA offices to produce a document that will be useful to field inspectors from all Regions. This manual is also intended to be practical and appropriate for use by cooperative agreement state inspectors working in regions in which permitting is a RCRA responsibility.

EXCLUSIVE USE OF THIS DOCUMENT

The policy and procedures set forth herein, and internal inspection procedures adopted pursuant hereto, are intended solely for the guidance of TSCA compliance personnel employed by or representing the U.S. Environmental Protection Agency or comparable state regulatory agency. They are not intended to nor do they constitute rule-making by the Agency, and may not be relied upon to create a right or benefit, substantive or procedural, enforceable at law or in equity, by any person. The Agency may take any action at variance with the policies or procedures contained in this manual, or which are not in compliance with internal office procedures that may be adopted pursuant to these materials.

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CHAPTER 1

INTRODUCTION

This manual was developed as a guidance document and training tool for EPA, state, and local inspectors who conduct inspections of PCB disposal landfills permitted under the Toxic Substances Control Act (TSCA). A secondary audience is the TSCA landfill permit writer, who may learn more about the contents of an enforceable permit by understanding the needs of inspectors. The manual provides:

* Background information on landfills and associated technologies: landfill siting, groundwater protection systems (liners, leachate management systems, cover technology) and ground and surface water monitoring technology and procedures.

* A TSCA overview, and an extended discussion of TSCA landfill regulations and the permitting/approval process.

* A detailed description of the approach to preparation and completion of a TSCA landfill inspection.

* A discussion of objectives and priorities for inspections, and an example of a generic regulations-based checklist.

This manual serves as a landfill-specific supplement to the *TSCA Inspection Manual* and is not intended to cover all of the general activities of a TSCA Compliance Evaluation Inspection. Although the scope is limited to "landfilling," as defined by TSCA, much of the information and the approach presented in this manual could be useful in planning inspections of other PCB disposal facilities.

This manual reflects the current state-of-knowledge of the TSCA landfill program (as of January 1990). Regulations and guidance may change as new knowledge and experience are gained. With only a few years experience in evaluating landfills after they have been permitted, the TSCA landfill program does not have extensive knowledge of "typical" or "predictable" long-term operational and maintenance problems associated with these facilities. As more experience is gained in this area, some changes in the approach to landfill inspection may become appropriate.

The inspection approach and activities detailed in this manual reflect the necessity for an inspector to identify the specific needs of an inspection for a particular facility and to establish inspector time-use priorities. The contents of an inspection are based on limits and conditions established by regulation and in a permit. However, a successful inspection also requires an inspector who can combine an inquisitive nature and a knowledge base to make the judgments needed in the field to provide clear, comprehensive documentation of the status of the landfill's compliance with TSCA regulations and permit conditions.

Chapter II of this manual provides background information of potential use to inspectors concerning landfill technology and monitoring system technology and procedures. It reviews basic concepts and serves as a quick reference to assist the inspector in understanding the function and potential problems associated with landfill technology and monitoring.

Chapter III provides an overview of TSCA landfill regulations and the permitting process.

Chapter IV deals directly with the preparations to be made prior to inspection and the approach to be employed to conduct and complete a TSCA landfill inspection. It also lists and describes some of the permit or Operations Plan conditions that an inspector may evaluate during an inspection. A regulations based checklist is provided at the end of Chapter IV.

Chapter V addresses appropriate follow-up activities to the inspection.

Chapter VI provides a list of the references that support this document.

CHAPTER II

LANDFILL TECHNOLOGY AND BACKGROUND

Three major components are linked to form the chain of measures taken to assure that hazardous or toxic constituents do not migrate from a TSCA landfill facility. This safety chain, which is intended to provide long-term protection of human health and the environment, is composed of the following elements: landfill siting considerations; ground water protection systems (includes landfill design features such as liner, leachate and landfill cover systems, and ground water monitoring systems); and a comprehensive program of ground water and surface water sampling and analysis. If one of these elements is ill-conceived, or improperly executed or constructed, the protectiveness of a landfill is greatly diminished. The following three sections, therefore, address these major components in turn, and are intended to provide a TSCA inspector with a basic understanding of proper landfill siting, design/monitoring, and analytical considerations/procedures.

A. LANDFILL SITING CONSIDERATIONS

There are several factors which must be considered in an evaluation of the suitability of a particular site for construction of a TSCA landfill. The first of these is whether or not the site meets the regulatory criteria as presented under 40 CFR 761.75(b). The subtopics addressed by the regulations which could collectively be grouped under landfill siting considerations include soils, hydrologic conditions, flood protection and topography.

1. Soils

The TSCA regulations specify that PCB landfills must be sited in thick, relatively impermeable formations or where the soil has a high clay and silt content (>30%). The minimum thicknesses for in-place and compacted soil liners must be 4 and 3 feet respectively. These soils must also have low permeabilities (no greater than 10^{-7} cm/sec), a liquid limit > 30 and a plasticity index > 15. These considerations are based upon a desire to place the facility into a setting which inhibits the migration of hazardous or toxic constituents from a TSCA landfill regardless of design or monitoring specifications.

2. Hydrologic Conditions

The regulations state that the bottom of the landfill liner system or natural in-place liner must be at least 50 feet from the historical high water table, that floodplains, shorelands and ground water recharge areas shall be avoided as landfill sites, and that there shall be no hydraulic connection between a site and surface waters. Clearly, it is desirable to site all landfills in locations that are as far removed as possible from a direct connection with ground water and surface water sources.

3. Flood Protection

The TSCA landfill regulations provide two specifications depending on the site's elevation relative to that of the 100-year flood plain. If the landfill site is below the 100-year floodwater elevation, diversion dikes having a minimum height equal to 2 feet above the 100-year floodwater elevation must be provided around the perimeter of the site. If the site is above the 100-year flood plain, diversion structures capable of diverting all surface runoff from a 24-hour, 25-year storm must be provided for the facility. Because of the potential for dispersal of contaminants due to flooding, it is required that these flood protection requirements be met for TSCA landfill sites.

4. Topography

TSCA landfill sites must also be located in areas of low to moderate relief to minimize erosion and to prevent landslides and slumping.

Provisions exist within the TSCA landfill regulations to allow these specifications to be waived on an individual basis, if, in the Regional Administrator's opinion, the facility is judged to be protective of human health and the environment. (See regulations discussion in Chapter III.)

Historically, the 50-foot ground water rule and the plasticity index/liquid limit rules have been waived for some facilities in exchange for EPA-imposed compensatory requirements (such as increased liner thicknesses, etc.).

Seismic considerations may be important for landfill siting in some regions. Although TSCA regulations do not address this subject, a landfill facility should not be built within 200 feet of an active Holocene fault if it is to be located within EPA Regions VIII, IX and X (see 40 CFR 264, Appendix VI).

CHAPTER II

B. GROUND WATER PROTECTION SYSTEMS

1. General Description and Purpose

A landfill is an engineered facility where hazardous, toxic, or other wastes are placed in or on the land. Landfills for hazardous or toxic wastes usually are regarded as a technology of last resort to be implemented after approaches to minimize or reduce the hazard or volume of the wastes have been evaluated. The intent is to bury or modify the wastes in a manner that does not pose an environmental or public-health threat.

Landfill technology is based on containment rather than treatment or detoxification for control of hazardous and toxic wastes. Landfilling is a very common technique for management of both untreated wastes and the residues from treatment technologies. Landfill designs require careful construction, continuous maintenance and monitoring, and a high degree of management and technical attention.

Landfills are typically non-homogeneous and are built in subcells in which partial volumes of the waste are isolated from adjacent subcells and wastes by suitable barriers. Figure 1 is a schematic cross section of a toxic waste landfill.

Barriers between cells and subcells or liner systems between the landfilled waste and the natural soil consist of a continuous layer(s) of natural and/or man-made materials which limit downward or lateral movement of the hazardous or toxic waste, waste constituents, or leachate. These barriers or liners may consist of compacted clay, soil, or man-made plastic material having very low permeability.

In any landfill designed for the disposal of hazardous and toxic wastes, careful consideration should be given to the long-term protection of the environment. For example, the Resource Conservation and Recovery Act (RCRA) demands that new secure landfills be able to maintain their integrity and security for 30 years after closure. This arbitrary time frame may not adequately consider the safe long-term disposal of some wastes which retain their hazardous or toxic characteristics for long periods of time.

A "secure" landfill may not be completely secure over its lifetime. Some of the reasons for failure are the following:

* Operating methods may permit too much fluid to enter the landfill prior to closure.

* Construction procedures or waste placement methods may produce tears, punctures or other physical failures in synthetic or soil/clay liners.

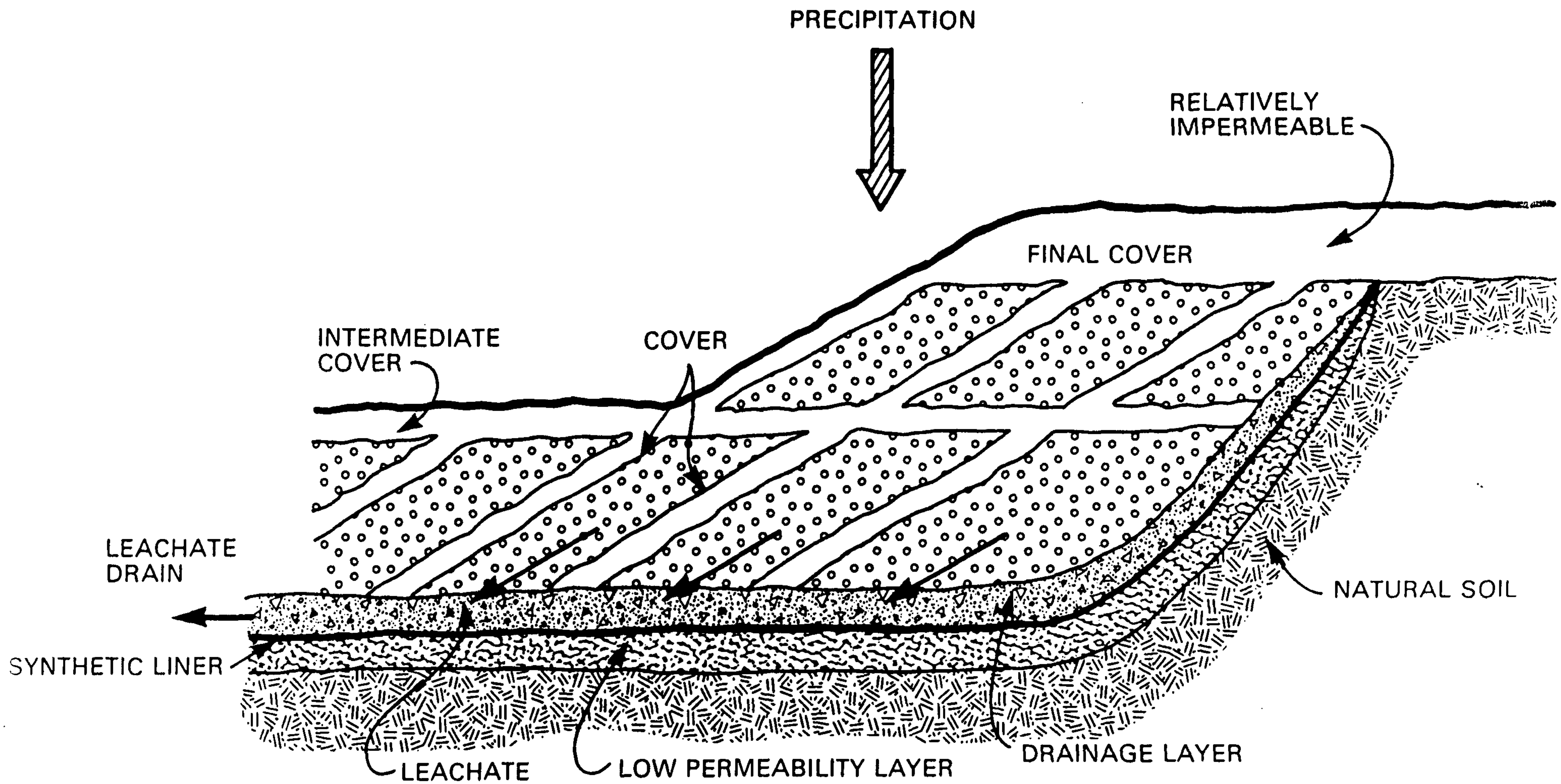

Figure 1: **SCHEMATIC OF A TOXIC WASTE LANDFILL**

* Leachate collection systems may include design or installation defects.

* Post-disposal consolidation and subsidence over time may result in breaks in the liner or cover material.

* Solvents can affect the permeability of clay liners by causing the clay to shrink or crack.

In order to understand the most important aspects of a secure landfill design, it is proper to briefly discuss possible contaminant migration pathways. If the cap of a landfill is disturbed or breached, contaminant migration may be caused by surface runoff, volatilization, wind-activated sediment suspension or infiltration, followed later by a substantial increase in the production of leachate. The most common of these, the leachate production problem, is one which is usually difficult and costly to resolve.

2. Modes of Chemical Contamination

There are several pathways by which chemical contamination can spread to an aquifer from a disposal site. In facilities where water infiltration is restricted and unsaturated conditions exist near the ground surface, a sudden release from a storage tank, surface impoundment or landfill will migrate downward and, if the ground water table is extremely deep, respond to a steadily decreasing driving force (hydraulic gradient) by slowing its advance to a rate of centimeters per year. In rainy climates where water tables are higher, or where sites tend toward saturation and hold much larger quantities of fluid, the driving force is not likely to decrease significantly before a contaminant plume reaches an aquifer. This is the most common situation, and the most difficult to rectify. In this case, the contaminants are carried by continuous flow until reaching the aquifer. At that point, flow, fluid, and chemical factors govern the ultimate fate of the involved contaminants.

Because of the seriousness of potential releases via any of the above-mentioned pathways, secure landfills intended for hazardous and toxic waste disposal must include additional design features above those required for conventional sanitary landfills to assure long-term protection of ground water, surface water, air, and human health.

3. Environmental Standards

Various techniques are available for reducing the potential for negative effects due to landfilling of hazardous and toxic wastes. Standards have been developed by the U.S. EPA with regard to most of these techniques. An environmental performance standard issued by the U.S. EPA (40 CFR 267.10 Subpart B) for new hazardous waste landfills dictates that they shall be located, designed, constructed, operated, and closed in a manner that will assure the protection of human health and the environment. Protection of human health and the environment would include but not be limited to the following:

a. Prevention of negative effects on ground water quality considering:

(1) The amount and physical and chemical characteristics of the waste in the facility, including its potential for migration through soil or through synthetic liner materials.
(2) The hydrogeological characteristics of the site and surrounding land.
(3) The quantity, quality and direction of ground water flow.
(4) The proximity and withdrawal rates of ground water users.
(5) The health risks involved by human exposure to waste constituents.
(6) The potential damage to wildlife, livestock, crops, vegetation and physical structures caused by exposure to waste constituents.
(7) The persistence and permanence of potential adverse effects.

b. Prevention of negative effects on surface water quality, considering:

(1) The volume and physical and chemical characteristics of the waste in the facility.
(2) The hydrogeologic characteristics of the facility and surrounding land, including the topography of the area around the facility.
(3) The quantity, quality and direction of ground water flow.
(4) The distribution of rainfall in the region.
(5) The proximity of the facility to surface waters.
(6) The existing quality of surface water, including other sources of contamination and their cumulative impact on surface waters.
(7) The persistence and permanence of potential negative effects.

c. Prevention of negative effects on air quality, considering:

(1) The volume and physical and chemical characteristics of the waste in the facility, including its potential for volatilization and wind dispersal.
(2) The existing quality of the air, including other sources of contamination and their cumulative impact on the air.

d. Elimination of negative effects due to migration of waste constituents in the subsurface environment, considering:

(1) The amount and physical and chemical characteristics of the wastes in the facility including its potential for migration through soil.
(2) The geologic characteristics of the facility and the topography of the surrounding land.
(3) The patterns of land use in the region.
(4) The potential for migration of waste constituents into subsurface physical structures.

Compliance with these standards is required under RCRA and recommended under TSCA for: (1) the impermeable liner design; (2) the design and operation of leachate and runoff control systems; (3) closure and post-closure activities; and (4) any additional measures deemed necessary.

4. Design of a Secure Landfill

The proper design of a particular secure landfill is dependent upon a number of variables, most of which are outlined for TSCA facilities under 40 CFR Part 761.75. Climatic conditions could also be added as an important consideration due to the substantial impact that the *evapotranspiration to precipitation ratio* can have on landfill design requirements. Some arid/semi-arid regions in the United States have evapotranspiration rates which greatly exceed precipitation. In such a case, little or no water moves from the ground surface to the water table, which typically is found at a considerable depth. This greatly reduces the potential for a leachate problem, particularly where liquid waste disposal is restricted in a landfill having a suitable cover. In wet regions, however, it is likely that leachate will be produced in landfills. Here, control measures are required to prevent leachate from contaminating ground water and surface water supplies.

Figure 2 illustrates the design of a secure landfill that has a cover to control the amount of leachate produced and which provides a backup system to collect and remove the leachate should the cover fail or be removed.

The principal design components from cap to base are as follows:

1. A layer of topsoil over the landfill cap, seeded with vegetation for cover stabilization and to encourage evapotranspiration of moisture that infiltrates the cover.

2. A drainage system at the edge of the cover to move runoff away from the cell.

3. A highly permeable drainage layer of sand or gravel between the soil cover and the sealing layer to divert infiltration to drains located at the sides of the landfill.

4. A sealing layer (e.g., fine clay or flexible plastic membrane) to stop infiltration of precipitation into the waste.

5. An underlayer (e.g., fine soil or sand) to provide a base for the sealing layer.

6 Buried waste surrounded by fill material.

7. A venting system to remove gases generated by microbial degradation of the waste.

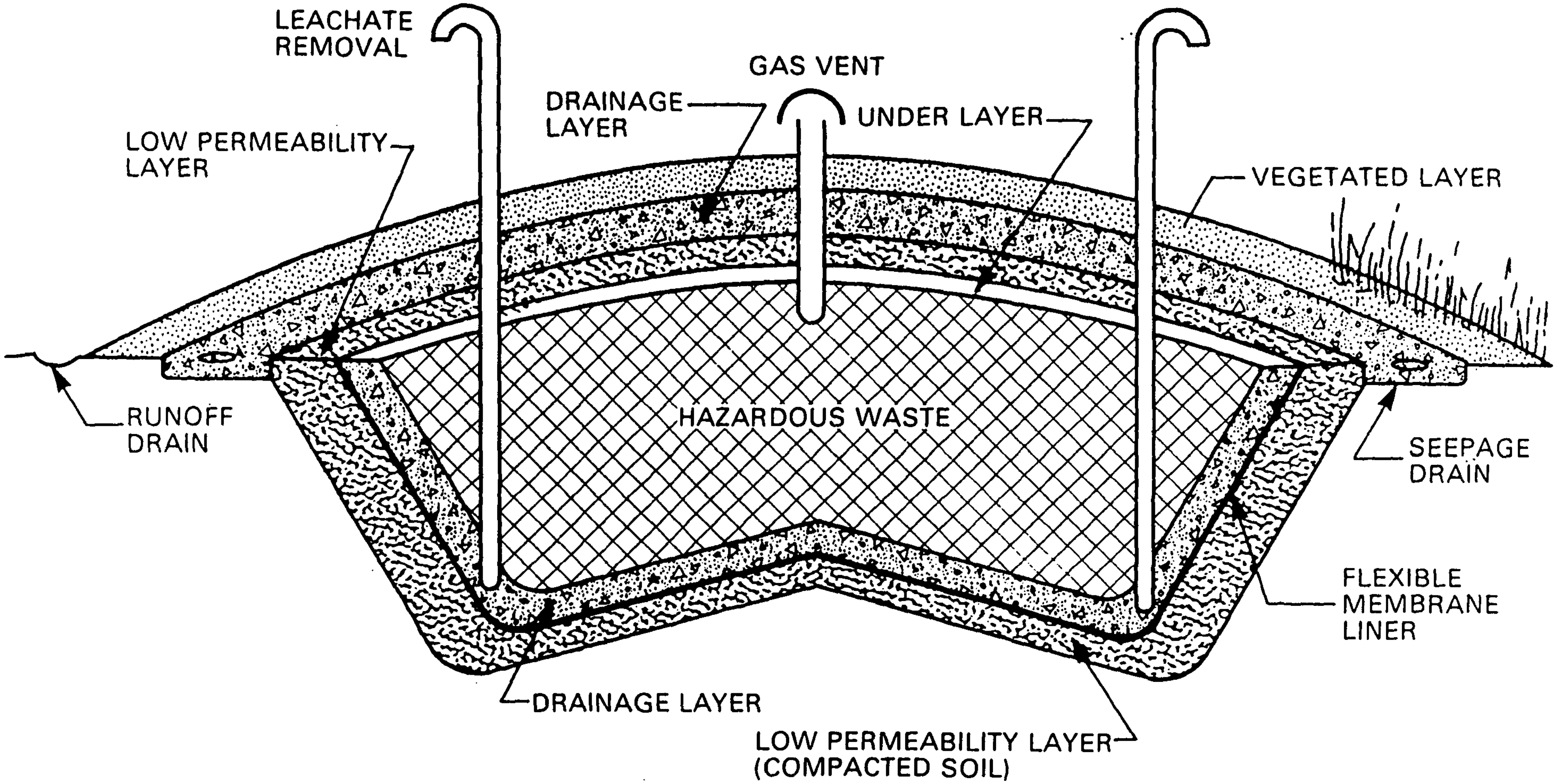

Figure 2: **SCHEMATIC OF A TOXIC WASTE LANDFILL WITH A LINER/DRAIN LAYER SYSTEM AT THE BOTTOM AND IN THE FINAL COVER.**

8. A drainage layer to collect leachate from beneath the waste accumulation and to divert it to drains at the edge of the landfill for removal to the surface.

9. A sealing layer of compacted soil and clay with or without a synthetic liner at the base of the landfill cell to prevent leachate from infiltrating into ground water.

If considerable subsidence of the landfill is predicted, a well-sealed cover may not be practical. In this case, protection of ground water from leachate contamination will depend on liner/drain-layer leachate collection systems at the bottom of the landfill, as shown in Figure 3. The primary drainage layer conducts leachate to a collection system for removal and treatment at the surface. The secondary drainage layer acts as a backup and leak detection system. Additional ground water protection is also provided by placement of two impermeable flexible membrane liners, one above the lowermost compacted soil liner and one between the two drainage layer systems. In some cases, a secondary low permeability soil liner may also be placed above the secondary leachate drainage layer. The cover of the landfill is again constructed to provide vegetative cover for increased evapotranspiration and is sloped to carry runoff to a drainage system. The double liner/drain system is suggested for areas where there is a possibility that ground water could be affected by the landfill.

It is the intent of the following sections to provide the reader with a detailed description of the design aspects of a secure landfill. A complete understanding of landfill design components should then enable an EPA inspector to conduct an effective and knowledgeable inspection of a TSCA landfill facility.

4.1 Liner Systems

4.1.1 Overview

Ground water protection is a fundamental objective of secure landfill design. This can be accomplished by keeping water out of the landfill by one of the following means:

1. Proper siting to avoid wetlands, flood plains and high ground water areas.
2. Diversion of surface runon.
3. Avoiding ponding of site precipitation.
4. Minimization of exposed waste surfaces through the use of adequate intermediate cover material.
5. Proper landfill cap construction and closure and post-closure monitoring.
6. Adequate subsurface preparation, using suitable liner and leachate collection systems.

Of the above-listed means for restricting the access of water to a landfill, the latter two involving subsurface preparation (liners/leachate collection systems) and landfill cap construction and closure/post-closure care are the most critical. The following discussions focus on these particular landfill design components.

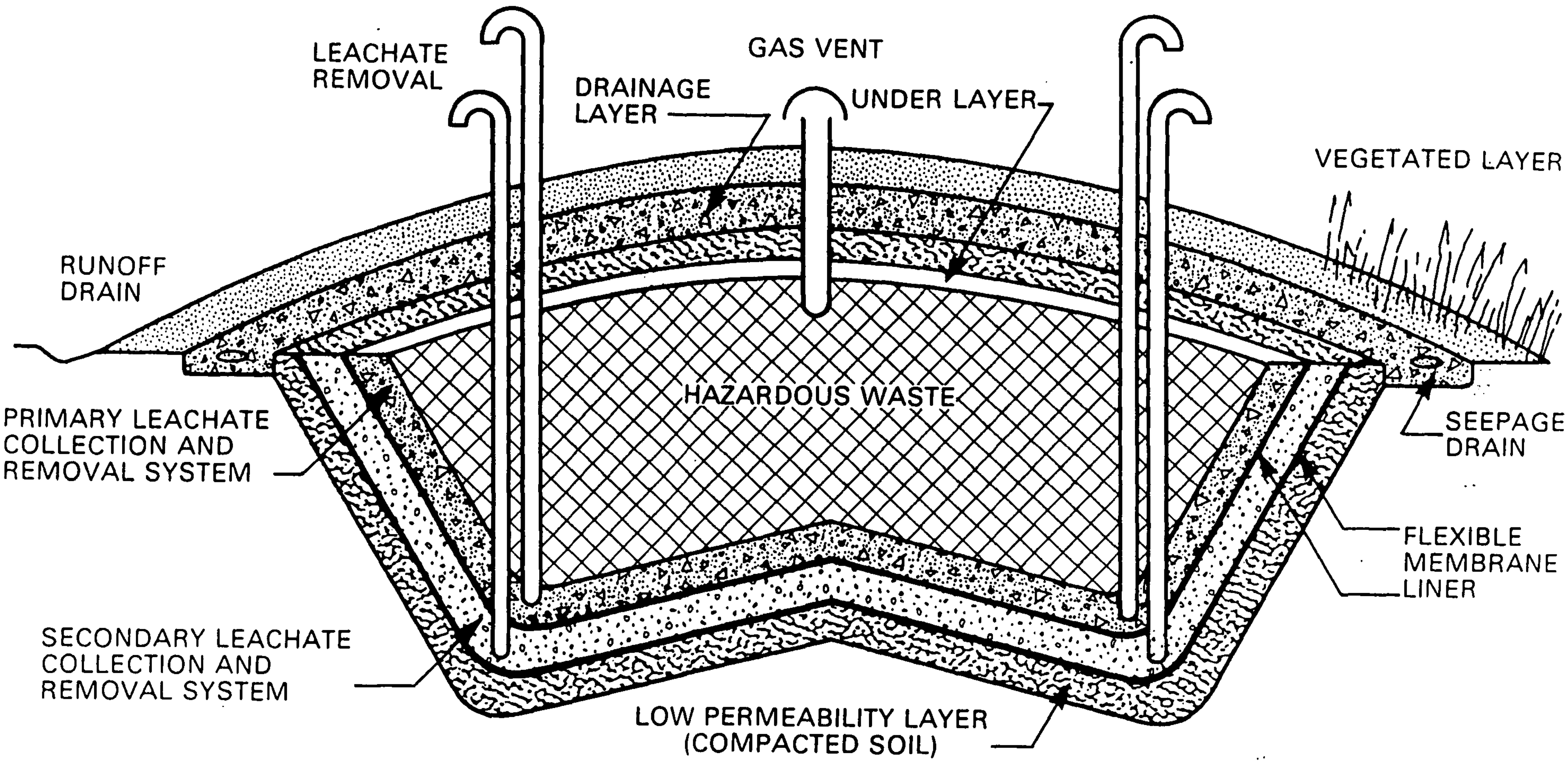

Figure 3: **SCHEMATIC OF A TOXIC WASTE LANDFILL WITH DOUBLE LINER/RAIN-LAYER SYSTEMS AT THE BOTTOM.**

Proper subsurface preparation depends on site conditions. Subsoils with high permeability (transmit fluids easily) must be sealed with natural or man-made materials to provide an unbroken barrier which prevents the migration of liquids from the landfill into ground water. The depth and areal extent of subsurface preparation depends upon local soil conditions.

In addition to subsurface sealing, liners are required to be placed on the sides and bottom of the landfill excavation. Liner systems are composed of man-made materials combined with natural low permeability soils and clays either available at the site or brought to the site and compacted to reduce permeability (restricts fluid flow) and to increase strength. There is no such thing as an impermeable liner. Liquid is transmitted through all liners to some degree. All hazardous and toxic waste landfills require liners having a very low permeability.

The liner must be designed and constructed to accomplish containment of fluids during the life of the landfill, by preventing the leakage of contaminants to surrounding soils and ground water. The liner should ideally be constructed wholly above the seasonal high water table and must cover all areas to be exposed to waste and to leachate. All material used for the liner system must be resistant to the chemicals it will encounter in the wastes and in the leachate and be of sufficient strength to withstand the forces encountered during installation and daily operation. The liner must also rest on a foundation or base capable of providing support and resistance to settlement or buckling.

Liners function in two ways: (1) they *restrict* the flow of pollutants and pollutant carrier (ground water); and (2) they *absorb* or minimize suspended or dissolved constituents. A liner with low permeability is required to limit the rate of pollutant migration. The absorptive or attenuative capability of a liner system depends on the chemical composition of the liner(s) and its/their mass.

Most liners include flow-control and filtration mechanisms to various degrees. Synthetic membrane liners are the most impermeable but have little absorptive capacity. Soils have a large absorptive capacity but can be more permeable. As soil liner thickness increases, transmission of pollutants is significantly reduced. The favorable properties of both soil and synthetic liners can be utilized when they are used in combination.

Landfill cells (i.e., units or discrete parts) should be designed with an underliner system consisting of the following, as a minimum:

- leachate detection, collection and removal system
- a synthetic liner

For large area landfills, particularly those designed to accept multiply layered wastes, the final cover may not be applied until the entire cell is closed. If final closure is not scheduled for many years, a double liner-double leachate collection system incorporating two synthetic liners, a secondary soil-based liner, and primary and secondary leachate detection, collection and removal systems is recommended. The leachate detection, collection, and removal systems between the liners function to reduce the liquid head on the secondary soil liner to a minimum, thereby severely reducing the rate of liquid transmission.

4.1.2 Soil Liners

Soils normally are considered as the first alternative for a hazardous or toxic waste landfill liner and should be clay-rich. They should have a saturated hydraulic conductivity (permeability) of not more than 1 x 10^{-7} cm/sec and be at least 4 feet thick if in-place soil is used or 3 feet thick if the soil is imported and compacted in place. The soil liner should be as tightly compacted as possible. Many clay soils can readily be recompacted to meet the specified permeability requirement. The tighter and more impermeable the clay layer is, the less fluid will penetrate, thereby increasing the efficiency of fluid removal by the overlying leachate detection, collection and removal systems.

Soil liners serve as backup systems and are depended upon to minimize the rate of liquid flow through them. A minimum thickness of the soil is necessary to retain structural stability (reducing cracking potential, etc.). Therefore, under TSCA regulations 3 feet is the minimum stable thickness for recompacted clay. In-place soil can be considered acceptable as a soil liner material provided the specifications in this guidance are met. In-place soil liners should be free of permeable zones, fractures, sand lenses or channels which increase the conductance of liquids through the liner.

4.1.3 Synthetic Liners

Liners consisting of synthetic membranes can be used for hazardous and toxic waste landfills. Such liners have very low permeabilities and are commonly used in waste disposal facilities.

Synthetic liners should consist of a membrane that is at least 30 mils thick and is chemically resistant to the waste managed at the landfill. In judging chemical compatibility of wastes and membranes, the EPA considers adequate historical data, demonstrations involving theoretical chemistry and actual test data. TSCA landfills typically employ high density polyethylene liners that are known to be compatible with PCBs.

The estimated service life of a liner under particular exposure conditions is an important factor in the liner material selection process. For secure landfills, a very long service life is required. Physical, chemical and biological failure of liners can occur. Principal causes of such liner failure are:

- Physical - Puncture, tear, differential stress, settling, thermal stress, hydrostatic stress, abrasion, cracking.
- Chemical - Solvents, hydrolysis, acid/base incompatibility, chemical oxidation.
- Biological - Microbial degradation.

Physical failures are commonly due to faulty subgrade preparation and improper operating conditions at the landfill and to changing hydrostatic pressures. Chemical failures normally are related to characteristics of the waste in contact with the liner.

Synthetic liners must be protected from damage that may occur during installation or operation. It is good practice to protect synthetic liners both from above and below by a minimum of six inches of bedding material. This will help protect against punctures or tears due to contact with sharp objects or other contingencies. The waste itself may contain sharp objects or abrasives which cause damage. Careless handling and placement of wastes and improper vehicle usage may also cause damage.

EPA, therefore, suggests that a bedding layer be installed above the liner as well as below it. The top bedding layer protects the synthetic membrane from damage due to exposure to sunlight and wind during operation. In addition, the first lift of solid waste placed upon the liner should not contain sharp protrusions, such as pipes that might puncture the liner. The bedding layer which underlies the liner in this case should consist of materials which are no coarser than sand as defined by the *Uniform Soil Classification System* (USCS) and which is free of objects such as large rocks and cobbles, concrete, branches, debris, rubbish and roots that could also puncture the liner.

Experience with these liners at hazardous waste landfills is limited. Of concern is their ability to maintain integrity and impermeability over the life of the landfill. Ground water monitoring, leachate collection and/or clay soil liners are invariably included in the design and construction of hazardous and toxic waste landfills when synthetic membranes are used.

4.2 Leachate Management System

4.2.1 Overview

For a better understanding of the mechanism of leachate production and movement, one must also be fully acquainted with the natural processes involved in the whole cycle of water movement in the environment. These natural processes together make up what is commonly known as the *hydrologic cycle*. Important terms relating to water movement are:

Process	Definition
Infiltration	Passage of water into the soil surface.
Percolation	Movement of water through the soil surface.
Evaporation	Moisture returned to the air by vaporization of precipitation.
Transpiration	Moisture returned to the air as water vapor from the surface of plants.

When rainfall in excess of the soil's infiltration capacity reaches the ground, the result is runoff. This runoff then flows over the ground at a velocity determined by the slope of the land and limited by the roughness of the surface. In any landfill design, the runoff velocity is an important consideration because steep slopes are prone to erosion which may result in exposure of waste materials. After runoff occurs, a certain amount of water determined by the geographic location and climate of the site is lost due to evaporation and transpiration.

A major objective in landfill design should be to minimize the quantity of water infiltrating the soil, and percolating through the waste to yield leachate.

4.2.2 Leachate Generation

The amount of leachate produced at any particular site is determined by absorptive capacity, the areal extent of the landfill, the composition and placement of waste, cover material usage, operations procedures, and the quantity of recharge water available for infiltration.

Leachate is a fluid which has percolated through solid waste and has removed dissolved and/or suspended materials from it. When water comes into direct contact with solid waste, it becomes contaminated to a certain extent. Many materials in solid wastes are highly soluble in water. Others, such as PCBs, are very insoluble. In some instances, soluble materials are formed as products of the natural degradation of solid waste constituents. Some materials also become soluble through the action of leachate upon them. Generally, as infiltration of water through a solid waste increases, rates of pollutant leaching and leachate production also increase. As a result of all the possible waste/water interactions, leachate generated by each landfill is unique, with its characteristics being primarily determined by the specific types of waste(s) disposed.

4.2.3 Leachate Collection Systems

A leachate collection and removal system at a hazardous or toxic waste landfill must be designed, installed, and managed in a manner that allows its anticipated life span to be attained. It must also be compatible with the characteristics of the leachate to be collected, strong enough to resist collapse due to the pressure imposed by equipment used at the site and by the accumulated waste and cover materials, and capable of withstanding possible changes in hydrostatic pressure.

It is always desirable to have a water balance at the site to determine the relative need for a leachate collection system as well as its capacity. The amount of leachate generated at a landfill depends on the volume of water flowing through the landfilled material plus the amount of free liquid produced during waste decomposition and compression.

Precipitation and runon are extremely important variables affecting the volume of leachate produced. External runoff should be diverted from the landfill site, and both intermediate and final cover should help divert the precipitation that falls on the site. Figure 4 illustrates a liquid flow diagram that can be used to determine water movement and leachate volume. The collection system acts to reduce the hydraulic head generated at the bottom of the landfill, thereby lessening percolation through the underlying soil/clay liner.

A leachate collection system can consist of perforated pipes placed in a permeable media that allows discharge by gravity to a sump from which the leachate is pumped. For chemical waste landfills slated to accept PCB wastes under TSCA (40 CFR 761.75(b)(iii)(7)) leachate monitoring/collection systems can be based upon any of the following designs:

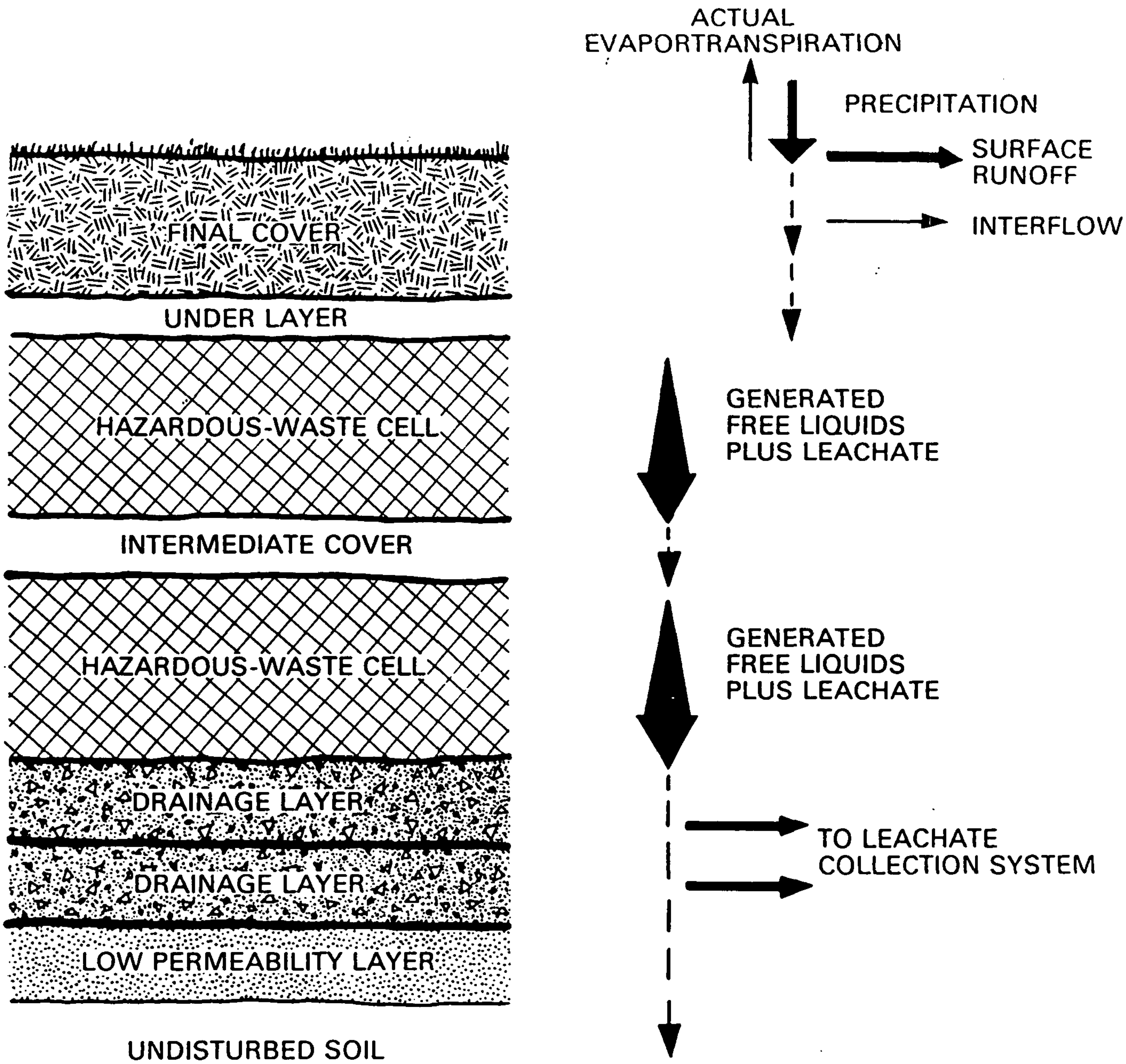

Figure 4: **SCHEMATIC OF A LIQUID ROUTING DIAGRAM IN A TOXIC WASTE LANDFILL.**

a. Simple Leachate Collection

This system includes a gravity flow drainfield placed under the waste disposal facility liner. Figure 2 illustrates a design of a secure landfill that has a liner/drain-layer system which operates to divert leachate to collection system for removal and treatment at the surface. This design is suggested for use when semi-solid or leachable solid wastes are placed in a lined pit excavated into a relatively thick, unsaturated homogeneous layer of low permeability soil.

b. Compound Leachate Collection

This system includes a gravity flow drainfield placed under the waste disposal facility liner and above a secondary installed liner. Figure 3 illustrates a design of a secure landfill that has a compound leachate collection system. A dual leachate collection system includes a primary collector and a secondary or leak detection system which functions as a backup collector in case of failure of the primary system. In some cases, a dual soil liner design is also employed in which both primary and secondary leachate collection systems are underlain by thick compacted soil liners. This type of design is recommended for use when semi-liquid or leachable solid wastes are placed in a lined pit excavated into relatively permeable soil.

c. Lysimeters

Gravity is the driving force behind which lysimeters operate. The two basic types, trench and caisson lysimeters, are described below.

A trench lysimeter is a trough made of any of a variety of metals and plastics. In its simplest form, the trench lysimeter is a halved section of piping. Trench lysimeters are then oriented so that leachate flows into them (see Figure 5).

A caisson lysimeter (see Figures 6a, 6b) is a section of corrugated steel pipe. The pipe is set vertically in place with a system of collector piping connected to it. This type of system works best when installed in a relatively permeable unsaturated soil immediately adjacent to the bottom and/or sides of the disposal area.

The advantage of both lysimeters is that a large leachate volume can contained and production rates can be measured. The disadvantages include construction-related alteration of ground water flow patterns and limitations in number of units that can be installed due to their cost.

4.2.4 Leachate Treatment

Once leachate has been collected, numerous alternatives exist for treatment and disposal. Selection of a leachate treatment process is not simple. The leachate characteristics depend on the nature of the landfilled wastes and on the stage of fermentation in the landfill. If the characteristics of the collected leachate indicate it is a RCRA hazardous waste, the leachate must be managed as such in accordance with the applicable permits and requirements. All leachate generated at TSCA landfills must be treated and disposed of by means that are generally specified as conditions written into the TSCA permit/approval.

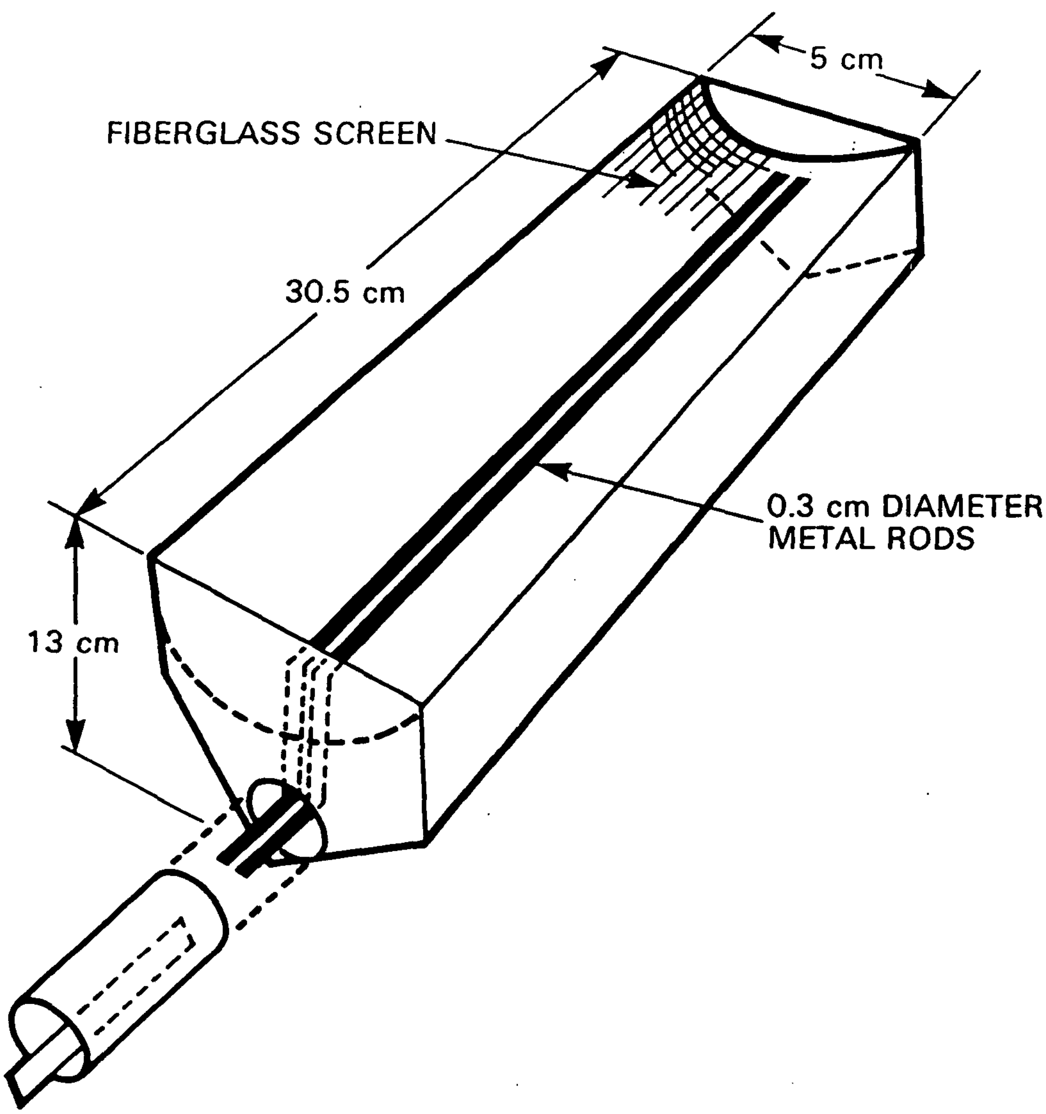

Figure 5: **TRENCH LYSIMETER** (REPRODUCED FROM SOIL SCIENCE, VOL. 105, 1968, PAGE 83, WILLIAMS AND WILKENS CO.).

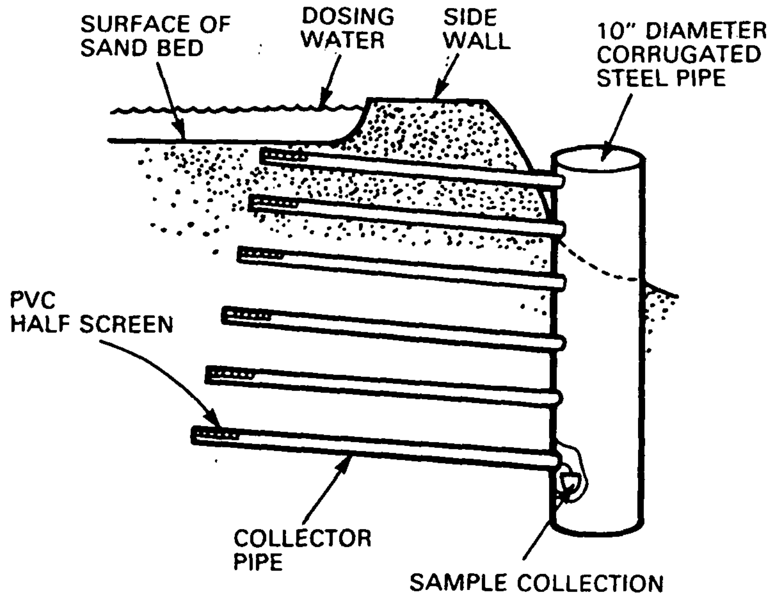

Figure 6a: **CASSION LYSIMETER.**

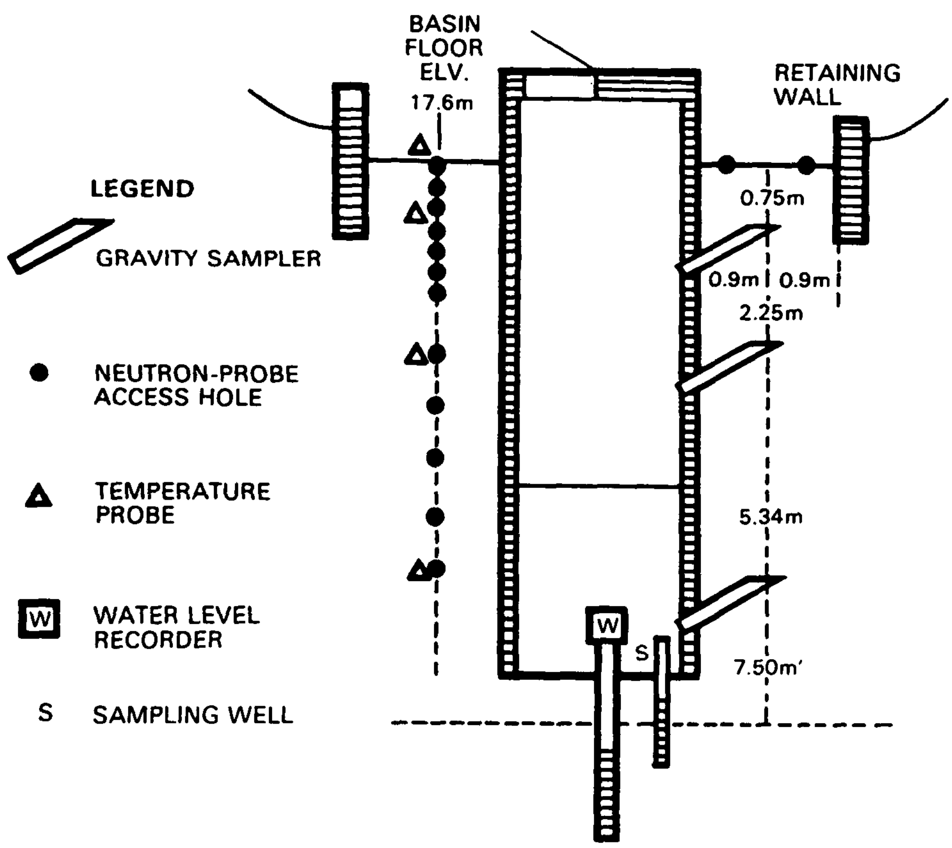

Figure 6b: **CASSION LYSIMETER WITH HORIZONTAL COLLECTOR PIPES (REPRODUCED FROM AIR, WATER, AND SOIL POLLUTION, VOL. 14, 1980, D. REIDEL PUBLISHING CO., HAURE, NETHERLANDS).**

The treatment processes applicable at a particular site depend upon leachate volume, characteristics, treatability and available discharge options. Residues, gases, and by-products that are formed during treatment may require additional control and management. Because leachates vary in composition, combinations of processes may be needed to achieve required levels of treatment.

4.3 Landfill Cap (Final Cover) Technology

4.3.1 Overview

According to EPA regulations, when landfills have reached the end of their useful life they must be closed. The landfill must be sealed in a way that prevents the need for additional maintenance and control, and eliminates post-closure escape of the hazardous or toxic wastes, other contaminated emissions (including leachate), contaminated rainfall and waste decomposition products to ground or surface waters or the atmosphere.

Upon closure, the top surface of the landfill must be sealed with soil and an impermeable layer of suitable material and graded to minimize the accumulation of surface water and erosion. Natural or planted vegetation is encouraged to grow on the cover to further reduce erosion. Deep-rooted vegetation should be avoided since it can damage any impermeable barrier.

Landfill covers can be damaged by soil erosion, uneven settling of fill material, vegetation and animal and human activity that can affect the integrity and performance of the liner. A sufficient final cover thickness is important for minimizing these potential problems. The thickness employed in the cover design is determined based upon the following considerations: freezing and thawing effects; moisture content effects; trafficability need; support requirements; gas migration control; expected infiltration rates; differential settlement; and liner protection.

4.3.2 Design

Final cover should be designed and constructed to:

* Reduce the need for additional maintenance and provide long-term minimization of migration of liquid through the sealed facility.
* Promote drainage and minimize erosion or abrasion of the cover.
* Adjust to settling and subsidence to maintain the integrity of the cover.
* Provide a hydraulic barrier with a hydraulic conductivity below that of the landfill liner(s) or subsoil. By this means, the infiltration of precipitation into the cell is limited to the maximum extent possible.

According to the *Minimum Technology Guidance on Final Covers for Landfills and Surface Impoundments* (EPA 1987), the suggested final cover should consist of a multilayer design (Figure 7) employing the following layers from top to bottom:

1. A vegetated layer composed of an erosion control component (vegetation, gravel, mulch, etc.) and a 60 cm (24 inch) minimum thickness topsoil component.

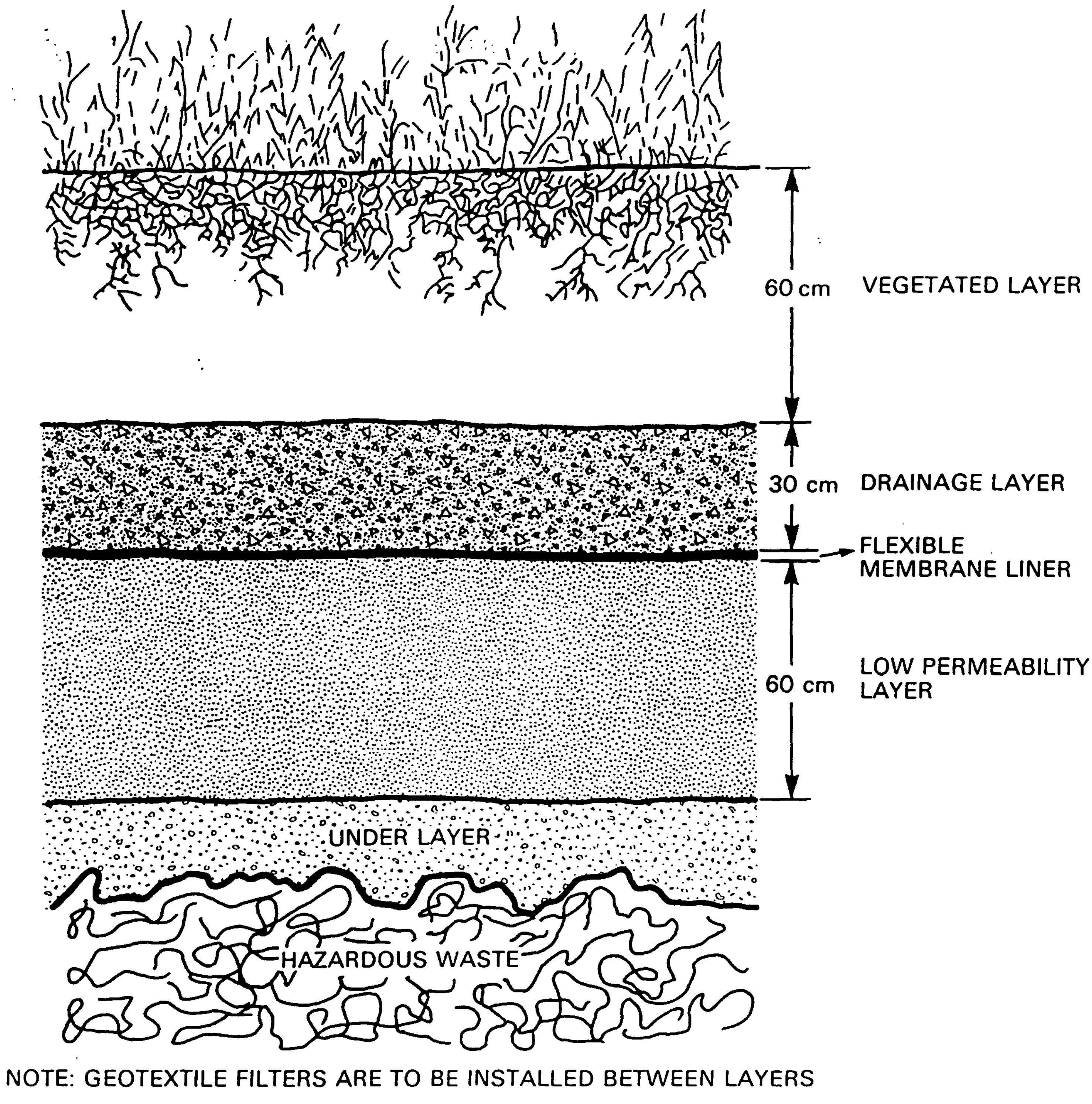

Figure 7: FINAL COVER SYSTEM DESIGN.

2. A 30 cm (12 inch) minimum thickness drainage layer to eliminate ponding on the underlying low permeability layer and to remove water that infiltrates through the top layer of the cover. This layer also acts as a protective bedding for the *flexible membrane liner* (FML).

3. A low permeability layer which includes a 20 mil minimum thickness flexible membrane liner (FML) and a 60 cm (24 inch) minimum thickness, compacted soil component. This layer is intended to increase the efficiency of liquid removal in the drainage layer and supplies backup to further reduce liquid infiltration.

A case-by-case evaluation is required to determine the appropriate type and thickness of landfill cover material. For instance, in highly arid regions, a gravel mulch could be needed above the topsoil to balance less extensive vegetative coverage; alternatively, the drainage layer may not be required. At a unit that is expected to produce gases, a gas vent layer between the waste and the low permeability layer must also be included.

a. Vegetated Layer

The vegetated layer should include the following:

* Soil material that is free from large rocks or debris and is at least 2 feet thick and capable of maintaining plant species to effectively reduce erosion. The soil must accommodate the root systems of most non-woody cover plantings.

* The layer should be sloped to carry runoff to a surface drainage system. It is suggested that the final slope (after settling and subsidence) should be at least 3 percent to avoid pooling due to surface irregularities and vegetation, but less than 5 percent to reduce excessive erosion. For slopes higher than 5 percent, the maximum erosion rate should not be higher than 2.0 tons/acre/year using the USDA Universal Soil Loss Equation.

* A drainage system at the edges of the cover to conduct runoff away from the site without creating erosion rills and gullies in the topsoil layer.

* Persistent species vegetation that will completely reduce erosion having a root system that will not penetrate beyond the vegetative and drainage layers. The plant species should not require unnatural applications of water or fertilizers to sustain growth.

b. Drainage Layer

The final cover should include a drainage layer for the removal of water that infiltrates through the vegetative layer. The drainage layer must be designed to reduce infiltration of water into the underlying low permeability layer, thus lowering the potential for leachate generation. In arid locations, this layer may not be required.

If composed of sand, the drainage layer should:

* Have a thickness of no less than 30 cm (12 inch) to facilitate transfer of liquids infiltrating through the vegetative layer and provide protection for the underlying FML component of the low permeability layer. To perform as protective bedding material for the FML, the drainage layer material must be no coarser than *Uniform Soil Classification System* sand (USCS) and must be free of debris that could damage the FML.

* Have a minimum hydraulic conductivity of 1 x 10^{-2} cm/sec.

* Include a final bottom slope of at least 2 percent after allowance for settlement.

* Have a filter (granular or geotextile) placed above the drainage layer to minimize clogging by infiltration of fine materials from the overlying layer.

Other drainage systems, such as geonets and geogrids, may also be utilized if it is demonstrated that they are equivalent to the recommended granular system in terms of hydraulic conductivity and FML bedding protection. These systems must be capable of removing liquid from the cover system while withstanding the effects of external forces.

c. Low Permeability Layer

The final cover system must be designed to have a permeability less than or equal to the permeability of the bottom landfill liner system(s) or natural subsoils. The low permeability layer should be situated below the average depth of frost penetration and should consist of the following two components at a minimum:

1. An upper FML component with the following characteristics:

* The FML should be at least 20 mils in thickness. Some facilities may require a thicker FML to prevent failure during the post-closure care period or during construction. FML thickness is also dictated by the specific type of FML material used.

* The FML surface should possess a minimum 2 percent slope after allowing for settlement.

* The FML material and seam specifications should meet or exceed those set by the *National Sanitation Foundation Standard* No. 54 (NSF,1985).

* The FML should be protected from above and below by at least 30 cm (12 inch) of bedding material which should not be coarser than sand and should be free of rocks, debris, rubbish, roots and sudden changes in grade that may affect the FML.

* Penetration of the FML by designed structures (e.g., gas vents) is not recommended.

* Stressed conditions in the FML should be avoided by providing proper slack allowance for shrinkage of the FML during installation and prior to placement of the protective layer or drainage layer.

2. A bottom component with the following characteristics:

* A compacted soil layer at least 60 cm (24 inch) thick composed of low permeability soil with an in-place saturated hydraulic conductivity of 1 x 10^{-7} cm/sec or less. This compacted soil must again be free of rocks, debris, rubbish and roots that may increase the hydraulic conductivity or create preferential flow paths for infiltration.

* The upper surface of the compacted soil (which is in contact with the FML) must have a minimum slope of 2 percent after allowing for settlement.

d. Optional Layers

There are cases where an alternative design (optional layers) are applicable. The optional layer designs discussed below are gas vent and biotic barrier layers.

Gas Vent Layer

The purpose of a gas vent layer is to monitor and control combustible, malodorous or toxic gases produced by biodegradation of organic matter buried in a landfill.

The gas vent layer should include 30 cm (12 inch) of coarse-grained material (similar to that used in the drainage layer) lying between the waste itself and the low permeability layer soil component. Gas is vented to a collection point for disposal or treatment through horizontal perforated pipes connected to vertical risers placed at high points in the landfill cross section.

The following design criteria are suggested for the gas vent layer

* The layer should be a minimum of 30 cm (12 inch) thick and should be placed between the compacted soil liner and the waste layer (Figure 8).

* Venting to an exterior collection point for treatment or disposal should be provided by means of horizontal perforated pipes patterned laterally throughout the gas vent layer to channel gases to vertical risers. Penetration of the cover should be avoided.

* Materials for the construction of the gas vent layer should be of the porous, granular type similar to those used in the drainage layer.

Other gas layer designs will be considered if it can be demonstrated that they can provide equivalent performance. Equivalence is determined by the ability of the design to consistently remove any gases produced, minimize clogging, infiltration, withstand expected overburden pressures, and perform under the stresses of construction and operation.

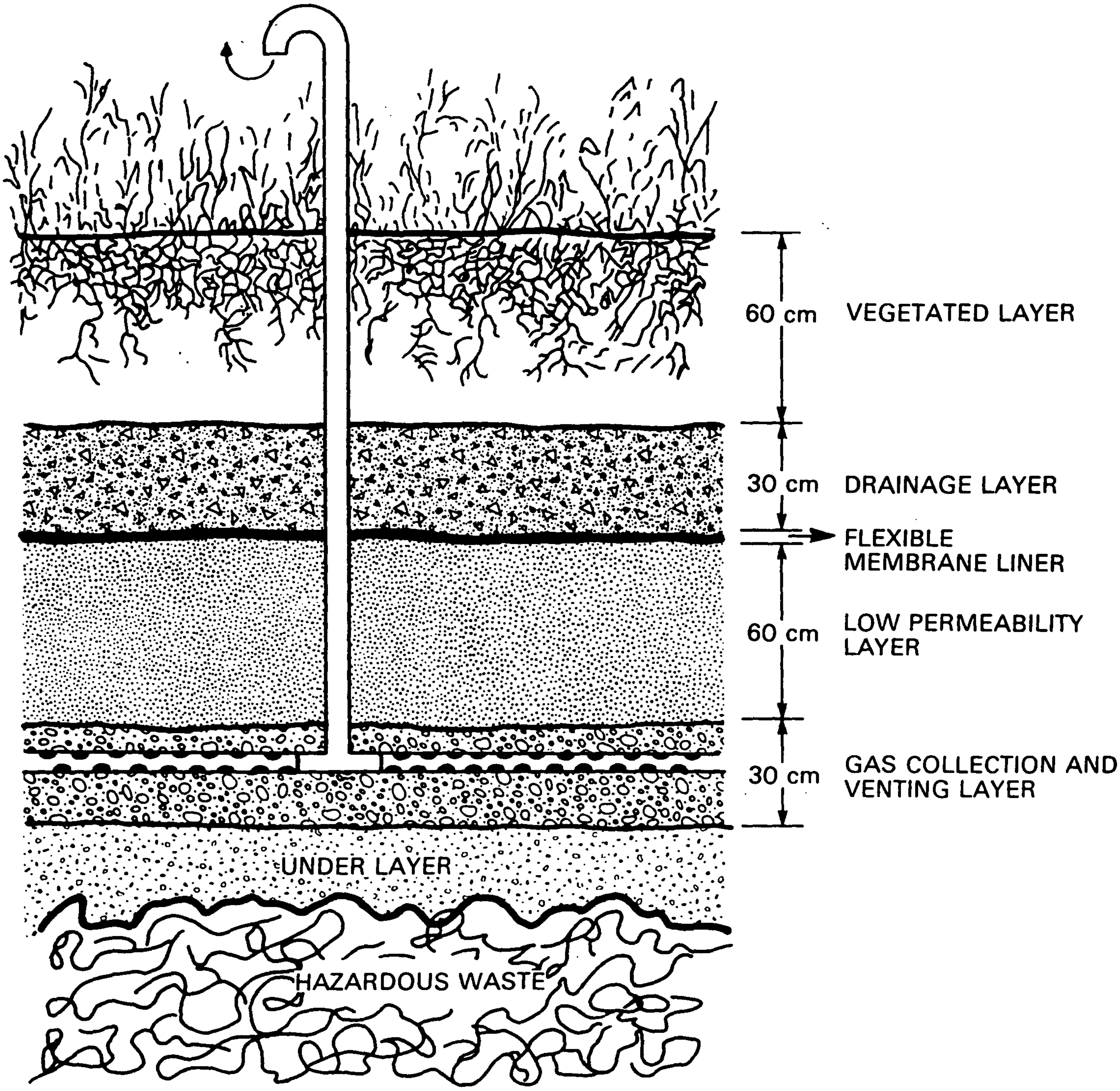

Figure 8: **OPTIONAL FINAL COVER SYSTEM DESIGN (GAS VENTING SYSTEM DESIGN).**

Biotic Barrier Layer

Burrowing animals or plant roots may affect the structure of the drainage and low permeability layers. Biotic barriers, such as layers of cobble- stones or coarse gravel beneath the drainage layer, minimize the effects of biointruders (see Figure 9).

The performance of biotic barriers has been documented by Hakonson (1986) who found that large or tightly packed objects placed in a burrowing animal's path, effectively stopped its progress. It was also found that the occurrence of large void spaces lacking water and nutrients within a layer of stone reduced the intrusion of plant roots.

The design of a biotic barrier is site-specific and is dependent upon the overlying topsoil layer, biotic barrier material, natural precipitation and anticipated biointruders.

5. Ground Water Monitoring Systems

5.1 Overview

The primary objective of ground water monitoring systems utilized for TSCA landfills is to provide high quality geohydrologic data to assure accurate detection of a release of contamination from operating or closed landfill cells to any aquifers that may underlie the site.

It is appropriate, before addressing the topic of ground water monitoring detail to briefly discuss the behavior of PCBs with respect to ground water flow.

The mobility of organic compounds in soil and ground water is controlled primarily by sorption to organic (carbonaceous) material in the soil or aquifer matrix. The *octanol/water partition coefficient* (Kow) for a specific compound is related to the compound's affinity for sorption to organic material. A high Kow indicates that the compound readily sorbs to organic material and would therefore have a low mobility; a low Kow indicates that the compound does not sorb readily and is therefore mobile. Volatile organic compounds (VOCs) have low Kows and are generally quite mobile with respect to ground water flow. PCBs, on the other hand, have very low solubilities in water and very high Kow values, indicating that they should be very immobile.

Retardation factors, which express the rate at which a particular chemical travels relative to ground water, can be calculated given the amount of organic matter in the soil and the *carbon/water partition coefficient* (Kcw) for the chemical being considered. As a comparison, the organic solvent acetone and the herbicide 2, 4-D have retardation factors of 1.0 and 2.6, respectively. These values indicate that acetone travels at the same rate as ground water and 2, 4-D travels 2.6 times slower. The retardation factor for PCBs ranges from 600 - 3,000. This shows that the tendancy of PCBs to sorb onto soil/organic matter versus ground water is so overwhelming that the movement of PCBs takes place at a rate which is up to 3,000 times slower than that of ground water.

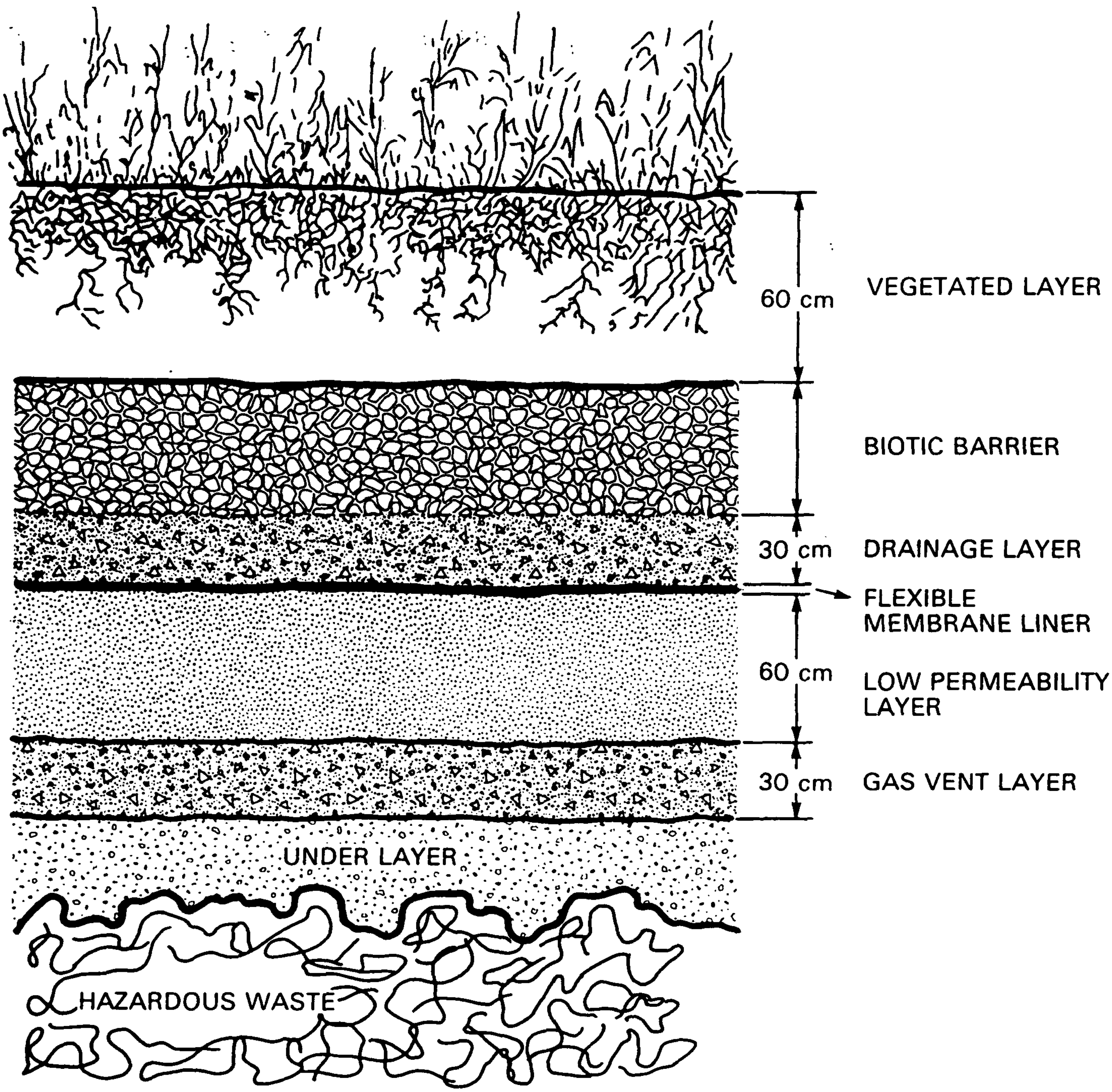

Figure 9: **OPTIONAL FINAL COVER SYSTEM DESIGN (BIOTIC BARRIER DESIGN).**

The above discussion of PCB mobility suggests that landfilling in a highly engineered and well-monitored facility should be an environmentally protective means of disposal of PCB wastes.

It must be kept in mind, however, that the mobility of PCBs is known to be significantly enhanced in the presence of some RCRA wastes, particularly the organic solvents. The specific provisions in the TSCA landfill regulations which prohibit the comingling of incompatible compounds with PCBs are the direct result of this understanding of the behavior of PCBs. In this light, it is therefore important for the TSCA landfill inspector to make an assurance that facility disposal practices do not allow PCBs and incompatible wastes to be comingled.

5.2 Components of Ground Water Monitoring Systems

Two primary components make up the ground water monitoring systems employed at TSCA landfill facilities; the array of ground water monitoring wells, and the sampling and analysis protocols. The ground water monitor wells must be placed, constructed and developed in a manner that assures that representative ground water samples can be consistently obtained for analysis. Monitor well placement, construction, and development information and protocols must be part of the facility's Operations Plan or must be included with the engineering drawings and other materials submitted as part of the TSCA approval application.

Given proper monitor well installation, it is vitally important that ground water sampling and analysis be carried out in accordance with guidelines set forth in the facility's sampling and analysis plan. This plan, which is typically included as part of the Operations Plan, is enforceable and must be strictly followed by facility personnel involved in sampling and/or analytical activities. The sampling and analysis plan should include the following at a minimum: sampling protocol (water level measurement, well purging, sampling equipment to be used, sample preservation/holding times, chain of custody); analytical parameters; analytical methods; quality assurance; and data analysis/interpretation procedures. The TSCA landfill inspector should be familiar with monitor well construction and development and the sampling and analysis plan if a planned inspection's interest is observation or oversight of well installation or sampling operations on site.

5.2.1 Ground Water Monitoring Wells

a. Well Placement

The proper placement and siting of ground water monitoring wells must involve consideration of horizontal and vertical perspectives. The horizontal and vertical distribution or array of wells placed around a TSCA landfill cell or facility must be arranged in order to intercept any ground water flows which could potentially carry contamination off site. Even though TSCA regulations call for a minimum of three sampling points per disposal area, this number is greatly exceeded at most facilities which typically employ a perimeter monitoring scheme. Under such a scheme, monitoring wells are placed on 200 to 400 foot centers surrounding the facility or waste disposal area. In addition, the wells may be nested where appropriate in order to provide ground water samples from several different permeable zones or aquifers located at various depths beneath the ground surface. This type of horizontal and vertical array of sampling points assures that the extent of any released contamination can be accurately determined regardless of any changes in ground water flow direction due to construction or dewatering activities on site. In some cases, a RCRA-style detection monitoring program may be employed at RCRA/TSCA facilities. In this instance, only the downgradient perimeter of the waste management area is monitored, again with a horizontal and vertical array of ground water monitoring wells. In general, any saturated, permeable zone exceeding a thickness of 1 foot and capable of yielding adequate water to a well should be monitored.

b. Subsurface Investigation

Proper monitor well installation must be preceeded by subsurface investigations involving soil sampling and soil description. The intent of these efforts is to characterize the subsurface geology, and locate and describe all potential water producing zones (aquifers) so that the monitoring well screens can be placed at the correct depth to allow representative samples to be obtained. Soil sampling and soil description should be done during the initial boring of the well and must be overseen by a qualified geologist. Soil samples should be collected continuously from hollow-stem auger borings using a 2-inch OD split-spoon sampler according to ASTM D-1586 guidance and should be logged using a standard soil classification system (ASTM D-2488). All sampling equipment should be thoroughly cleaned before collection of each soil sample. Where multiple water-bearing zones are encountered during drilling, additional borings shall be augered to install monitoring wells in each zone. Where nested wells are to be installed in such a setting, it is expedient to continuously sample and log the deepest hole first in order to locate the zones to be monitored. The remaining borings slated for monitoring wells then can be blind augered to within 10 feet of the appropriate target zone prior to their completion using continuous split-spoon sampling techniques to a depth of 3 feet below the bottom of the water-bearing zone.

In settings where a bedrock aquifer exists, rock coring is required for wells to be completed as bedrock monitoring wells. Rock cores will provide information on the bedrock present and the *Rock Quality Designation* (RQD). Coring, logging, and RQD determinations should be overseen by a geologist. A complete geologic description of the rock cores obtained should be produced for each cored hole. Cores must be carefully removed from the core barrel and placed in core boxes, noting the depth interval contained in each box. The project name, project number, borehole number, depth interval, and box number should be clearly marked on each box along with run number, run depth, recovery, and RQD data.

c. Well Design/Construction - Installation

Stringent drilling and installation protocols must be followed during the monitoring well construction process and should include steam cleaning of all equipment and material between well locations.

Monitor well construction typically involves one of two methods depending on well diameter:

1. For 4-inch wells, 8-inch temporary casing should be set to the bottom of the hole to facilitate well construction.

2. For 2-inch wells, 6 1/4-inch I.D. hollow-stem augers are utilized to drill the hole and the well is then constructed inside the augers.

After the stainless steel, teflon, or PVC well string is in place, the 8-inch casing or the 6 1/4-inch I.D. augers are slowly withdrawn as the sand filter pack, bentonite seal and grout backfill are placed in the annulus.

Each monitoring well installed is intended to provide representative ground water samples from a particular water-bearing zone or aquifer. As shown on Figure 10, a schematic drawing showing construction details for a typical 2-inch PVC well, a slotted or perforated well screen allows ground water to enter the otherwise impermeable riser pipe. Well screens are typically 5 to 10 feet long. The well string is plugged at the bottom and screwed together in 5 to 10 foot flush threaded sections. In order to allow communication between the permeable zone to be monitored and the well, the well screen must be surrounded by a permeable sand or gravel pack which should extend from the base of the well to a height at least 2 feet above the top of the well screen. It is critical that the sand pack and well screen be set at the correct depth. The bottom of the well screen should always be placed slightly below the depth of the base of zone to be monitored to assure that a maximum volume of water may be obtained for sampling. A 2-foot thick bentonite clay seal should overlie the sand pack. In accordance with TSCA regulations, the annular space above this seal should then be completely filled with Portland cement-bentonite grout and then topped with a concrete or Portland cement pad to effectively prevent percolation of surface water into the well bore. In addition, a steel protective pipe with a removable but locking cap must also be installed over the well top in order to provide access and prevent entrance of rainfall or storm water runoff.

During the construction of all monitoring wells, accurate records must be maintained of the depths at which various materials are installed (nearest 0.1 foot) and the quantity of various materials utilized in constructing the monitoring well. All sections of well screen and riser pipe should be measured prior to emplacement in the hole to accurately measure the depth of the monitoring well. The amount of all backfill materials emplaced around the well screen and riser pipe should be noted and the depth of emplacement of the sand pack and bentonite seal sounded utilizing a weighted steel tape. After the monitoring well construction has been completed, the well must be tagged and the well number permanently marked in at least two places on the well cover. Well construction data should be recorded and presented for each well on monitor well completion diagrams.

d. Well Development

The objective of monitoring well development is to assure that ground water obtained for samples is representative of the formation or zone being monitored. To this end, well development procedures are designed to eliminate the effects of well vicinity disturbance caused by drilling and installation processes. For instance, the boring walls may be smeared with clay or the well screen and sand pack may contain fine sediments derived from the formations adjacent to the screened interval. Proper well development using a surge block and bailer or pump assures that the well screen and sand pack are cleared of any accumulated sediments, and that representative formation waters can be obtained for sampling.

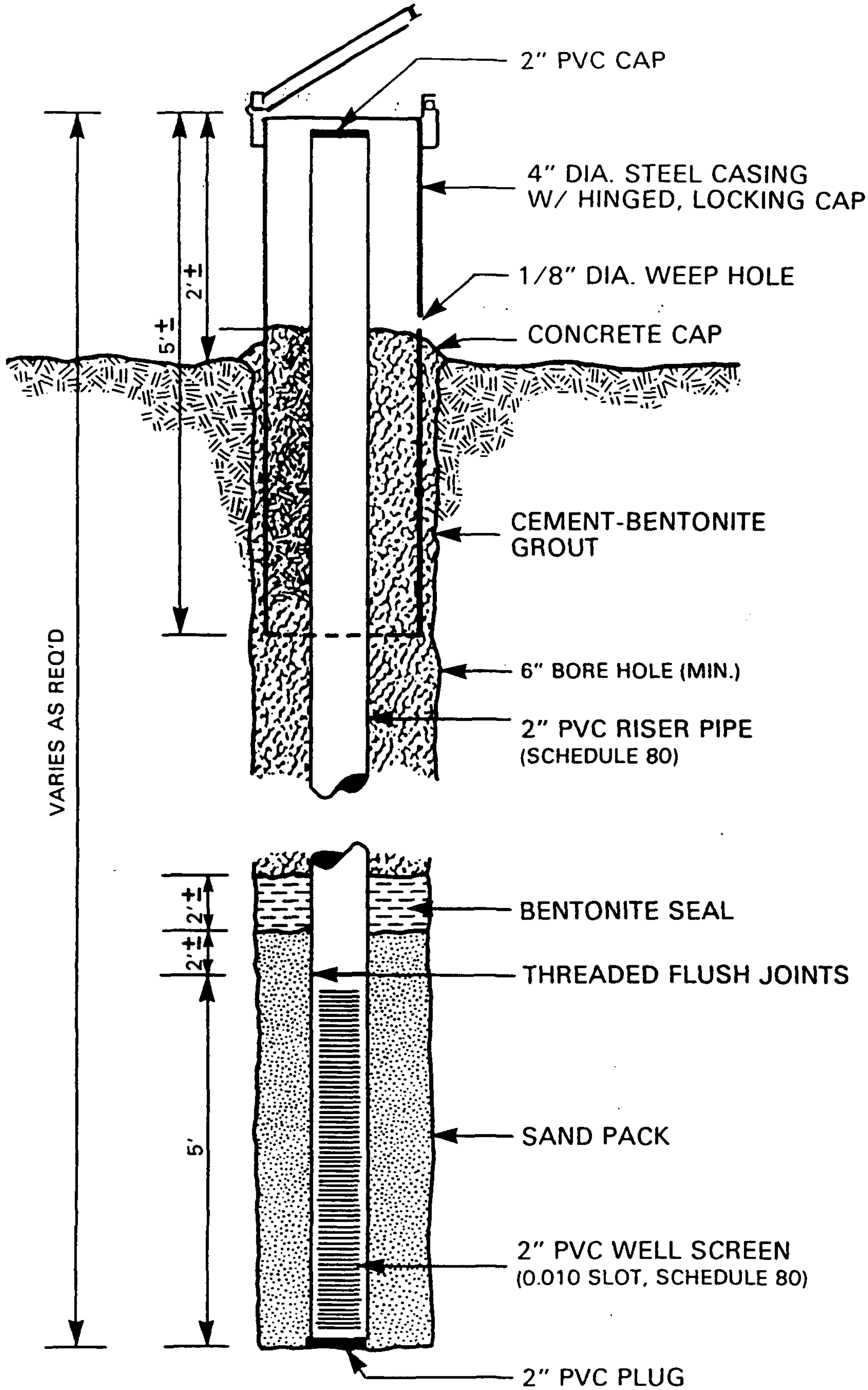

Figure 10: **GROUND WATER MONITORING WELL SCHEMATIC DIAGRAM**

Following installation, all wells must be fully developed. Ideally, each well should be surged for approximately two hours, then bailed or pumped. If after bailing, the water produced is sand free and the water level recovers, the well shall be considered developed. If the water produced is not sand free, additional surging is necessary, followed by bailing or pumping until the well is judged satisfactory. In a completely developed well, the water quality parameters (temperature, pH, specific conductivity) should have become stabilized. If readings indicate that these water quality parameters have not stabilized, additional development is required.

A well development data sheet must be completed for each monitoring well installed. All well development activities should be carefully recorded including an accurate record of the amount of time spent surging each well. In addition, all records of specific conductance, temperature, and pH should be carefully recorded including the time of measurement. The amount of water removed from the well must be recorded along with the time of removal.

e. <u>Surveying</u>

All monitoring wells installed must be surveyed by a licensed surveyor. A point on the top of each well casing should be identified and surveyed to the nearest 0.01 foot. In addition, the ground surface elevation at each monitoring well must also be surveyed to the nearest 0.01 foot, and the well located within a site coordinate grid system to the nearest 1.0 foot.

CHAPTER II

C. SAMPLING AND ANALYSIS

The objective of any sampling and analysis plan is to obtain high quality, reproducible results from representative samples. Consistency in both sampling and analytical procedures is essential to yield high quality data. The procedures outlined below have been field or laboratory tested and proven to be practicable, reproducible and capable of yielding quality results. Sampling points invariably include ground water monitoring wells but may include under-drains, leak detection systems, leachate standpipes, and surface water locations depending on the type of leachate collection system employed and the hydrologic setting of a particular TSCA landfill. Presampling procedures involving water level measurements and/or purging of stagnant fluid must be followed for all wells and leachate collection systems as described below.

1. Pre-Sampling Sampling Protocol - Ground Water

1.1 Water Level Measurement

Water level elevations must be taken and recorded at each ground water monitoring well just prior to sampling. In addition, the potentiometric surface of each significant water-bearing zone beneath a TSCA landfill facility should be mapped on a regular basis (semi-annual or quarterly) to determine horizontal and vertical ground water flow gradients. In this case, the measurements should all be made on the same day or at most over a two-day period.

Water levels should be measured using an electric water level indicator and must be made from the surveyed top of the well reference point to the static water level, and recorded to the nearest 0.01 foot. This value is then subtracted from the surveyed top of the well elevation to obtain the water elevation above mean sea level (msl). The date and time of each measurement should be logged as part of the sampling record by the personnel conducting the sampling effort. The electric sounder and tape that contacts well water must be thoroughly cleaned with deionized water prior to use in each well.

1.2 Monitoring Well Evacuation

Ground water sampling involves several steps including measures to remove stagnant water from the well prior to sample withdrawal and to further ensure that the method used for sample collection provides representative samples. The first step in sample collection is the determination of the volume of water in the well. The depth to static water should be measured prior to each sampling event as previously described and subtracted from the depth to bottom. The depth to the bottom of the well should also be measured for each sample event and recorded to the nearest 0.01 foot.

The difference between the depth to water and the total well depth is equal to the height of the standing water column within the casing. The volume of this water is calculated using the following equation:

$$V = pi\ r^2h/231$$

where,

V = volume of the standing water column in gallons
(one well volume)
pi = a mathematical constant approximately equal to 3.14
r = inside radius of the well casing in inches
h = height of the standing water column in inches
231 = a constant that converts cubic inches to gallons

Even though the TSCA regulations call only for the removal of one well volume prior to sampling, it is strongly recommended that a minimum of three well volumes be removed from wells with high hydraulic yields (recharge rate exceeds purge rate); low yielding wells should be evacuated to dryness.

Wells should be evacuated using bailers equipped with bottom-fill check valves. Under ideal conditions, one bailer is to be dedicated to each monitoring well to reduce the potential for cross-contamination between wells. Prior to initial use in a monitoring well, bailers must be cleaned using a hot non-phosphate detergent solution wash, hot tap water rinse, a deionized water rinse, and air dried. Bailers should then be wrapped in plastic and placed in a clean, secure area until use. After initial use in a well, the bailer should be dedicated to that well.

The volume of water purged should be monitored by pouring purge water into a calibrated container. Purge water in general should be contained and treated as a hazardous waste. Purge water from any upgradient background wells may be disposed of on the ground near the well.

Wells with high hydraulic yields must be sampled immediately following evacuation. Wells with low hydraulic yields may be sampled when adequate water has recharged to collect a complete sample set, usually within two hours. Wells with extremely low hydraulic yields may require sample withdrawal on an individual aliquot basis.

2. Pre-Sampling Protocol - Leachate

2.1 Leachate Standpipe Evacuation

Although the composition of landfill leachate varies with time, attempts should be made to collect representative samples from any leachate standpipes at the site. Each leachate standpipe should be evacuated in the following manner prior to sample withdrawal. The first step in sample collection is a determination of the volume of fluid in the leachate standpipe. The depth to the bottom of the standpipes should be measured annually using a weighted surveyor's tape and recorded to the nearest 0.1 foot. The depth to the static fluid level must also be measured prior to each sampling event using the weighted tape. The difference between the total standpipe depth and the depth to fluid is equal to the height of the standing fluid column inside the leachate standpipe. The volume of this fluid (one casing volume) can be calculated using the equation presented above. Three casing volumes should be removed from standpipes with high hydraulic yields (recharge rate exceeds purge rate), when possible. Standpipes with low hydraulic yields (purge rate exceeds recharge rate) should be evacuated to dryness.

Standpipe evacuation is normally accomplished by use of a small dedicated submersible electric pump. Also dedicated to each leachate standpipe are sufficient lengths of tubing and electrical wire to place the pump at the base of the leachate standpipe. All fluid evacuated from each standpipe should be contained and treated as a hazardous waste. Samples must be collected within 24 hours of standpipe evacuation.

2.2 Lysimeter Evacuation

Some TSCA landfills, particularly those excavated into relatively permeable unsaturated soils, employ suction lysimeters as their leachate collection system. Samples from lysimeters should be collected using a two-way hand pump which is used to place a vacuum on the lysimeter. The lysimeters should be placed under a vacuum 24 hours prior to sampling to allow sufficient time for moisture to collect in the lysimeter.

2.3 Underdrain and Leak Detection System Evacuation

Some highly engineered TSCA facilities are equipped with underdrains and leak detection systems as components of their leachate collection and management systems. Underdrains should be evacuated by one of two methods. The first method employs non-dedicated electric venturi surface pumps and dedicated jet-type pressure nozzles. Also dedicated to these underdrains is a length of tubing sufficient to place the jet nozzle at the base of the underdrain sump. The venturi pumps should be thoroughly cleaned with a deionized water rinse after each use.

The second method of underdrain evacuation which also applies to a leak detection system involves use of a dedicated submersible electric pump. Also dedicated to these underdrains are sufficient lengths of tubing and electrical wire to place the pump at the base of the underdrain sump.

Purge water from underdrains and the leak detection system should be contained and treated as a hazardous waste. Each underdrain should be purged to dryness or until approximately 200 gallons have been removed. This insures that samples collected will be representative of the water contained within the underdrain and leak detection drainage media.

3. Water Sampling

3.1 Ground Water and Leachate Sampling

Ground water monitoring wells, leachate standpipes, lysimeters, underdrains, and leak detection systems must be sampled immediately after purging, except as previously described for low-yielding monitor wells and leachate stand- pipes. The sampler should wear clean PVC or latex gloves when handling all evacuation and sampling equipment and sample containers. The gloves are discarded once sample withdrawal is complete. PVC or stainless steel bailers are normally used to purge wells; stainless steel bailers should be used to obtain the samples. Sample water must be transferred from the bailer or pump directly into a sample container that has been specifically prepared for that constituent or set of constituents. For bailed wells, the bailer should be lowered slowly into the water to avoid agitation. For samples collected with pumps, the pumping rate should be lowered below one gallon per minute, if possible, and the sample containers filled directly from the pump discharge.

Each sample container must be carefully filled to minimize aeration and capped in sequence of decreasing volatilization potential as listed in Table 1. After filling all sample containers, a clean beaker should be filled with a sample for a field chemical analysis. The beaker must be cleaned between sampling points using a deionized water rinse.

3.2 Surface Water/Stream Sampling

Stream sampling does not require evacuation. A similar sampling technique and sequence as outlined in the water sampling section should be followed except that the procedures call for pre-cleaned sample containers to be inverted and slowly submerged into the midpoint of the stream channel. The sample container should then be gently righted in the upstream direction until fully upright and filled. The sample container is then removed from the stream and capped.

3.3 Field Analyses

Due to the physical and chemical instability of the parameters, temperature, pH, and specific conductance, they must be measured in the field immediately following sample withdrawal.

Each instrument used for field analyses must be calibrated to operation manual specifications. The pH meter should be calibrated with 7 and 10 pH buffers at least once daily during use. Although a specific conductance meter cannot be calibrated in the field, it should be checked against a standard potassium chloride solution at least once daily during use. All specific conductance measurements should be compensated to a reference temperature of 25 degrees Celsius, using correction factor curves for a 0.1N KCl solution such as those presented in *American Water Works Association* (1985). Field and temperature compensated specific conductance and pH readings must be recorded in a field log book.

TABLE 1

SAMPLE COLLECTION SEQUENCE

Sample	Order
Volatile Organics (VOA) **	First Aliquot
Total Organic Halides (TOX) *	
Total Organic Carbon (TOC)	
Semi-Volatile Organics and Pesticides	
Polychlorinated Biphenyls (PCB) **	
Total Metals	
Dissolved Metals	
Cyanide	
Other Inorganic Ions	Last Aliquot

NOTE: A separate sample aliquot should be collected for field analysis after all other sample containers have been filled. This applies to the pH, and specific conductance measurements required under TSCA, 40 CFR 761.75(b)(6)(iii).

* Analyses sometimes required under special permit conditions.

** Analyses required specifically under TSCA, 40 CFR 761.75(b)(6)(iii).

3.4 Sample Containers

Only new sample containers may be used for collection of samples. The appropriate container type and preservatives to be employed are specified in Table 2. All containers must be pre-cleaned and capped by the manufacturer, distributor or laboratory prior to use. Each sample container must also be assigned a unique container number or lot number once cleaned and capped. Documentation verifying the cleaning procedure followed in preparation of each container should be maintained. To track containers from cleaning through analysis, the container number must be recorded on field log and chain-of-custody forms.

Sample containers to be used for analysis of organic constituents must be constructed of glass with Teflon-lined caps. The proper cleaning procedure for glassware consists of a non-phosphate detergent wash, hot tapwater rinse, pesticide-grade hexane rinse, deionized water rinse and kiln drying at 110 degrees Celsius. Cap liner preparation should be the same except they should be air dried.

Sample containers to be used for analysis of inorganic constituents (metals) should be polyethylene with polyethylene or polypropylene-lined caps. The cleaning sequence for plastic containers consists of a non-phosphate detergent wash, hot tapwater rinse, 10 percent nitric acid rinse, deionized water rinse and air drying.

The sample in each container may be analyzed for several constituents or parameters, provided the sample is of adequate volume and appropriate preservation and handling considerations have been employed.

3.5 Sample Preservation

Samples must be preserved (if necessary) at the sample location immediately after collection (see Table 2). Once collected and preserved, each sample must be stored in an ice chest containing frozen refrigerant packs. Any dissolved metal samples must be field filtered on-site prior to their transport to the analytical laboratory.

3.6 Special Handling Considerations

In some cases, analysis for metals may be required for certain TSCA landfill facilities. Samples to be analyzed for metal parameters should be collected in two aliquots, one to be analyzed for total metals and one for dissolved metals. The aliquot for dissolved metals analysis must be filtered at the sample location using a pressure filtration system. The filter assembly must be cleaned after each use following the procedure outlined for metals sample containers.

TABLE 2
RECOMMENDED CONTAINERIZATION AND PRESERVATION OF SAMPLES

Constituent	(ml)	Container	Preservation	Holding Time
Metals (Dissolved)	200	P.G	Field-filter HNO_3 to pH <2	6 months
Metals (Total)	200	P.G	HNO_3 to pH <2	6 months
Sulfate, Chloride,	50	P.G	Cool, 4°C	28 days
Bicarbonate	200	P.G	Cool, 4°C	14 days
Phenol	500	G	H_2SO_4 to pH <2 Cool, 4°C	28 days
Total Organic Carbon (TOC)	4 x 15	G. amber, Teflon-lined cap	HCl to pH <2 Cool, 4°C	8 days
Total Organic Halides (TOX)*	4 x 15	G. amber, Teflon-lined cap or septum	Cool, 4°C 1 ml 1.1M Sodium sulfite	7 days
Polychlorinated Biphenyls*	1,000	G. Teflon-lined cap	Cool, 4°C	7 days to extraction, 40 days from extraction to analysis
Volatile Organic Compounds**	2 x 50	G. Teflon-lined septum	Cool, 4°C No headspace	14 days
Pesticides	2,000	T.G	Cool, 4°C	7 days
Fluoride	300	T.P	Cool, 4°C	28 days
Nitrate	1,000	T.P.G	4°C/H_2SO_4 to pH <2	14 days
Cyanide	500	G	Cool, 4°C	14 days
Semi-Volatiles	1 gal. teflon liner	G	Cool, 4°C	7 days to ex-extraction, 40 days from extraction analysis

TABLE 2 (Continued)

References:

1. U.S. EPA (1986a) RCRA Groundwater Monitoring Technical Enforcement Guidance Document, OSWER-9950.1.

2. U.S. EPA (1986b) Test methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, third edition.

NOTES:

** Analyses sometimes required under special permit conditions.
* Analyses specifically reauired under TSCA, 40 CFR 761.75(b)(6)(iii).

Samples to be analyzed for volatile constituents must be collected and capped with zero headspace. Samples must also be transported to the laboratory promptly to provide ample time for analyses to be conducted within the holding times specified in Table 2. Prior to shipment, all samples will be carefully placed in an ice chest with frozen refrigerant packs to keep samples cool.

3.7 Sample Labels

Each sample container must have a sample label affixed to the outside of the container in an obvious location. The label should specify: container number (or lot number), sample identification number, name of collector, location sampled, date and time sampled, preservatives used, and parameters to be analyzed. All information must be recorded on the sample label with water-resistant ink.

3.8 Sample Seals

Samples shipped from the facility to the laboratory by a commercial courier must be transported in a refrigerated shipping container sealed with tamper evident tape or a tamper evident seal. Each seal must have a unique number. In the event samples are received with broken seals, or the chain-of-custody seal is broken, the well(s) or leachate collection component(s) in question must be resampled.

3.9 Field Logs

An example of a field log sheet is provided in Figure 11. The sampler must complete a field log form for each sample location noting the following information:

* Sample location.
* Sample identification number.
* Sample source: monitoring well, leachate standpipe, stream, etc.
* Sample type and collection equipment: grab sample, composite sample, bailer, pump, etc.
* Evacuation date and time, if applicable.
* Purge rate and volume purged (note will be made if purged to dry), if applicable.
* Personnel present at time of evacuation, if applicable.
* Depth to bottom, depth to water, and casing volume, if applicable.
* Water level after purge, if applicable.
* Casing inside diameter and type, if applicable.
* Weather conditions at time of purge, if applicable.
* Comments and observations at time of purge, if applicable.
* Date and time of sample withdrawal, if applicable.
* Sample appearance: color, turbidity, odor, sediments, etc, if applicable.
* Depth to water at time of sample withdrawal, if applicable.
* Estimate rate of recharge, if applicable.
* Weather conditions at time of sample withdrawal.

* Field analyses: temperature, pH, specific conductance.
* Container number of each aliquot collected.
* Container size, type, and preservative used in each sample aliquot.
* Parameters (analytes from each sample aliquot).
* Comments and observations at time of sample withdrawal.
* Signature and date of samples upon field log completion.

All field log entries should be made in ink. If an error is made in the field log, corrections should be made by crossing a single line through the error, initialing, and entering the correct information. The erroneous information should remain legible.

3.10 Chain-of-Custody-Record

Each sample set for a sample location may consist of several individually numbered containers. Each sample container must be logged onto the chain-of-custody form (Figure 12) prior to placement in ice chests for shipment to the analytical laboratory.

The following information must be recorded on the chain-of-custody form:

* Sample source: monitoring well, leachate standpipe, stream, etc.
* Collector's name.
* Purpose of sample collection.
* Dates of sample collection.
* Sample identification numbers.
* Sample location.
* Container number of each sample aliquot.
* Container size, type, and preservatives used in each sample aliquot.
* Constituents or parameters (analytes from each sample aliquot).
* Rush analyses requested, if applicable.
* Special handling instructions.
* Destination of samples, if applicable.
* Name, date, time and signatures of each individual possessing the samples.
* Shipping container seal number and condition (used only if transported by commercial courier).

The chain-of-custody form must be signed by each individual responsible for handling the sample containers and must accompany the samples until they are received by the outside laboratory.

Custody of the samples is defined as actual physical possession, in view after physical possession, or locked and/or sealed in a tamper resistant container after physical possession. At the time of custody transfer, the individual relinquishing the samples shall observe as the transferee inspects the samples for integrity and number, dates, and signs the chain-of-custody form. A signed original copy of the chain-of-custody form must be returned to the facility once the samples have been received by the laboratory.

FIGURE 11/EXAMPLE FIELD LOG SHEET

Sample Location ________
Field Log Page# ________

________ Lab # ________
________ Lab # ________

Sample Source: ________ Monitor Wells; ________ Leachate Standpipe; ________ Leak Detection; ________ Underdrain; ________ Stream; ________ Pond; ________ Other ________

Sample Type/ Equipment: ________ Grab; ________ Composite; ________ Dipping Bottle In Standing/Flowing Water: ________ Bailer; ________ Electric Pump; ________ Venturi Pump; ________ Dipping; ________ Split Spoon; ________ Other; ________

Evacuation:

Date: ____/____/____
Start time: __:__
End Time: __:__
Purge Rate: __:__ gpm
Volume Purged: ________ gal
Purged To Dry: yes/no
Comments: ________

Personnel Present: ________
Depth To Bottom: ____.____ ft
Depth To Water: ____.____ ft
Height Of Water Column: ____.____ ft
Casing Volume: ____.____ gal
Water Level After Purge: ____.____ ft
Casing I.D. & Type: ____ in. ____
Weather Conditions: ________

Sampling:

Date: ____/____/____
Time -Collected: __:__
Sample Appearance: ________
Comments: ________

Personnel Present: ________
Depth To Water: ________ ft
Recharge Rate: ____ ft/ ____
Weather Conditions: ________

TEMPERATURE (C)		pH (std)		CONDUCTIVITY (Umhos/cm)		
____	____	____ TC	____ TC	____ TC	____ TC	____
____	____	____ TC	____ TC	____ TC	____ TC	____

CONTAINER NUMBER	SIZE (ml)	TYPE pl/gl	PRES.	PARAMETERS/COMMENT

SIGNATURE: ________ DATE / /

FIGURE 12/EXAMPLE CHAIN-OF-CUSTODY FORM

Sample Identification: Sample Source: ______ Purpose: ______

Collector: ______ Dates Collected: ______

Sample I.D.	Sample Point	Container Number	Size (ml)	Type (pl/gl)	Pres.	Parameters/Comments	Rush

Special Handling Instructions: ______

Destination: Company: ______ Attn: ______

Address: ______ Phone No.: ( ) ______

______ P.O. No. ______

Shuttle Chronology:

1. Prepared By: ______ Date: / / ______ Time: __ : __
   Signature: ______ Seal No. ______ Intact ______
2. Transported By: ______ Date: / / ______ Time: __ : __
   Signature: ______ Company: ______
3. Received By: ______ Date: / / ______ Time: __ : __
   Signature: ______ Comments: ______

4. Analytical Procedures

Sample analyses must be performed using only EPA-recognized laboratory procedures. Table 3 indicates the test methods and detection limits to be used in the analyses of samples collected at the TSCA landfill facilities. Detection limits for specific volatile organic compounds are compiled in Table 4.

5. Field and Laboratory Quality Assurance/Quality Control

One of the fundamental responsibilities of the TSCA landfill facilities is the establishment of continuing programs to ensure the reliability and validity of field and analytical laboratory data gathered as part of the overall monitoring program.

The facility's Operation Plan must explicitly describe the QA/QC program that is to be used in the field and laboratory. Most facilities use commercial laboratories to conduct analyses of ground water samples. In these cases, it is the facility's responsibility to ensure that the laboratory of choice is utilizing a proper QA/QC program. The QA/QC program described in the Operation Plan must be the one used by the laboratory that is analyzing samples for the owner/operator.

5.1 Field QA/QC Program

The Operation Plan should provide for the routine collection and analysis of two types of QC blanks: trip blanks and equipment or field blanks. Trip blanks are used to determine if contamination is introduced from the sample containers. They are prepared by the analytical laboratory and consist of a series of laboratory cleaned sample containers filled with laboratory demonstrated contaminant-free water. Equipment or field blanks are used to determine if contamination is introduced by the sample collection equipment. They are prepared by passing deionized water through clean sampling equipment (bailers, pumps, etc.) prior to transfer to sample containers using the normal handling procedures (filtering, preservation, etc.). Field blanks must be analyzed for the same parameters as the other samples collected through the same devices. This allows the source of any contaminants detected in the field blank to be identified and corrected. Locations sampled with the same equipment as a field blank showing contamination may require resampling.

Some Operation Plans may include provisions for taking blind duplicate samples as a check on the precision of the analyses. In this case, a duplicate sample should be taken periodically and collected in the identical manner as routine monitoring samples. The sample labels and chain-of-custody forms should not indicate where the duplicate sample was collected. The actual identity of the blind duplicates must be recorded only on field log sheets. The duplicate sample is to be analyzed for the same parameters as the regular samples and the analytical results are to be compared with those from the original sample. Discrepancies in the concentration of contaminants detected in either sample should then be explained if in excess of the error limits of the analytical procedures used.

TABLE 3

ANALYTICAL TEST METHODS

Constituent	Test Method	Method Detection Limit (mg/L)
Sodium	D-1428(a)	0.05
Potassium	D-1428(a)	0.05
Calcium	7140(b)	0.001
Magnesium	7450(b)	0.01
Iron	7380(b)	0.05
Manganese	7480(b)	0.015
Chloride	9252(b)	1.0
Sulfate	9038(b)	1.0
Bicarbonate	406(c)	1.0
Fluoride	300.00(e)	0.1
Semivolatile Organic Compounds	8250(b)	0.010
Cyanide	335.3(e)	0.005
Arsenic	7060(b)	0.001
Barium	7080(b)	0.1
Cadmium	7130(b)	0.005
Chromium	7190(b)	0.05
Lead	7420(b)	0.1
Mercury	7470(b)	0.0002
Selenium	7740(b)	0.002

TABLE 3 (continued)

Constituent	Test Method	Method Detection Limit (mg/L)
Silver	7760(b)	0.01
Strontium	(f)	None Given
Phenol	9066(b)	0.005
Total Organic Carbon (TOC)	9060(b)	1.0
Total Organic Halides (TOX)*	9020(b)	0.002
Volatile Organic Compounds (VOA)**	5030 + 8240(b)	d
Pesticides and Polychlorinated Biphenyls (PCB)*	3510 + 8080(b)	0.0002

Notes:

(a) ASTM (1979) Water and Environmental Technology, Vol. 11.02.

(b) U.S. EPA (1986b) Test Methods for evaluating Solid Waste, Physical/ Chemical Methods, SW-846, third edition.

(c) AWWA (1985) Standard Methods for the Analysis of Water and Wastewater, 16th edition.

(d) Detection limits for volatile organic compounds are described in Table A-4.

(e) Methods of Chemical Analysis of Water and Wastes, EPA-600/4-79-020. March 1983.

(f) Handbook of Radiochemical Analytical Methods, EPA-680/4-75-001.1975.

** Analyses sometimes required under special permit conditions.

* Analyses specifically required under TSCA, 40 CFR 761.75(b)(6)(iii).

References:

1. U.S. EPA (1986a) RCRA Groundwater Monitoring Technical Enforcement Guidance Document, OSWER-9950.1.

2. U.S. EPA (1986b) Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, third edition.

TABLE 4
VOLATILE ORGANIC COMPOUNDS
PRACTICAL QUANTITATION LIMITS

Volatile Organic Compound	Practical Quantitation Limit (ug/L)
Acrolein	5
Acrylonitrile	5
Benzene	5
bis (Chloromethyl) ether	10
Bromoform	5
Carbon tetrachloride	5
Chlorobenzene	5
Chlorodibromomethane	5
Chloroethane	10
2-chloroethylvinyl ether	10
Chloroform	5
Dichlorobromomethane	5
Dichlorodifluoromethane	5
1,1-dichloroethane	5
1,2-dichloroethane	5
1,1-dichlorethylene	5
1,2-dichloropropane	5
cis-1,3-dichloropropylene	5
Ethylbenzene	5
Methyl bromide	10
Methyl chloride	10
Methylene chloride	5
1,1,2,2-tetrachloroethane	5
Tetrachloroethylene	5
Toluene	5
1,2-trans-dichloroethylene	5
1,1,1-trichloroethane	5
1,1,2-trichloroethane	5
Trichloroethylene	5
Trichlorofluoromethane	5
Vinyl chloride	1
Methyl ethyl ketone	100
2-Hexanone	50
Acetone	100

Notes:
1. Practical Quantitation Limits are from Federal Register, July 9, 1987, for method 8240.
2. Actual GC/MS method detection limits may vary because of analytical interference and dilution effects. PQLs are provided as an example of typical detection limits.

Evacuation and sampling equipment must be handled in a manner to prevent contamination from outside sources. Surfaces that come into contact with samples must be thoroughly cleaned with deionized water, handled with disposable PVC or latex gloves and capped or stored in plastic until use.

5.2 Laboratory QA/QC Program

The Operation Plan should also provide for the use of standards, laboratory blanks, duplicates and spiked samples for calibration and identification of potential matrix interferences. The facility should use adequate statistical procedures to monitor and document performance and implement an effective program to resolve testing problems. Data from QC samples (e.g., blanks, spiked samples) should be used as a measure of performance or as an indicator of potential sources of cross-contamination but should not be used to alter or correct analytical data. These data should always be submitted to the Agency along with the monitoring sample results.

6. Data Analysis and Interpretation

Once samples have been collected and analyzed at the laboratory, the data produced must be interpreted in order to determine whether or not the facility has had a significant negative effect on ground water or surface water due to a release of contamination. This determination is based upon the results of a statistical test involving a comparison of background chemical data to that obtained from appropriately associated downgradient ground water monitoring well sampling and surface water sampling.

Although TSCA regulations do specifically require that background contaminant levels be established by sampling and analysis of ground and surface water prior to commencing operations, no guidance is provided regarding how this data is to be collected and how contaminant detection and assessment are to be done. The following discussion of data interpretation techniques, with respect to contaminant detection and assessment, is therefore largely based upon applicable RCRA 40 CFR Part 264-265 regulations and guidance. Therefore, the following should only be taken as a strong recommendation, one that would not be enforceable under TSCA unless specifically included as a permit condition or in an Operations Plan.

6.1 Establishment of Background Conditions

The first step in the procedure used to evaluate possible releases of contamination from a TSCA landfill facility is the establishment of background conditions. In concept, background conditions are thought to represent the pristine or natural chemical conditions of ground or surface water that exist or existed at the time the facility commenced its disposal operations. As such, background sampling locations must be upgradient from the facility with respect to ground and surface water flow directions and must be far enough removed from the facility that any potential influences from the site are avoided. It is possible that some background monitoring wells may later be found to be downgradient as a result of an incorrect assessment of ground water flow direction, site-related contamination, contamination unrelated to the facility or a change in ground water flow direction due to site dewatering or other activities. Because of these possible difficulties, it is recommended that background conditions be assessed on a year-by-year basis. In addition, it is preferable to employ more than one background ground and surface water sampling location in order to understand possible spatial variability of background concentration levels in the vicinity of the site.

Background ground water and surface water quality should be established based upon data obtained from quarterly sampling of upgradient wells and surface water locations for one year. Four replicate measurements should be obtained from each well or surface water location during each sampling event. The background mean and variance values determined for each parameter of interest (PCBs, pH, specific conductance, chlorinated organics (TOX), others) should then be calculated from the data sets utilizing procedures outlined under *Cochran's Approximation to the Behrens-Fisher* (CABF) *Students' T-test* (see 40 CFR Part 264, Appendix IV). These summary statistics (mean, variance), which describe the background concentrations, form the basis against which all subsequent upgradient and downgradient concentrations are compared. Note: For sites in which all background values are nondetectable (i.e., less than the parameter detection limit), background levels should be set at 1/2 the method detection limit. (Of those parameters listed above, this applies only to PCBs and TOX.)

6.2 Statistical Analysis of Monitoring Data

After the first year in which background concentrations are established, ground water and surface water monitoring data are compared with their respective background values to determine if there is an indication that a release of contamination has occurred. Once again, the CABF Students' T-test is recommended to make this comparison. A statistically significant increase in the mean concentration of any parameter of interest above that found in the background suggests that contamination may have taken place. Note: In the case of pH, the T-test is conducted to detect either an increase or decrease (a significant change).

All of the upgradient and downgradient wells and surface water locations must be sampled each year after the first year. The parameters of interest must again be measured by performing at least four replicate analyses from each sample in the monitoring network at least semi-annually. The data obtained here must then be used to compute mean and variance values for each parameter from each well or sampling station (surface water) utilizing the same methodology used to define the background means and variances.

If the increase between the mean of the parameter measured at each well or surface water sampling location and the respective background value for the parameter is significant at the 0.05 level (95% confidence limit), using the CABF Students' T-test, a suggestion that the facility may be affecting water quality is indicated. It is then the facility owner's responsibility to resample the wells or surface water stations where a significant increase has been detected. These samples should be split in two and analyzed to determine by reapplying the T-test whether the indicated increase was the result of laboratory error or actual contamination. If a significant increase is confirmed by the additional analyses, the facility must take steps to begin the detailed assessment of the nature and extent of the ground water or surface water contamination.

6.3 Assessment of Contamination Extent

Once the facility has detected a contaminant release as a result of the above-outlined or other monitoring efforts, a more aggressive program of ground or surface water assessment monitoring must be undertaken in order to determine the extent of contamination that is related to the facility and its operations. Generally speaking, the owners of the facility must determine the vertical and horizontal profiles of all hazardous or toxic constituents present in the contaminant plume that has been found to be escaping from the landfill area(s). In addition, the rate and extent of contaminant migration must also be established. The goal of an assessment monitoring program is to provide sufficient information to form the basis for plans to remediate the affected ground and/or surface water.

Contaminant assessment monitoring involves a more intensive and specifically-focused investigation of ground water and/or surface water quality; an investigation aimed at the immediate vicinity of the area(s) in which contamination has been proven to exist. This investigation generally consists of a more detailed characterization of the geohydrologic setting of the site and the chemistry of the affected waters. Geophysical surveys may be employed in attempts to define the extent of a contaminant plume. Installation of a more extensive, denser network of ground water monitoring wells and well nests or clusters is often necessary along with increased sampling frequencies. Mathematical modeling of contaminant movement may also be used to estimate the migration rates and expected concentrations of the particular constituents of interest. This can then be compared with the actual ground water data from wells to fine tune the model to provide an accurate three-dimensional picture of contaminant migration within the affected aquifers or surface water bodies.

CHAPTER III

REGULATIONS AND PERMITTING

A. TSCA OVERVIEW

1. Introduction

The Toxic Substances Control Act (TSCA) was enacted by Congress in 1976 to identify and control chemicals which posed an unreasonable risk of injury to health or the environment. Under Section 2 of TSCA, Congress delegated the authority to control the chemical substances whose manufacture, processing, distribution in commerce, use or disposal presented such risks, to the Administrator of EPA. Within EPA, the Office of Toxic Substances is responsible for enforcement of the Act.

2. TSCA Synopsis

A review of the entire Act is recommended to provide the inspector with an understanding of EPA's authority with regard to chemical substances, specifically PCBs, which may be considered harmful. Several sections of the Act are summarized below.

Section 6(e) of TSCA specifically required the EPA to establish rules to: (1) prescribe the methods for the disposal of PCBs; (2) require PCBs to be marked with adequate warnings; and (3) unless granted an exemption, prohibit the manufacture, processing, or distribution of PCBs, and the non-totally enclosed use of PCBs. These rules, as compiled in 40 CFR Part 761, were established and became effective in 1978 and 1979. This Section also allowed the EPA to regulate other chemicals if they were determined to be harmful.

Under Section 11, representatives of EPA may inspect an establishment, facility, or other premises or conveyance for the purpose of administering the Act. The inspection, however, may only be made upon the presentation of appropriate credentials and a written notice to the owner, operator or agent in charge of the premises or conveyance being inspected. It should be conducted at reasonable times, within reasonable limits, and in a reasonable manner, and can extend to records, files, papers, processes, controls, and facilities.

Section 15 of TSCA states that, among other things, it is unlawful for any person to fail or refuse to comply with any requirements under Section 6, or to deny entry for inspection as required by Section 11.

CHAPTER III

B. TSCA LANDFILL REGULATIONS - PCB CONTROL

1. Introduction

The remainder of this chapter deals with the regulations and permitting activities effecting chemical waste landfills which accept wastes whose disposal is governed by TSCA. As of the penning of this manual, the only chemical whose disposal is regulated by TSCA is PCBs. Prior to the acceptance of PCBs, a chemical waste landfill must be approved by the Regional Administrator for the Region in which the landfill is located. The approval, in the form of a written permit, establishes enforceable operating conditions. The landfills discussed throughout the remainder of this manual will be those permitted to accept PCBs (TSCA landfills).

In addition to the PCB disposal, storage, marking and recordkeeping regulations listed under 40 CFR Part 761, the inspector should have a thorough understanding of the operating permit for the TSCA landfill prior to its inspection. It is also recommended that the inspector become familiar with the chemical waste landfill requirements under the Resource Conservation and Recovery Act (RCRA) as listed in 40 CFR Part 264 Subpart N, as well as any other Federal, State, or local permits or approvals for a particular landfill. The requirements for RCRA landfills are in many instances more detailed and stringent and may be incorporated into landfill permits written under TSCA.

2. Landfill Regulations (40 CFR Part 761.75)

The minimum technical requirements for TSCA landfills fall into three major topics: (1) landfill siting; (2) monitoring wells; and (3) landfill design.

Landfill Siting

Soils. The landfill must be located at a site underlain by thick, relatively impermeable soil formations or by soils having a high clay and silt content with: (1) an in-place soil thickness (4 feet) or compacted soil liner thickness (3 feet); (2) a permeability equal to or less than 1×10^{-7} cm/sec; (3) greater than 30% soil passing No. 200 Seive; (4) a liquid limit greater than 30; and (5) a plasticity index greater than 15.

Hydrologic Conditions. The bottom of the landfill liner or natural inplace soil barrier must be at least 50 feet from the historic high water table. In addition, the site should avoid floodplains, shorelands and ground water recharge areas and should not have a hydraulic connection between it and surface water.

Flood Protection. A surface water diversion dike, with a minimum height equal to two feet above the 100-year floodwater elevation, must be provided around the perimeter of a landfill which is located below the 100-year floodwater elevation. If the site is above the elevation, structures capable of diverting the surface water runoff from a 24-hour, 25-year storm are required.

Topography. The landfill site must be located in an area of low to moderate relief to minimize erosion and to help prevent landslides or slumping.

Monitoring Systems

Water Monitoring Systems. Ground and surface water from the disposal site must be sampled prior to commencing operation. In addition, surface watercourses designated by the EPA must be sampled at least monthly when the landfill is being used for disposal operations, or at least every six months after final closure of the disposal area.

At least three ground water monitoring wells are required. They must be equally spaced on a line through the center of the disposal area and extend from the highest to the lowest water table elevation on the property. Each monitoring well must also be cased, have a removeable cap, and have its annular space between the monitor zone and the surface backfilled with Portland cement or its equivalent.

The frequency at which the facility must sample the wells is specified in the permit. Prior to obtaining a sample for analysis, the well's initial volume of liquid must be removed. The liquid purged from the well prior to sampling must be recycled to the landfill or treated to meet applicable State or Federal standards.

All water samples, including those from the leachate collection system, must be analyzed for PCBs, pH, specific conductance, and chlorinated organics.

Landfill Design

Synthetic Membrane Liners. If required by the EPA, a synthetic liner can be used to provide a minimum total permeability equivalent to 1×10^{-7} cm/sec. The liner must be compatible with PCBs and have a minimum thickness of 30 mils.

Leachate Collection. Depending on the site's geologic setting and the waste type(s) to be disposed, a simple, compound, or suction lysimeter system should be used to collect leachate. The leachate collection monitoring system shall be installed above the landfill and must be monitored monthly for the quantity and physiochemical characteristics of the leachate produced. The leachate must be treated for discharge or disposed of in accordance with the State or Federal permits or regulations.

Supporting Facilities. The site must be bounded by a 6 foot woven fence, wall or similar device to prevent unauthorized persons or animals from entering.

The types of waste and the handling of the wastes to be disposed of in a TSCA landfill are regulated as follows:

* PCBs and PCB items must be placed in the landfill in a manner that will prevent damage to the containers or articles.

* Incompatible wastes must be segregated from PCB wastes at all times.

* Liquid wastes must not contain over 500 ppm PCBs, and PCBs must not migrate from the site.

* Bulk liquids containing less than 500 ppm PCBs must be pretreated and/or stabilized into a non-flowing consistency prior to disposal.

* Ignitable wastes must not be disposed of in TSCA landfills.

* Containers of liquid PCBs (50 - 500 ppm) must be surrounded by an amount of inert sorbent material capable of absorbing all of the liquid contents of the container.

Prior to the disposal of PCBs, an Operation Plan must be submitted as part of the TSCA permit application process. This plan governs day-to-day procedures and must include detailed explanations of the procedures to be used for recordkeeping, surface water handling, excavation/backfilling, vehicle movement/roadway use, leachate collection systems, sampling and monitoring procedures, emergency contingency plans, site security and liquid waste disposal limitations. Provisions must be made to assure that containers are not damaged during disposal and that incompatible wastes, such as organic solvents, are segregated from PCB wastes in the landfill. Ignitable wastes are prohibited from disposal in TSCA landfills.

During the operation of the landfill, records must be maintained for all PCB disposals and must include information on the PCB concentration in liquid waste and three dimensional burial coordinates for all PCBs and PCB items placed in the landfill.

3. Related Disposal Regulations (40 CFR Part 761.60)

The following wastes are approved for disposal in TSCA landfills:

* Liquids containing PCBs at concentrations of 50 ppm or greater, but less than 500 ppm, provided information is available to show that the liquid does not exceed 500 ppm PCBs and is not an ignitable waste.

* Non-liquid PCBs in the form of contaminated soil, rags, or other debris.

* Dredged materials and municipal sewage treatment sludges containing PCBs.

* PCB transformers, provided that they are first drained of all free-flowing liquid, filled with a solvent, allowed to stand for 18 hours and then drained thoroughly.
* Capacitors containing less than 500 ppm PCBs.

* PCB articles other than PCB transformers, provided all free-flowing liquids have been drained.

* PCB containers which have not been decontaminated, provided they are first drained.

* PCB small capacitors, provided they are placed in appropriate containers.

The following wastes cannot be disposed of in TSCA landfills:

* Liquid PCBs at concentrations of 500 ppm or greater.

* PCB large high or low voltage capacitors.

* Industrial sludges or slurries containing 500 ppm or greater PCBs.

An additional requirement of notification is specified within the PCB disposal regulations. Each operator of a TSCA landfill must give written notice to the appropriate State and local government at least 30 days before a facility is first used for the disposal of PCBs. If requested, an annual notice of the quantities and types of PCBs disposed must also be submitted no more than 30 days after the end of the year covered.

4. Related Storage Regulations (40 CFR Part 761.65)

Long-term storage areas used in TSCA landfills to store PCBs and PCB items must meet the following requirements:

* Adequate roof and walls.

* A floor and continuous curbing with a minimum 6-inch high curb, both of which must be constructed of smooth and impervious materials.

* A containment volume equal to at least two times the internal volume of the largest PCB article or PCB container, or 25 percent of the total internal volume of all PCB articles or PCB containers in the storage area, whichever is greater.

* No drains, valves, expansion joints, sewer lines or other openings within the diked area.

* Not located at a site below the 100-year flood water elevation.

In addition, non-leaking, undrained, and undamaged PCB large high voltage capacitors and PCB contaminated electrical equipment may be stored on pallets next to a long-term PCB storage area. However, the storage area must have immediately available unfilled storage space equal to 10 percent of the volume of capacitors and equipment stored outside the facility, and must be checked for leaks weekly.

A temporary storage area, which does not meet the requirements of a long term storage area, can be used to store the following PCB articles and PCB containers for up to 30 days from the time the generator designated the article or container in storage for disposal, provided that a notation is attached to the PCB article or container indicating the date the PCB article or container was removed from service:

* Non-leaking PCB articles and PCB equipment.

* Leaking PCB articles and PCB equipment, provided they are placed in a non-leaking PCB container with sufficient sorbent material to absorb any liquid PCBs remaining in the PCB items.

* PCB containers containing non-liquid PCBs.

* PCB containers containing liquid PCBs at concentrations between 50 and 500 ppm, provided a Spill Prevention, Control and Countermeasures (SPCC) Plan has been prepared, and each container bears a notation that indicates that the liquid in the drum does not exceed 500 ppm PCBs.

Both types of storage areas used for the storage of PCBs and PCB items must be marked with the mark M_L, as illustrated in 40 CFR Part 761.45.

All PCB articles and PCB containers in storage for disposal must comply with the following regulations:

* Must be checked for leaks at least once every 30 days.

* Must be dated when they are placed in storage.

* The storage of the articles and containers must be arranged so they can be located by the date they entered storage.

* If any PCB articles or containers are discovered to be leaking, the article, container and their contents must be transferred to a nonleaking container.

* Any spilled or leaked material must be cleaned up immediately.

Any container used for the storage of liquid PCBs must meet the following Shipping Container Specifications of the Department of Transportation (DOT):

* Specification 5 (steel drums without removable heads).

* Specification 5B (steel drums without removable heads).

* Specification 6D overpack (cylindrical steel overpack) with Specifications 2S or 2SL (polyethylene containers).

* Containers designed, constructed, and operated in compliance with Occupational Safety and Health Standards 29 CFR Part 1910.106, provided an SPCC Plan has been implemented.

For PCB non-liquids, the following containers, which meet the DOT specifications, can be used:

* Specification 5 and 5B (both steel drums with removable heads).

* Specification 17C (steel drums).

* Other containers larger than those above, provided they are designed and constructed in a manner that provides as much protection as the DOT containers.

Moveable equipment used for handling PCBs and PCB items within the storage area must be decontaminated prior to removal from the area if it has come in direct contact with PCBs.

5. Related Marking Regulations (40 CFR Part 761.40)

Each of the following items observed at a TSCA landfill must be marked with the mark M_L or, if allowable, the mark Ms, as illustrated in 40 CFR Part 761.45:

* PCB containers.

* PCB transformers.

* PCB large high and low voltage capacitors.

* PCB article containers containing PCB transformers, or PCB large high or low voltage capacitors.

* Equipment containing a PCB transformer or PCB large high voltage capacitor.

* Electric motors, hydraulic systems and heat transfer systems which contain >50 ppm PCBs.

* Storage areas used to store PCBs and PCB items for disposal.

* Transport vehicles, on each end and side, if they are loaded with PCB containers that contain more than 99.4 lbs. of PCBs in the liquid phase, or with one or more PCB transformers.

6. Related Recordkeeping Regulations (40 CFR Part 761.180)

The owner or operator of a TSCA landfill must prepare and maintain an annual document which tracks the PCBs and PCB items handled at the facility. The document should be maintained for each year beginning with July through December, 1978, and must be prepared by July 1 of each succeeding year. The following information must be included in these documents for the previous calendar year:

* The date when PCBs and PCB items were received for storage or disposal at the landfill, or transferred to another disposal or storage facility.
* The identification of the specific types of PCBs and PCB items that were stored or disposed.
* The identification of the facility and the owner or operator of the facility from whom the PCBs were received, and the identification of the facility to which PCBs and PCB items were transferred.
* A summary of the total weight in kilograms of PCBs and PCB articles in containers and PCBs in PCB transformers received and/or transferred to other facilities during the calendar year, or retained at the facility at the end of the calendar year.
* The total number of PCB articles or PCB equipment not in PCB containers received or transferred to other storage or disposal facilities during the calendar year, or retained at the facility at the end of the calendar year.
* Records of any water analysis required from ground water and surface water sampling.
* Operation records, including burial coordinates for PCBs and PCB items disposed.

In addition to the annual recordkeeping requirements mentioned above, owners or operators must also maintain the following data:

* Any and all documents, correspondences, and data between the owner or operator of the facility and any State or local government agency that pertains to the storage or disposal of PCBs and PCB items at the facility.
* Any application and related correspondence sent by the owner or operator of the facility to any local, State, or Federal authorities in regard to waste water discharge permits, solid waste permits, building permits, or other permits or authorizations.

All of the above-mentioned records and documents are required to be maintained at least 20 years after the landfill is no longer used for the disposal of PCBs and PCB items. If the facility ceases to be used for PCB storage or disposal, the owner or operator must notify the EPA within

60 days. The notice should also specify where the documents are located.

If a TSCA landfill has PCBs and/or PCB items in service or projected for disposal, the owner or operator must maintain records on the disposition of the PCBs if they are using or storing at one time at least 45 kilograms of PCBs contained in PCB containers, or one or more PCB transformers, or 50 or more PCB large high or low voltage capacitors. The records should have been initiated, if applicable, beginning July through December 1978, and should be prepared by July 1 covering each previous calendar year. These documents and records must be maintained for five years after the facility ceases using or storing PCBs and PCB items, in the aforementioned quantities, and should include the following information:

* The dates when PCBs and PCB items were removed from service, were placed in storage for disposal, and were placed into transport for disposal, and the quantities associated with each change using: (1) the total weight in kilograms of PCBs and PCB items in containers including the identification of the container contents, (2) the total number of PCB transformers and the total weight in kilograms of PCBs contained in the transformers, and (3) the total number of PCB large high or low voltage capacitors.

* For PCBs and PCB items removed from service, the location of the initial disposal or storage facility, and the name of the owner or operator of the facility.

* PCBs and PCB items remaining in service at the end of the calendar year using: (1) the total weight in kilograms of any PCBs and PCB items in PCB containers, including the identification of the container contents, (2) the total number of PCB transformers, and the total weight in kilograms of any PCBs contained therein; and (3) the total number of PCB large high or low voltage capacitors.

CHAPTER III

C. PERMITTING

1. Application Process

Prior to disposal of PCBs or PCB items in a TSCA landfill, the owner must receive written approval from the Regional Administrator for the Region in which the landfill is located. This approval must be obtained through the owner's submittal of an initial report containing the landfill location; a detailed description of the landfill; plans and design drawings; an engineering report describing the landfill's compliance with the technical requirements outlined in the regulations; the sampling and monitoring equipment and facilities available; the expected PCB waste volume; a general description of wastes other than PCBs (if any) also to be disposed of in the landfill; a detailed landfill Operations Plan (as outlined above); any applicable local, State or Federal permits or approvals; and any schedules or plans for complying with the approval requirements of the regulations.

2. Approvals

In general, the Regional Administrator may not approve a chemical waste landfill unless he finds that the facility meets all of the regulatory requirements under TSCA. The Regional Administrator can waive one or more of the technical requirements, if, in his opinion, the owner of the facility submits sufficient evidence indicating that landfill operation will not present an unreasonable risk of injury to health or the environment from PCBs. Any such waiver is stated in writing and included as part of the approval. For example, the rule requiring that the base of the landfill be 50 feet above the ground water table is invariably waived for landfills in the Great Lakes Region (EPA Region V) because of the typically shallow depth of ground water and the relative impermeability of the clay-rich glacial soils that occur in the area. Soil liquid limit and plasticity index requirements are also commonly waived.

As compensation for such a waiver, the Regional Administrator has the authority to impose additional technical requirements or provisions that are deemed necessary. Examples of such compensatory requirements imposed under this omnibus provision are: RCRA-style double leachate collection/double soil liners; increased soil liner and synthetic liner thicknesses; RCRA-style landfill caps; submittal of closure plans; extensive monitoring programs; and financial assurance. Such compensatory requirements can and often do exceed the minimum technical standards outlined under TSCA or RCRA.

Generally, the TSCA landfill regulations form a framework for permitting purposes with waiver and omnibus provisions giving EPA authority to impose necessary requirements and permit conditions. Approvals issued under TSCA are, therefore, specifically tailored to each facility on a case-by-case basis with enforceable operating or other conditions being imposed where appropriate. This allows EPA to maintain tight control over landfill design, construction, operations and monitoring to assure that public health and the environment are protected.

CHAPTER IV

TSCA LANDFILL INSPECTION

A. INTRODUCTION

An on-site inspection of a TSCA landfill is necessary to insure that the landfill is in compliance with the Act and any regulations, permits or enforcement actions issued under it. The inspections serve as a mechanism for the detection and verification of potential violations and the observation and evaluation of operating practices by providing EPA an opportunity to compare actual operations with those allowed in the operating permit and the PCB Regulations. As a result of information gathered during an inspection, EPA can take the following enforcement actions: (1) issue a notice of noncompliance; (2) assess a civil administrative penalty; (3) institute a civil court action; (4) institute a criminal court investigation; or (5) revoke an operating permit written under TSCA.

The EPA was granted the authority to conduct inspections under Section 11 of TSCA. Under this Section, a duly designated representative of the EPA, identified by appropriate credentials, may inspect the records, files, papers, controls, and facilities of a TSCA landfill, provided the inspection is conducted at reasonable times, within reasonable limits, and in a reasonable manner.

The inspector's role in this process is to use the time at the site to assess the performance of the landfill and provide evidence supportive of violations in the form of samples or documentation, all of which may be used in future enforcement actions. It is also the inspector's responsibility to conduct the inspection in a technically and legally correct manner to insure the accuracy and quality of the evidence gathered.

Advance preparation for a TSCA landfill inspection is necessary to insure that the inspection is focused and conducted efficiently. There are many steps which should be taken as part of a proper preparation for a TSCA landfill inspection. To begin with, the objective and goals of the inspection should be established and prioritized to insure that the review and inspection are conducted efficiently and thoroughly. Next, the inspector should review the landfill's TSCA permit as well as any previous inspection reports or reports of violation for the facility. An inspection checklist should then be formulated outlining the inspection and particular parameters and activities to be observed; and finally, as with any other inspection, the proper documents, safety equipment, and sampling equipment shall be prepared.

Each of the steps for preparing for a TSCA landfill inspection will be covered in more detail in the following sections of the manual. Some of them may vary from State or Regional policies currently being practiced. At this point, it should be emphasized that the material presented regarding advance preparation and the actual inspection and follow-up are offered as general guidelines, which should be considered in light of State and Regional needs as well as individual inspection goals.

CHAPTER IV

B. PREPARATION FOR A TSCA LANDFILL INSPECTION

Much of the preparation for the inspector involves the review of the facility's operating permit, previous inspection reports, and follow-up enforcement actions, if applicable, and formulation of an inspection checklist. The inspector should be familiar with the up-to-date PCB Regulations applicable to TSCA landfills. These were covered in Chapter III (above), and should be reviewed as necessary. During the preparation, the inspector should keep in mind the objectives and goals for the inspection and adjust his/her review accordingly. For instance, is the landfill to be inspected because of a complaint, as part of an enforcement action, or is it a routine inspection? This information may facilitate the preparation by allowing the inspector to concentrate his/her efforts on special issues, effectively using time in the office and at the site. The inspector, however, should have an understanding of all the permit and regulatory requirements the landfill must meet, so that noncompliances will not be missed due to unfamiliarity with the requirements.

1. Review of the Permit (Conditions, Waivers)

Comparing the permit conditions and the regulatory requirements to current and past operating practices and parameters is an important part of a TSCA landfill inspection. The inspection of a landfill's current operations is done by on-site observations and sampling, while that of past operations is dependant on a review of the facility's records. A major part of the preparation for the inspection is a review of the operating TSCA permit for the facility as well as the application material which includes the landfill Operations Plan. The review of this material should be conducted to provide the inspector with:

* General background information.
* The operating conditions which can be inspected.
* The technical operating requirements.
* Any recordkeeping requirements in addition to those in 40 CFR Part 761.

While reviewing the general background information, the inspector should note when the landfill was established and permitted, its size, location and owners, the general site plans, design drawings and the layout of the landfill, monitoring systems, as well as a description of waste materials other than PCBs disposed of in the landfill. Most of this information is contained in the application material submitted to the EPA's Regional office for approval. The application material can be a valuable tool in the preparation for an inspection. This information provides the inspector with an overview of the landfill, allowing him/her to determine what to inspect on site, so an initial order of approach for the inspection can be planned, as well as providing him/her with background information that will not have to be covered during the actual inspection.

The landfill Operations Plan, which must be submitted as part of the application material, contains information on how the landfill conducts its day-to-day operations. The Operations Plan must be approved prior to the acceptance of PCB waste, and once approved, becomes part of the enforceable requirements for the landfill. The information required to be maintained in the Operations Plan is discussed in Chapter III above. This plan is one of the most important documents to be reviewed and understood. The procedures mentioned in the plan must be followed by the facility, and the inspector should be aware of them to insure that facility personnel are following the proper procedures for sampling, monitoring, waste handling and maintenance. In addition, any other construction plans or technical drawings submitted by the facility as part of its TSCA application should be reviewed to verify the existence of the proper certifications, if required, and to determine if there are significant departures from these documents.

The conditions of approval in the TSCA permit must also be reviewed to determine the site-specific requirements the landfill must meet. Special attention should be paid to those which can be observed while at the site such as: the verification of monitoring locations; sample, waste, leachate and ground water handling; and any newly added amendments to the permit which may not have been previously inspected. These observable conditions should be noted during the review for later incorporation into an inspection checklist.

In addition to the recordkeeping requirements in 40 CFR Part 761.180, a landfill may be required to maintain records under conditions of the permit. Some TSCA landfill permits require the submittal of an annual report to the Region in which the landfill operates. This report may contain annual analytical data from ground and surface water monitoring and the leachate collection system, volumes of leachate collected, the types and quantities of PCBs accepted and disposed and may contain water table maps, etc. If this report is required to be submitted, it should be reviewed prior to the inspection to: (1) determine compliance with the permit; (2) provide the inspector with an idea of the wastes collected and disposed and the volumes of leachate collected; and (3) give the inspector a feel for the tracking records maintained by the facility. Other permit conditions may require records to be maintained regarding monitoring frequency and waste handling. Again, as with the other parts of the permit review, the observable records should be targeted for inspection.

2. Meeting With the Permit Writer

The permit writer can be a valuable source of information for the inspector. They have spent many hours reviewing the application material for the landfill and should be able to provide the inspector with a physical description of the facility and its equipment, and offer guidance as to what the inspector should look for. The permit writer is also the best source of information regarding clarification of possible confusion related to imposed approval conditions, their background, and the granting of any waivers. In addition to the permit writer, Federal or State agency officials involved in previous inspections of the site may have information pertinent to a new inspection. The inspector should contact these individuals and the permit writer prior to the inspection.

3. Review of Previous Inspection Reports/Reports of Violations

Another important aspect of the preparation is a review of the previous inspection reports and, if applicable, past enforcement actions related to the facility. This step should not be overlooked. Not only will it provide more information concerning the background of the facility, it also provides the inspector with the compliance history of the landfill and a description of the actual on-site practices. Some of the specific information which should be covered and noted during the review are:

* Responsible parties and participants.
* Site-specific background information.
* Daily operational practices.
* Records and documents maintained.
* Past violations.

The name, title, phone number, and locations of responsible parties and past inspection participants should be noted. This information will be useful for making arrangements for the inspection or, if the inspection is to be unannounced, for gaining entry at the site.

General site information such as the landfill's size, location, layout, and equipment should also be noted. This information may fill in any gaps in the permit application materials and/or reveal any variances from the operation practices outlined in application material or from the site-specific conditions of approval.

The description of the daily operations contained in the previous reports will indicate what wastes are accepted by the facility, how they are managed from receipt to disposal, as well as the facility's monitoring and sampling practices. It may also describe how the receiving and storage facilities and roadways are maintained. If an on-site laboratory is being used, the report may describe the analytical practices followed by landfill personnel. Particular attention should be given to observations of activities which violate the TSCA regulations or permit conditions. These are clearly areas to be reinspected.

Any enforcement actions and related documents resulting from previous inspections should also be reviewed. This review provides the information on past practices which resulted in violations, enabling the inspector to focus on specific topics which should be rechecked to verify that the facility corrected the areas of noncompliance. For example, does a particular operation of the facility continually result in an enforcement action, or are wastes being repeatedly mismanaged at various stages of the disposal process? The effort a facility makes to maintain compliance may also be determined by a reveiw of these documents.

Since there are no specific format requirements for the records to be maintained by the facility, they can often be very detailed and confusing and may require an explanation by a representative of the facility. If these records are available as an attachment to the inspection report, or as a submittal to an enforcement action, they should be reviewed and understood prior to the inspection. The inspector may contact the facility for a description or clarification of the data recorded. During the review of these documents, the inspector should note the title of the forms, the types of data recorded and how it is recorded. If the forms are understood prior to the inspection, the time spent at the landfill may be used more effectively.

While conducting the review of the landfill's TSCA permit, inspection reports and enforcement actions, the inspector should prepare a summary sheet which contains the reviewed information which relates to the overall understanding of the landfill. Information on background, operations and the areas of concern pertinent to the inspection (such as conditional requirements, past violations and recordkeeping practices) should be recorded. This sheet will subsequently be used to construct an inspection checklist.

4. Formulation and/or Review of Inspection Checklist

The formulation of a checklist can be a useful practice in the preparation of a landfill inspection. It serves as a guideline for the entire inspection process by providing an internal check of preinspection activities and a detailed list of information to be covered while on site. Most importantly, it outlines steps of the inspection, in sequence, and if followed, adds a measure of insurance that specific areas of the inspection will not be overlooked. If prepared and used properly, it can effectively assist the inspector in conducting a thorough and efficient inspection.

The information which should be included on the checklist includes;

* Special topics related to facility background and operations to be covered during the opening conference and subsequent interviews.

* The types of records required to be maintained by the facility for regulatory purposes.

* The procedure or schedule to be followed during the inspection, including the areas of particular interest.

The inspector must first determine what the site-specific goals of the inspection are and the order in which they are to be achieved. Then, using the summary sheets and other information accumulated from the previous review stages, develop a fact sheet containing all information relevant to the inspection. The inspector may include general descriptive information as well as more specific information on monitoring practices, operations, waste handling, and recordkeeping. The checklist will take on the appearance of a questionnaire with "yes" or "no" answers or with blanks to be filled in during the inspection. The questions which are to be answered "yes" or "no" should relate to the observation of operations and practices and if certain records are maintained, and should be phrased so a "yes" answer indicates compliance with the regulations and permit conditions. The questions with blanks should apply to readings on monitors or records where the actual value observed is entered in the blank. A "comment" section may be included if the inspector feels that particular questions may require further explanation. Since the checklist may be used in an enforcement action, care must be taken with the phrasing of the questions to avoid any ambiguities. It is suggested to keep the checklist as simple and straightforward as possible. While preparing the checklist, the inspector should take into account his or her experience and the complexity and purpose of the inspection. For instance, if the inspector has conducted frequent landfill inspections and/or is familiar with their operations, a simpler version or none at all may be necessary. Finally, as with the previous stages of the preparation, the time spent on the formulation of a checklist should be limited and unnecessary information should be avoided.

By using a checklist, the inspector can help assure that the inspection is conducted in an organized and efficient manner and that the original goals of the inspection will be met. The checklist, however, is only a tool designed to be used on site as a supplement to the notes normally taken during an inspection. In other words, the inspector should not be limited simply to completion of the checklist and should not feel bound to strictly adhere to its format and questions. Rather, the checklist can simplify and eliminate various aspects of the note taking process; if other areas of concern arise during the inspection, the inspector should be sure to pursue these in more detail as necessary.

State and Regional policies regarding the use of checklists should be followed. Also, if a preferred checklist has been prepared, the inspector should continue to use it. An example of an inspection checklist is included at the end of this section.

Since landfills vary from site to site, there will not be a specific checklist which can apply to each landfill inspection. The inspector should compare any existing checklist with the one included in this manual and make any appropriate changes.

5. Safety and Field Equipment Preparation

The preparation of inspection documents and gathering of safety and field equipment are the final activities to be undertaken prior to the inspection. The documents and equipment required for the inspection are similar to those for any TSCA inspection with a few exceptions.

Several documents and items to be prepared, brought on site and presented as required or necessary include:

* Credentials
* Notice of Inspection
* TSCA Inspection Confidentiality Notice
* Receipt for Samples and Documents
* Declaration of Confidential Business Information
* TSCA Landfill Inspection Checklist
* PCB Regulations, 40 CFR Part 761
* TSCA Landfill Permit (site-specific)
* Outreach Materials
* Notebook

In order to effectively use the time at the facility, the inspector should complete the documents with as much information as possible prior to the inspection.

Most of the equipment required for the inspection falls into two categories: that for safety; and that for sampling. The safety equipment to be assembled and used during the inspection include:

* Hard hat
* Safety glasses or goggles
* Rubber soled, metal-toed shoes
* Coveralls
* Liquid-proof gloves
* Disposable plastic shoe covers
* Respiratory protection devices, depending on the scope of the inspection
* Tyvek suit, depending on the scope of the inspection

The inspector should be familiar with the proper use of the safety equipment and should have a complete understanding of all health and safety practices to be followed during the inspection. The facility's own safety policies must be followed on site and should be discussed prior to, or at the beginning of the inspection.

The areas of greatest health and safety concern while at a landfill are the actual wastes themselves and equipment. Extra caution should be taken around containers which appear to be leaking, bulging or are stacked improperly, and those having unknown contents. Also, the inspector should always be aware of equipment which is moving or has moving parts. Knowledgeable factiliy representatives should accompany the inspector to answer questions and to provide extra safety-related guidance. The inspector should never voyage into unknown areas or near unknown wastes if not properly prepared.

The media which may be sampled during the inspection include: oil, water, soil, sediment, solid surfaces and biological items. The inspector should be prepared to sample any of these and, therefore, should have the proper equipment available. The proper equipment will include:

* Sample bottles and containers
* Liquid waste samplers (e.g., glass rods and aspirator)
* Scoop sampler (e.g., shovel)
* Core sampler
* Surface samplers (e.g., wipes and templates)
* Hexane
* Sediment sampler
* Towels and bags
* Tags and seals
* Tape measure or ruler

The types of samples that are typically taken as part of landfill monitoring activities and which may also be split in some cases with TSCA inspectors are covered in the next section. Guidance for surface sampling techniques (wipe sampling, soil sampling) are provided in volumes One and Two of the TSCA Inspection Manual. Proper and consistent sampling techniques are crucial to insure the validity of sample analyses which may be used as evidence in subsequent enforcement actions.

Advance planning regarding the location and shipping restrictions of a particular air carrier for some samples may apply if air travel is required.

In addition, to the items listed above, a camera, flashlight and other equipment may be appropriate for use during the inspection. All of the equipment to be used on site should be in proper working condition and should be properly decontaminated. The choice of documents andequipment to bring to the inspection will be made in light of the goals of the inspection and the availability of the equipment.

6. Making Inspection Arrangements

The final stage of preparation for a TSCA landfill inspection involves making the necessary arrangements. Three considerations apply during this stage: (1) coordination of the inspection with other Federal, State or local agencies; (2) the procurement of a warrant; and (3) notification of the facility.

Prior to the inspection, other Federal, State or local agencies having approval or regulatory authority over the landfill should be contacted. The reasons for this are: (1) they may have planned or ongoing actions with the landfill that the inspector should be aware of; (2) a joint inspection may be scheduled; (3) they may have additional information that may be useful; (4) scheduling interferences can be avoided; and (5) the inspector may be able to provide them with information concerning the site.

If the inspection is to be conducted to support an enforcement action, the compliance officer and attorneys involved with the case should be consulted. They will be able to identify specific areas or operations of the landfill which should be inspected.

Another consideration which may be made prior to an inspection concerns the acquisition of a warrant. A warrant is a judicial approval for designated officers to inspect a specific location or function. It is normally used to gain entry when entry is denied or consent to conduct an inspection is withdrawn. One can be obtained prior to an inspection if there is sufficient reason to believe there will be a denial of entry or withdrawal of consent to inspect. If a warrant is deemed necessary, the Office of Regional Counsel should be contacted. Additional procedures pertaining to the procurement and use of a warrant are included in the *TSCA Inspection Manual.*

Depending on the purpose of the inspection, State or Regional policies, suspicion of noncompliances and the planned duration of the inspection, the inspector may wish to notify the landfill of the inspection. If the inspection requires examination of a large volume of records, certain personnel to be available, or expensive sampling, it may be more convenient to prearrange the inspection with the facility. However, if the actual operations and practices of the facility are to be observed, an unannounced inspection may be necessary. They are particularly effective if an act of noncompliance is suspected. An annual notification, without specifying dates, of EPA's authority to conduct TSCA inspections can be an effective way to avoid admittance problems when unannounced inspections are to be conducted.

CHAPTER IV

C. THE INSPECTION

1. Entry

After preparations and arrangements have been completed and made, the on-site inspection can be conducted. The first step is to gain entry to the site. Under TSCA, Section 11, a representative of EPA may inspect a facility upon presentation of proper credentials and a written notice of inspection. The credentials and notice must be presented to the owner or operator in charge of the facility. The inspector, however, must have consent by the owner, agent-in-charge or other authorized official before proceeding with the inspection.

The owner or agent-in-charge can deny access to the facility, records, files, etc. When this occurs, the inspector should question and document the basis for denial, and discuss this basis with the facility in an attempt to have denial removed. If a resolution cannot be reached, the inspector may suggest that the party contact their attorneys for clarification of EPA's authority under TSCA. If all attempts to acquire consent have failed, the inspector should withdraw from the site, but not before recording the names of the officials involved and any observations made while on site, particularly those which may suggest noncompliances.

After leaving the site, the inspector should contact his or her supervisor or the Office of Regional Counsel to begin the process of obtaining a warrant.

The consent to inspect may also be withdrawn at any time during the course of the inspection. This action constitutes a denial of inspection and a warrant may be necessary to complete the inspection. Some typical but non-valid reasons for denial:

* Refusal to allow photographs to be taken.
* A temporary shutdown or strike.
* Refusal of the inspector to sign a waiver.
* Too busy to accommodate the inspector.

If the facility personnel use any of these excuses, the inspector should inform them that their action constitutes an act of denial, and then follow the procedures outlined above which describe the proper responses when confronted with denial.

2. Opening Conference

After the inspector has found the person with whom the inspection will be conducted and has presented his or her credentials and the Notice of Inspection, an opening conference may be held. During this conference, and after the presentation and explanation of the TSCA Inspection Confidentiality Notice, the purpose and objectives of the inspection should be explained.

For example, is the inspection the result of a complaint, a reported violation, or is it a routine compliance inspection? Will it consist of a review of the facility's records and/or operations and will samples or photographs be required?

The inspector should then provide a brief rundown of the predetermined plans or schedules for the inspection. At this time, arrangements can be made to schedule meetings with various landfill personnel, to have records made available for review and areas accessible for observation. The time and participants of the closing conference should also be discussed.

Most of the time spent on the opening conferences should involve discussions concerning the facility, its background and operations, as well as any new policies, regulations, or conditions related to the landfill. Specific information that the inspector should discuss and/or document includes:

* Names and addresses of inspection participants.
* Facility owners and parent companies.
* Background and history of the site.
* Operating requirements and practices.
* Recordkeeping requirements and records maintained.
* Health and safety reports (e.g., injury or spill occurrences).
* Wastes accepted and disposed (types and volumes).
* Monitoring requirements and practices.
* Sampling procedures.
* Facility maintenance.

Inconsistencies between information presented during the opening conference, and that reviewed prior to the inspection should be pursued. The opening conference should also be documented in the field notes. An inspection checklist may be used to record specific information.

The inspector can forego the opening conference and proceed directly to a specific area or operation of the landfill if he or she feels that a possible noncompliance exists.

3. Scope of Inspection

In some cases, particularly where older, larger facilities having a pre-TSCA history are concerned, contaminant assessment efforts may be ongoing while newer landfill cells are being used, planned, and constructed. In such an instance, a TSCA inspector could, depending on the scope of the inspection, be called upon to inspect and evaluate a facility's contaminant assessment effort, routine monitoring efforts and procedures, various phases of landfill construction, operations/disposal practices, or closure/post-closure care/conditions. It is not possible for an inspector to evaluate all of these aspects of landfill operations during a single one-day visit. It is therefore important for the inspector of these types of facilities to focus on one major topic of interest or schedule either a longer, more extensive inspection visit or a series of one-day inspections. Some facilities are scheduled for routine recordkeeping, storage and disposal inspections on a regular basis (quarterly, biannual) and are also subjected to non-routine technical inspections on an as-needed basis (if permit violations are suspected or operation problems arise). With these considerations in mind, it is vital that the TSCA landfill inspector carefully plan the scope of his or her inspection so that its objectives can be efficiently and reasonably met within any scheduling or time frame limitations.

The TSCA landfill inspector must also keep in mind the facility's responsibility to comply not only with the PCB landfill regulations, as compiled in 40 CFR 761.75, but also with the letter of their submitted application materials, including the Operations Plan, monitoring plans, sampling and analysis plan, and landfill design/construction methodologies. Any deviation from the procedures outlined in these plans or submitted drawings (governing construction) without prior written notice to TSCA constitutes a permit violation, and may subject the facility to an enforcement action. In addition, all site-specific permit conditions are enforceable and should be checked for facility compliance during an inspection. Therefore, the inspector may also need to prepare, in addition to a generic regulations-based checklist (see end of section), an Operations Plan, permit conditions, monitoring or construction/design checklist that is tailored specifically to the facility to be inspected.

The following discussion pertains to items which are not directly addressed under the TSCA regulations but are believed to be appropriate for inspection at any TSCA landfill facility.

3.1 Monitoring System Integrity

3.1.1 Ground Water Monitoring Wells

It is important for an inspector of TSCA landfill cells to inspect the monitoring well array at the facility to assess well integrity. Several components of each well should be inspected as follows:

* Stainless steel, teflon, or PVC monitor well casings (well pipes) should be checked visually for evidence of excessive rusting, cracking, or other damage. Any damaged wells must be replaced.

* The surface grouting and concrete pads that are required to be placed at the surface surrounding the well casing should be checked for cracking or other evidence of frost-heave or freeze-thaw damage. Any damaged concrete pads must be replaced.

* Wells containing water with very high pH readings (> 10) were probably grout contaminated due to improper installation and should be evaluated and replaced as necessary.

* The protective pipes emplaced over the top of the well casing and their locking caps should be checked for damage and evidence of frost-heave (where appropriate).

* Inspectors who may be in a position to supervise or inspect monitor well installation and development should verify that the proper techniques and procedures (outlined in Chapter II or presented in the facility's Operations Plan) are being followed.

3.1.2 Leachate Collection Systems

The structural integrity of leachate collection systems can not normally be directly determined by an inspector of an operating landfill since most of the components that make up these systems are installed below grade. Those components of leachate collection systems which do reach the ground surface can and should be inspected as follows:

- Large diameter concrete leachate standpipes can be inspected for evidence of cracking, degradation, or other damage during the period in which disposal activities are ongoing in a cell. After capping, the standpipes are no longer accessible for inspection.

- Lateral leachate discharge pipes (6" or 10" steel or PVC) which are associated with primary standpipes, secondary leachate drainfields, or underdrain/leak detection system discharge should all be inspected for evidence of cracking, heaving, or other damage (perhaps due to vehicle accidents).

- The inspector may be interested in observing leachate volume measurement or the procedure employed for leachate treatment (if any).

3.2 Landfill Cell Integrity

Maintaining the structural integrity of the landfill cell as a whole is critical to protect human health and the environment from the potential negative impact of an escape of contamination to surface or ground water. Therefore, an inspector should be prepared to evaluate the following landfill features:

3.2.1 Landfill Cap

A landfill cover or cap should be inspected to assure that the waste contents of the cell are prevented from having excessive contact with percolating surface infiltration or runoff. This reduces the potential for leachate production and treatment problems, and prevents releases of ground and/or surface water contamination. The landfill cap should be free of any evidence of excessive erosion or gullying due to inadequate runoff control, anomalous amounts of rainfall, or an inadequate soil or vegetative cover layer.

3.2.2 Landfill Walls and Berms

The inner and outer landfill walls and subcell divider berms should be inspected when possible to assure that excessive erosion, slope failure (slumping), or ground water or leachate discharge have not taken place at the cell. The inner walls and divider berms can only be inspected during the construction or active phases of cell operation.

4. Receiving Area

Two areas of a TSCA landfill which should be inspected are the shipping and receiving areas for the wastes to be disposed. Large volumes of waste pass through these areas and proper handling is important to reduce the risk of exposure to the environment. The inspector should know the regulatory and conditional requirements that these areas must meet. Although they may be included on the inspection checklist, the following questions provide examples of what should be observed and documented:

Access Roads

How are they maintained?
Is there enough room to accommodate all vehicles?
Are there signs of damage or deterioration?
What are the facility's restoration policies?
How many vehicles currently occupy the roads?
How much dust is raised by the vehicles?
Do the roads show signs of spills or accidents?

Equipment

What are the decontamination procedures used for equipment and vehicles?
Is the equipment being overloaded with waste?
Are there signs of leaks or damage to the containers handled by the equipment?
Is the equipment marked with the mark M_L?

Waste Handling

How are the wastes handled in the shipping and receiving areas?
Are the wastes piled or stacked?
Are PCB wastes segregated from other wastes? If so, how?
Do some of the containers appear to be damaged due to the waste handling process?
Are there any spills or leaks in these areas?
Are the wastes stored temporarily?
Are the PCB containers or articles marked with the mark M_L?

Waste Analysis

Where, when, how and how often are the wastes sampled?
Are the procedures and techniques used to sample the wastes satisfactory?
What types of sampling equipment are used?
Is there sufficient protection against contamination?
How are the samples tracked?

Temporary Storage

Is there an area used for off-loading or temporary storage?
If so, does the area have containment or diking?
What is the containment volume?
Is the area marked with the mark ML?
Are there signs of spills or leaks in the area?
How long do the wastes remain in this area?

Records

What types of records are maintained relating to shipping and receiving?
How are the wastes tracked?
What do the records contain?
Who maintains the various records?
Where are they maintained?

During the walk-through of these areas, the inspector should take detailed notes of observations and responses to questions. If stains or unmarked wastes, or containers being improperly stored are observed, samples or photographs should be taken as necessary to support claims of noncompliance. If other observations or responses indicate a potential noncompliance, they should be pursued and the inspector should not limit him or herself to the checklist or questions above.

5. Storage Area

The area used to store the wastes, including PCBs and PCB items, prior to disposal should also be inspected to insure that the wastes are managed properly. The inspector should be familiar with the storage requirements in the PCB regulations, and any applicable conditions in the TSCA permit. The following questions provide an inspector with general guidelines regarding the types of observations to be made. Any observed potential noncompliances should be followed up and documented in detail.

General Storage Area

Is the storage area maintained as a temporary (30 day maximum) or a permanent storage area?
Does the area have sufficient diking? What is its containment volume?
Are there any drains, sewers or expansion joints within the containment area?
Does the storage area have adequate roof and walls?
Is there an indication that the roof or walls leak?
Is the storage area marked with the mark ML?

Containers

What types of containers are being used to store PCBs and PCB items?
What condition are they in? Are they damaged or leaking?
Are the containers marked with the mark ML or dated with the date they were placed in storage?
Do the containers indicate the concentration of PCBs within them?

Waste and Storage Area Handling

Are the containers arranged in the storage area by dates?
Are the containers stored within the diked and enclosed area?
Are inspection records maintained?
Is an SPCC plan required? If so, is one maintained?
Do any of the containers appear to be leaking?

Records

Are waste blending or batching records maintained?
How are the wastes tracked through the storage area?
Who maintains the records, and where are they maintained?

Detailed notes, samples and/or photographs should be used to document and substantiate any observations made while inspecting the storage area(s).

6. Laboratory

A TSCA landfill may use an on-site laboratory to analyze wastes, leachate, and ground water. The laboratory may not have to be certified, but the analytical procedures used must meet EPA standards and should be documented by the inspector. Since some inspectors have limited chemical backgrounds, a thorough inspection of the laboratory will require the presence of a chemist or other specialist, however, an inspector may uncover inconsistencies through on-site observations. Based upon these observations, a chemist or specialist within the State or Regional office may be able to make a determination regarding possible problems with laboratory's quality assurance/quality control and analytical procedures. With this in mind, the following presents some general guidelines on the topics that should be reviewed during an inspection of an on-site laboratory:

Handling of Samples

How are samples preserved, stored and prepared?
Are the containers marked?
After the samples are analyzed, what is done with them?
What steps are taken to avoid cross contamination of samples?

Laboratory Equipment

What types of equipment are used to analyze the samples?
How and when are they calibrated?
Are spiked samples, lab blanks or controls run? If so what are the results?
How are the containers and equipment decontaminated?
Are there signs of spills in the laboratory?

Analysis

What are the procedures used to analyze the various samples?
What EPA standards are followed?
Is there a QA/QC plan for the laboratory?
What calculations are done during the analysis?

Records

What types of records of the analysis are maintained?
How are the samples logged and tracked through the laboratory?
Who is responsible for the maintenance of the records?

While in the laboratory, the inspector may want to obtain a split sample of waste or leachate or ground water that has been, or is in the process of being analyzed. The analysis of such a sample provides a check on the accuracy of the facility's equipment and practices. A copy of the QA/QC plan should be requested, and an actual analysis of a sample should be observed and documented, time permitting. Once in the office, the inspector should discuss the QA/QC plan and his or her observations with appropriate and qualified laboratory personnel. Their comments may be included in the inspection report.

7. Recordkeeping

The PCB Regulations and TSCA permits require owners or operators of TSCA landfills to establish and maintain various records. One important element of a landfill inspection consists of a review of these records. The records required to be maintained include annual PCB reports, operational records, waste, water and leachate analysis, and correspondence between the facility and environmental authorities. Several specific recordkeeping requirements which are discussed in some detail in Chapter III will also be covered in this section.

Some considerations to be made for an effective review of a landfill's records are similar for each type of record maintained, however, the approach will vary widely between on-site and in-office reviews. When reviewing records at the site, the time available, the volume of records and clarity or conciseness of the records must be taken into account. There are also several options for review. The inspector can review records on or related to questionable periods or periods in which violations are known to have occurred. Alternatively, time periods can be randomly selected for review. Another option is to select specific waste streams and track them through the entire disposal process. The records should be reviewed for overall completeness, discrepancies, deficiencies, accuracy and compliance. The types of information to be noted should include:

* The title of the documents reviewed.
* Information maintained on the documents.
* Periods or dates of information reviewed.
* Specific information reviewed, including values.
* Preparers of the records.
* Location where the records are maintained.
* The origin of the data recorded.

The inspection checklist may be used to list values for the data observed while on-site. It is most effectively used when the records' formats are known in advance and specific dates and data are slated for review. If there is not enough time during the inspection, or if potential noncompliances are found, the inspector should request copies of the records for specifically defined periods. The records can be received during the inspection or submitted to the inspector afterwards. When copies are made at the site, the inspector should number or identify them. If the information is stored on a computer, arrangements should be made to obtain a "hard copy." While at the office, the inspector should review the documents in their entirety, noting the same information as indicated above.

The remainder of this Section is devoted to an explanation of the types of records that the facility is required to maintain and what should be inspected.

7.1 Annual Reports

Annual reports which track the PCBs and PCB items handled at the facility each calendar year must be maintained. The reports have been required to be completed by July 1 of each year since 1979. Specifics regarding the information to be recorded are covered in Chapter III and 40 CFR Part 761.180(b), (d), and (f). In general, the records should include the identification of PCB wastes; their generators and their disposal sites; dates PCB wastes were received, disposed of or transferred off site; and summaries of the total weight in kilograms of each type of PCB waste received, disposed of or transferred off site during the calendar year. In addition, records of any required water analyses, waste burial coordinates and correspondence between the facility and environmental agencies must be maintained. The records mentioned above must be maintained for 20 years after the facility has ceased accepting PCB wastes for disposal.

Additional records must be maintained if the facility owns or operates in service PCBs or PCB items or PCBs/PCB items projected for disposal, as indicated in 40 CFR Part 761.180(a).

In addition to the review considerations described in the beginning of this Section, the inspector should also review the material/reports to ensure that the following requirements are met:

* All applicable years were represented.
* The reports were prepared by July 1 of each following year.
* The PCB wastes were described satisfactorily.
* Were the PCBs or PCB items in storage for more than one year?
* The year to year value changes should equate.
* The analysis dates must meet monitoring frequency requirements.

* Burial coordinates must be maintained.
* The PCBs must be segregated from other wastes.

7.2 Operations Plan Conformance

The Operations Plan must include among other things, detailed explanations of the procedures to be used for recordkeeping, sampling and monitoring, water and leachate handling, waste sampling and segregation, and maintenance (see 40 CFR Part 761.75(b)(8)(ii)). This plan should be located in the Regional TSCA Office and should be reviewed by the inspector to determine which records the facility must maintain with respect to the TSCA approval. The self-proposed recordkeeping practices explained in the Operations Plan are part of the requirements the facility must meet to maintain compliance status. The records that are often described in the Operation Plan may be in the form of spreadsheets, sampling and inspection logs, and other operations/tracking documents. Review procedures similar to those previously described should be followed and documented when inspecting these records. The inspector should review these records for completeness, consistency, and compliance.

7.3 Permit-Specific Requirements

Additional recordkeeping requirements are often specified as direct or indirect conditions in the TSCA permit or approval. Most of these deal with the analysis of liquid samples collected from the landfill's ground water, surface water and leachate monitoring systems. The frequency in which sampling is to be conducted is typically specified in the conditions of the permit. Leachate handling procedures and volume requirements are also commonly included as permit conditions. Because the format is not specified, these records can be maintained in various forms (e.g., charts, tables, graphs, etc.) The first step in a review is to understand the data recording method. Because most of the records are required to be submitted to the Regional Office, the reporting format used can usually be determined through a review of the documents already in EPA's possession. Some specific items that should be checked may include:

* Were sampling dates in compliance with the sampling frequency requirements?
* Were the volumes of leachate recorded? If so, were they recorded at the specified frequencies?
* Were all analysis parameters performed? (Normally, these include pH, PCBs, chlorinated organics, and specific conductance.)
* Were records for each monitoring system maintained?
* Were accurate values included in the reports? (This will involve a review of raw data while at the facility.)

If, after the review of the records, it is determined that one of the above questions could be answered "no", the facility would appear to have insufficient records. In such a case, the specific deficiencies should be explained in the inspection report, as would deficiencies observed during the review of any other facility records.

8. Active Versus Closed Landfill Inspection

The inspection of a TSCA landfill which has entered the *closure/post-closure phase* of its history is a much simpler process than that which is appropriate for a currently active facility. The only issues of concern in the case of a closed facility are those related to its overall integrity and its recordkeeping, sampling and analysis and monitoring practices. Inspection of receiving and storage areas and observation of construction or other landfill operations practices is not possible for closed facilities.

Currently active facilities should be inspected not only for recordkeeping, storage and disposal, sampling, analysis and monitoring practices but also for compliance with any stipulations or specific requirements which may have been set down as conditions in the permit, construction methods as shown in the submitted designs and plans or as procedures to be followed in accordance with the Operation Plan.

8.1 Conformance with Permit Conditions

Most TSCA landfill permits do not limit the operating requirements simply to the records and systems that have been discussed above. It is therefore also important to inspect and evaluate the facility with respect to its conformance with some functions and requirements that are specified in permit conditions. Examples of some typical conditions include those related to leachate collection system monitoring; notification; health and safety; financial assurance and closure and post-closure plans. The conditions which are inspectable should be targeted during the review of the permit, and incorporated into the site-specific checklist, if used. Examples of items to consider while evaluating the following commonly included permit conditions are listed below:

Hydraulic Head Monitoring

Recording of periodic water level measurements in ground water monitoring wells may be required as well as the compilation of potentiometric surface maps. Determination of the ground water flow direction may also be specified.

Leachate Collection System Monitoring and Fluid Characterization

Analysis of fluids gathered by the leachate collection system may have to be undertaken and leachate generation (volume) figures may have to be recorded according to an established frequency. Requirements pertaining to the handling, storage and disposal of leachate may also appear as specific conditions in some TSCA permits.

RCRA Coordination and Financial Assurance

Some landfills may be required to comply with all or certain provisions of the RCRA closure requirements; financial assurance for maintenance, monitoring and remediation may have to be secured, usually through requirements outlined under RCRA.

Notification, Health, and Safety

The permit may contain conditions which require the landfill to notify the Regional Administrator if sample analysis indicates over 1 ppb PBCs; or if there has been an accident or a lost-time personnel injury.

The inspector is likely to encounter more site-specific permit conditions than those mentioned above and throughout this manual. Standard inspection procedures, however, should be followed. Appropriate questions should be posed and responses documented, samples and photographs of potential violations should be taken, and records should be completely reviewed.

8.2 Conformance with Construction Specifications

Although a TSCA landfill inspector is not normally equipped to make an inspection of landfill construction techniques without some aid from a technical assistant, an opportunity may arise for an inspector to observe the installation of compacted soil liners, primary or secondary leachate collection systems, standpipes, synthetic liners or landfill cap systems. Where possible and practicable the observed techniques or construction practices should be checked and should conform to those outlined in the construction specifications or technical drawings/plans submitted by the facility as part of its TSCA application.

An inspection of aspects of landfill construction is generally not done unless the inspector is technically equipped for the task and the inspection is a comprehensive one covering a wide-variety of landfill practices and operations.

8.3 Conformance with the Operations Plan

As indicated above, the procedures and practices covered by a facility's approved Operations Plan, are enforceable and therefore inspectable. The inspector should make an assurance that the facility is following the plan by evaluating conformance with all procedure/protocols detailed under the following Operations Plan sub-topics:

* Surface water handling
* Excavation and backfilling
* Waste segregation burial coordinates
* Vehicle and equipment movement (roadway use)
* Leachate collection systems
* Sampling and monitoring procedures
* Monitoring wells
* Environmental emergency contingency plans
* Site security
* Liquid waste disposal practices

9. Sampling

On some occasions, a TSCA inspector may be called upon to observe or participate in water, leachate or other sampling procedures at a facility. It is the inspector's responsibility in such a case to determine if the sampling is done in accordance with protocols outlined in this manual, in the facility Operations Plan, or in the TSCA Inspection Manual (for wipe sampling/soil sampling).

9.1 Observation/Supervision

Procedures employed in ground water, surface water, and leachate sampling should be evaluated by an inspector to determine whether or not the facility complies with its own self-imposed, TSCA-approved Operations Plan. In cases where an older Operations Plan is in force at a facility, the procedures given in this manual can be used as general guidance. The inspector should determine the facility's compliance with the following requirements:

* Presampling water level measurement
* Proper presampling purging or evaluation, if necessary
* Proper decontamination/dedication of sampling equipment
* Proper sample collection procedure and sequence
* Field analysis performance
* Use of the appropriate sample containers/preservation methods
* Proper packing for transport
* Proper sample labeling and logging procedures
* Maintenance of chain-of-custody logs
* Collection of QA/QC samples

9.2 Split Sampling

In some instances, the TSCA inspectors may want to take a set of split samples in order to compare the results obtained by the Regional EPA laboratory to those returned by the commercial laboratory employed by the facility. In such a case, the inspector will need to assemble the necessary sample containers, labels, preservatives, coolers, log sheets, chain-of-custody forms, etc., prior to the inspection.

All other procedures, as outlined above, should be followed identically for both sets of samples. Holding times, detection limits, and analytical methods must be the same. If an entire suite of parameters are to be analyzed it should be kept in mind that the two splits taken for analyses of a particular class or type of parameter (PCBs, for example) should be obtained sequentially. It is not good practice to take a complete suite of samples from a well before taking the second suite (the split) because of the tendency of some parameters (VOCs) to volatilize.

10. Closing Conference

After the inspector is satisfied that the facility's procedures and records have been reviewed and documented, and that the objectives of the inspection have been met, a closing conference should be held with the appropriate landfill personnel. The conference is an opportunity to obtain answers to outstanding questions, or to obtain additional explanations of the landfill's practices. Also, the inspector could take this time to answer the facility's questions pertaining to his or her area of responsibility regarding the inspection or related EPA or industrial topics. In addition, any claim of Confidential Business Information should be organized and clarified.

The preliminary results of the inspection can be discussed. The facility representatives should be informed of any potential problem areas observed during the inspection, however, the inspector should inform them that final conclusions of compliance can not be made until the inspection information has undergone official review. All of the possible results of a TSCA landfill inspection should be briefly explained, but no indication of which will apply should be given.

After these issues have been discussed, a receipt should be issued for the samples and documents acquired during the inspection, carefully logging each sample and/or document received.

11. The Inspection Report

The inspection report serves as a summary of the evidence gathered during the review, on-site inspection and follow-up activities. Its main objective is to collect and organize the evidence into a usable package. The foundation of subsequent enforcement actions will depend on the information contained in the report. Therefore, it should be presented as a concise, factual summary of the observations and be organized in a logical manner. The evidence contained in the report should be supported by specific references where appropriate.

The first step in writing the inspection report is to review all of the gathered information. This will include inspection notes, checklists, sample results, photographs, records, correspondences and records of telephone conversations. The information should then be organized. The guidelines at the end of this Section should assist in the organization of the information. Finally, the narrative should be written, with particular detail given to the facts relating to potential noncompliances.

This report should, for the most part, be written to follow the sequence of events as observed before, during and after the inspection. A general list of topics that should be addressed in the report is given below.

<u>General Information</u>

The purpose and objectives of the inspection should be explained, and the names and titles of all the inspection participants should be listed.

Background of the Facility

A general description of the facility's size, parent company (if any), operations and siting characteristics should be given. A brief history of the landfill's compliance status and results of previous inspections should also be included.

Opening Conference

The inspection report should document the presentation of the inspector's credentials, the Notice of Inspection and the TSCA Inspection Confidentiality Notice. This section can also be used to describe any difficulties encountered while attempting to gain entry, or any other observations made at the beginning of the inspection.

Landfill Operations

Most of the information concerning the inspection will be contained in this section. It can be simplified by breaking it down into subsections for each operation of the landfill (e.g., leachate collection; water monitoring; shipping; receiving and storage; disposal operations; maintenance; laboratory practices). Within each subsection, the report should contain information regarding system(s) operating status. Were samples, photographs and/or records taken? If so, what were the results or what did they show? The regulatory or conditional requirements may also be mentioned if a particular operation did not appear to be in compliance. Also, as mentioned before, references should be made to the supportive information and it's location.

Recordkeeping

A general description of the records maintained for regulatory purposes should be given. The description should include the particular record's title, preparer, location and the information contained in it. The results of the records reviewed and any apparent noncompliances should be detailed.

Samples and Photographs

The purpose for taking a sample or photograph should be explained, along with a summary of the analytical results, the sample identification numbers, sample locations and media. If special considerations were taken while collecting samples, they should also be explained. If a split sample was provided for the facility, this should be indicated and the chain of custody mentioned. Some of this information may be available in the sample forms which can be included as attachments to the report. For photographs, the specific contents and other pertinent information should be explained.

Closing Conference

The results and possible outcomes of the inspection as summarized during the closing conference should be outlined. Also, the issuance of a receipt for samples and documents should be documented.

Attachments

Attachments to the report provide the supportive evidence of apparent noncompliances. At a minimum, the following should be included as report attachments: inspection documents; sample analysis reports; checklists; chain-of-custody forms; landfill records; photographs; and documented telephone conversations.

12. TSCA Inspection Checklist

The following pages contain a suggested format for a TSCA landfill inspection checklist.

TSCA LANDFILL INSPECTION CHECKLIST (A Suggested Format)

Date ____________________
Facility Name ____________________
Facility Address ____________________
Participants ____________________
____

A. Background

1. Years in operation? ______________
2. Parent company? ______________
3. Have there been any transfers of ownership? ______ Yes ______ No
   If yes, was the Regional Administrator notified 30 days in advance? ______ Yes ______ No
4. Types of wastes accepted?
   a.______________
   b.______________
   c.______________
   d.______________

B. Approval

1. If the landfill is multi-celled, have PCBs and/or PCB items been disposed of in the proper cells ______ Yes ______ No
2. Are there any waivers in the TSCA permit? (If yes, the waivers may be incorporated in the checklist in the appropriate sections.) ______ Yes ______ No

C. Siting and General Design

1. If surface water diversion dykes are required, (a) are they currently provided around the perimeter of the landfill, and/or (b) is their minimum height equal to two feet above the 100-year floodwater elevation?
   a.______ Yes ______ No
   b.______ Yes ______ No
2. If surface water diversion structures are required, do they appear to be properly maintained? ______ Yes ______ No
3. Has a 6 foot woven mesh fence, wall or similar device been placed around the site? ______ Yes ______ No
4. Are measures taken to prevent PCBs from migrating from the landfill? ______ Yes ______ No

CHECKLIST (continued)

D. Operation Monitoring Systems

1. Are the designated surface watercourses sampled at the permit-specified frequency? _______ Yes _______ No
2. Are all of the monitoring wells cased? _______ Yes _______ No
3. Has the backfilling and plugging of the annular spaces between the monitoring zone and the surface prevented the percolation of surface water into the well bore? _______ Yes _______ No
4. Do all of the well openings have removable caps? _______ Yes _______ No
5. Are all of the samples analyzed for PCBs, pH, specific conductance and chlorinated organics? _______ Yes _______ No

E. Leachate Collection

1. Are the leachate collection systems monitored at the permit-specified frequency for quantity and physiochemical characteristics of the leachate produced? _______ Yes _______ No
2. Is the leachate treated or discharged in accordance with a State or Federal permit? _______ Yes _______ No
   If no, is it disposed of by another State or Federally approved method? _______ Yes _______ No
3. Is the aqueous phase of the leachate collected analyzed for PCBs, pH, specific conductance and chlorinated organics? _______ Yes _______ No

F. Recordkeeping

1. Does the owner/operator maintain records at the facility? _______ Yes _______ No
   If yes, are records maintained for the following?
   a. Water analysis from ground and surface water sampling? _______ Yes _______ No
   b. Three dimensional burial coordinates for PCBs and PCB items? _______ Yes _______ No
   c. Liquid waste PCB concentrations _______ Yes _______ No
   d. Annual PCB documents for disposal and storage facilities (40 CFR Part 761.180(b)) _______ Yes _______ No
      If yes, are all years represented when PCBs were accepted for storage and/or disposal? _______ Yes _______ No
   e. Annual PCB documents for owners of PCBs or PCB items in service or projected for disposal? _______ Yes _______ No
      If no, was this type of annual PCB document required? _______ Yes _______ No

2. Have any annual PCB reports as specified in the permit been submitted to the Regional Administrator? ______ Yes ______ No

(Although not detailed on the checklist, the annual PCB documents and reports should be reviewed to ensure compliance with 40 CFR Part 761.180 and the landfill's TSCA approval.)

G Receiving

1. Are access roads (a) to and (b) within the landfill adequately maintained?
   a. ______ Yes ______ No
   b. ______ Yes ______ No
2. Are there any vehicles owned or operated by the landfill at the site which are loaded with (a) PCB containers containing more than 45 kg of liquid PCBs or (b) one or more PCB transformers?
   a. ______ Yes ______ No
   b. ______ Yes ______ No

   If yes to either (a) or (b) in 2, are the vehicles marked with the mark M_L on all four sides? ______ Yes ______ No
3. Are the PCBs and PCB items segregated from wastes not chemically compatible with the PCBs through the receiving and storage process? ______ Yes ______ No
4. Are there procedures to determine that liquid PCBs designated for disposal at the landfill do not contain over 500 ppm PCBs? ______ Yes ______ N
5. Within the receiving process, is there a storage area for PCB wastes? ______ Yes ______ No
   If yes, is the storage area marked with the mark M_L? ______ Yes ______ No
6. Are there signs of spills or leaks in the receiving area? ______ Yes ______ No

H. Storage

(Since storage areas at disposal facilities are likely to encounter PCB wastes which have been removed from service for over 30 days, the questions in this section will apply to the permanent storage area.)

1. Does the storage area have a roof and walls? ______ Yes ______ No
2. Is there an indication that the roof or walls leak? ______ Yes ______ No

CHECKLIST (Continued)

3. Is the storage area diked?	______ Yes ______ No
If yes, are the following conditions met?	______ Yes ______ No
a. Does it have continuous curbing with a minimum 6 inch high curb?	______ Yes ______ No
b. Does it have 2 times the internal volume of the largest PCB article or container stored therein?	______ Yes ______ No
c. Does it have a volume equal to 25% of all PCB articles or PCB containers stored therein?	______ Yes ______ No
d. Is it constructed of a smooth and impervious material?	______ Yes ______ No
4. Can spilled liquids flow from the area through any openings?	______ Yes ______ No
5. Is the storage area marked with the mark ML?	
6. Do all of the containers used to store PCBs and PCB items meet the Shipping Container Specifications of the Department of Transportation (5, 5B, 6D with 2S or 2SL or 17E for liquids; and 5, 5B, 17C for containers equivalent to the DOT containers for non-liquids)?	______ Yes ______ No
7. Are all of the PCB containers (a) marked with the mark ML and (b) dated with the date they were placed in storage?	a. ______ Yes ______ No b. ______ Yes ______ No
8. Do the PCB containers indicate the concentration of PCBs within them?	______ Yes ______ No
9. Are all of the PCB containers in good condition (ie. not leaking, rusted, or damaged)?	______ Yes ______ No ______ Yes ______ No ______ Yes ______ No
10. Are the PCB containers arranged in the storage area by dates placed in storage?	______ Yes ______ No
11. Does the storage area have containers for liquid PCBs larger than the DOT containers?	______ Yes ______ No
If yes, has a Spill Prevention Control and Countermeasure (SPCC) Plan been prepared?	______ Yes ______ No

I. Laboratory

1. Are the PCB containers in the laboratory area marked with the mark ML?	______ Yes ______ No
2. Are spiked samples or controls run to check the accuracy of the analytical equipment?	______ Yes ______ No
3. Are the analytical guidelines contained in the operation or QA/QC plan?	______ Yes ______ No

J. Disposal

1. Has the restriction against the disposal of ignitable wastes in the landfill been followed? ______ Yes ______ No
2. Are the PCB wastes segregated from wastes not chemically compatible with the PCBs during placement into the landfill? ______ Yes ______ No
3. Are PCB containers with liquid PCBs at concentrations between 50 and 500 ppm surrounded inert sorbent material capable of absorbing all of the liquid contents? ______ Yes ______ No
4. Are bulk liquids containing less than 500 ppm PCBs pretreated and/or stabilized into a non-flowing consistency prior to disposal? ______ Yes ______ No
5. Are measures being taken to suppress dust during disposal? ______ Yes ______ No
6. Is the equipment decontaminated prior to leaving the disposal site? ______ Yes ______ No

K. Comments

(Some questions which have negative responses may require additional explanations to determine compliance.)

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CHAPTER V

FOLLOW-UP AND SPECIAL ISSUES

A. FOLLOW-UP TO THE INSPECTION

After the inspection, the inspector should be prepared to discuss his or her observations with supervisors, case development officers, permit writers and other State or Regional personnel. The inspector's assistance may be required for the development of any potential enforcement action if education or clarification of the landfill's operations is necessary. In addition, the permit writer should be consulted to discuss the permit conditions as related to observations made during the inspection concerning potential violations or new equipment or practices. If potential violations governed by another State or Regional agency were observed, that agency should be notified.

The discussions mentioned above should be conducted as soon as possible after the inspection. This will reduce the possibility that information will be forgotten or become distorted. Since the inspector may have to discuss the landfill several months after the inspection, the organization of his or her reports, notes and thoughts becomes an important aspect of the post-inspection activities.

B. SPECIAL ISSUES

There are several issues that the inspector should be prepared for or aware of and which may be encountered during and after the inspection and reporting process. First, a chain-of-custody should be initiated for each sample that has been taken. A "chain-of-custody" is a written record (usually a form) which traces the possession of samples from the moment of collection through their possible use as evidence in an enforcement action. It serves to protect the integrity of each sample collected.

Confidential Business Information (CBI) may be encountered at any stage of the inspection process. The inspector should be cleared for access to such information by the Agency and understand and observe the proper procedures for handling CBI material. The Document Control Officer for each Region has the CBI material within his or her possession and should be referred to gain access to the material for Agency review or to determine what has been claimed by the landfill facility as CBI.

Finally, as part of the enforcement process, an inspector may be required to testify in court. If this occurs, the inspector should be able to relate the facts of the inspection in a objective and professional manner.

More information on the issues mentioned above is contained in the *TSCA Inspection Manual* and will not be repeated here. The inspector is encouraged to review the material included in that manual for the specific details concerning each issue.

CHAPTER VI

REFERENCES

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