DOE/EH-0512

ENVIRONMENTAL GUIDANCE

# SOLID WASTE LANDFILLS

under the

## Resource Conservation and Recovery Act Subtitle D

November 1995

U.S. Department of Energy
Office of Environmental Policy & Assistance
RCRA/CERCLA Division, EH-413
Washington, D.C.

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Washington, D.C. 20585

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United States Government **Department of Energy**

# memorandum

DATE: November 16, 1995

REPLY TO ATTN OF: Office of Environmental Policy and Assistance(EH-413):Petts:6-2609

SUBJECT: SOLID WASTE LANDFILLS

TO: Distribution

**PURPOSE OF THIS MEMO**

The purpose of this memorandum is to provide Department of Energy (DOE) Program Offices and Field Organizations with an environmental guidance document entitled: *Solid Waste Landfills under RCRA Subtitle D.* The attached document addresses federal regulations governing the management of landfills receiving non-hazardous solid waste regulated under RCRA Subtitle D.

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**CONTENTS OF THIS PACKAGE**

The manual covers design and operating standards for both municipal and non-municipal landfills. In addition to the requirements outlined in this manual, owners/operators will need to be familiar with applicable requirements of the State in which the landfill is operated.

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**CONTACT**

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Thomas P. Traceski
Director, RCRA/CERCLA Division
Office of Environmental Policy and Assistance

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National Low-Level Waste Management Program, EG&G Idaho
Hazardous Waste Remedial Action Program, (HAZWRAP)
Remedial Action Program Information Center
Center for Environmental Management Information

## Table of Contents

# Chapter 1
# Introduction

## Contents

## 1.1 Purpose and Overview

This document provides guidance for meeting:

(1) Guidelines for the Land Disposal of Solid Waste (40 CFR 241);
(2) Criteria for Classification of Solid Waste Disposal Facilities and Practices (40 CFR 257); and
(3) Criteria for Municipal Solid Waste Landfills (MSWLFs) (40 CFR Part 258). Revisions to 40 CFR 257 and a new Part 258 were published in the Federal Register (56 *FR* 50978, 10/9/91).

The Guidelines for the Land Disposal of Solid Waste set requirements and recommended procedures to ensure that the design, construction, and operation of land disposal sites is done in a manner that will protect human health and the environment. These regulations are applicable to MSWLFs and non-MSWLFs (e.g., landfills used only for the disposal of demolition debris, commercial waste, and/or industrial waste). These guidelines are not applicable to the land disposal of hazardous, agricultural, and/or mining wastes.

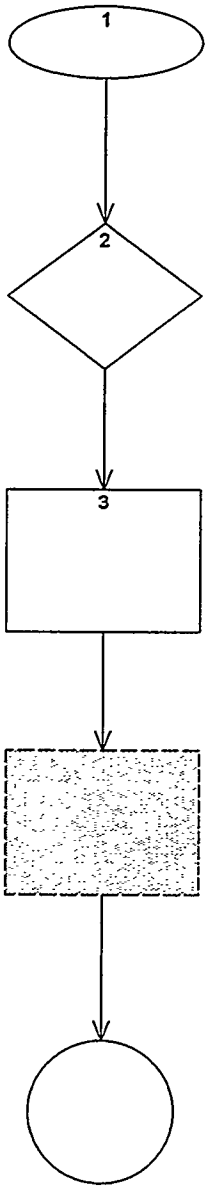
The Criteria for the Classification of Solid Waste Disposal Facilities and Practices apply to all solid waste disposal facilities, except for those specifically excluded by the regulations (MSWLFs are excluded). Like 40 CFR 241, these criteria do not apply to certain wastes (e.g., mining overburden intended for return to the mine site). These criteria are to be used under the Resource Conservation and Recovery Act (RCRA) in determining which solid waste disposal facilities pose a reasonable possibility of adversely affecting human health or the environment. Facilities failing to satisfy these criteria will be considered to be open dumps which are prohibited under Section 4005 of RCRA (see Section 1.3 below).

The Criteria for MSWLFs are applicable only to MSWLFs, including those MSWLFs in which sewage sludge is co-disposed with household waste. Based on specific criteria (as described in Chapter 5), certain MSWLFs are exempt from some, or all, of the regulations of 40 CFR 258. MSWLFs that fail to satisfy the criteria specified in 40 CFR 258 are also considered open dumps for the purposes of Section 4005 of RCRA.

Through the use of a series of interrelated flow diagrams (see Figure 1-1), this guidance document directs the reader to each design, operation, maintenance, and closure activity that must be performed for MSWLFs and non-MSWLFs. Beginning with Chapter 2, each chapter in this guidance contains: a table of contents, an introduction to the chapter, and modules. All of the modules contain: an introduction, milestones that highlight the most important actions within each module, flowcharts, and information to supplement the flowcharts.

The Solid Waste Disposal Facility Criteria Final Rule published in the Federal Register on 10/9/91 (56 *FR* 50978) and codified in 40 CFR 258 and 40

# Figure 1A: Guide to Shapes Used in This Manual




The oval is used to begin each flowchart.

Shaded diamonds are used to ask a question.

Plain boxes are used to present answers to questions found in diamonds or to tell the reader about a section of the regulations.

Shaded dashed boxes give the reader directions that are needed to successfuly complete each module.

Round circles direct the reader to turn the page to continue a flowchart.

CFR 241 were used to provide the majority of the text for both the flowcharts and the supplemental information supporting the flowcharts.

## 1.2 Federal Regulation of Subtitle D Landfills

The guidelines contained in 40 CFR 241 are mandatory for Federal facilities. If the Federally generated waste is to be disposed of on non-Federal land, the Federal agency must utilize processing and disposal facilities that are in compliance with the guidelines.

The criteria found in 40 CFR 257 address floodplains, endangered species, surface water, groundwater protection practices, land application, air, safety practices, and disease vector control practices. These criteria are used to determine which solid waste disposal facilities and practices pose a reasonable probability of adverse effects on health or the environment.

An MSWLF is defined by 40 CFR 258 as "a discrete area of land or an excavation that receives **household waste** and that is not a land application unit, surface impoundment, injection well, or waste pile, as those terms are defined under 40 CFR 257.2." (Consult the glossary at the end of this document for the definition of these terms.) "An MSWLF also may receive other types of RCRA Subtitle D wastes, such as commercial solid waste, nonhazardous sludge, small-quantity generator waste, and industrial solid waste. Such a landfill may be publicly or privately owned. An MSWLF may be a new MSWLF, an existing MSWLF, or a lateral expansion."

40 CFR 258 provides criteria for the design, management, operation, closure, and post-closure care requirements for MSWLF facilities.

Furthermore, the criteria also address the requirements for groundwater monitoring and corrective action.

An important aspect of the MSWLF program is the ability of States/Tribes with approved programs to allow some flexibility in the application of some of the regulations. Among the regulations to which this flexibility can be extended are: the application of some site-specific criteria, and the deletion of or modification to the lists of groundwater monitoring constituents. Again, this flexibility can only be granted when a program has received approval by the USEPA.

## 1.3 Prohibition of Open Dumping

Landfill units which fail to satisfy the criteria of 40 CFR 241, 257 or 258 are considered "open dumps" and are prohibited under Section 4005 of RCRA. EPA **does not** have the authority to directly enforce the prohibition on open dumping except in situations involving the disposal or handling of sludge from publicly owned treatment works (POTWs) where Federal enforcement of POTW sludge-handling facilities is authorized under the Clean Water Act. In addition, MSWLFs containing sewage sludge that fail to satisfy the criteria of 40 CFR 258 are in violation of Sections 309 and 405(e) of the Clean Water Act. The open dumping prohibition may be enforced by **States** and other persons under Section 7002 of RCRA.

## 1.4 Managing Municipal Solid Waste Landfills at DOE Facilities

DOE facilities produce a variety of non-hazardous solid wastes, including commercial solid waste, industrial solid waste, and **household waste**. (These terms are defined in the glossary at the end of this document.) Solid wastes must be disposed of properly and in accordance with the regulations mandated under RCRA. Non-hazardous solid waste streams at DOE facilities are derived from many diverse sources including offices, cleaning and maintenance operations, temporary residences, crew quarters, lunchrooms/lunch areas and cafeterias, and various manufacturing or decommissioning processes that produce waste material regulated under the provisions of Subtitle D of RCRA. The volume of solid waste produced at some DOE facilities can be appreciable, especially when site remediation, construction, or demolition debris is present.

Much of the solid waste produced by DOE facilities is disposed of in landfills. The Federal regulations for non-MSWLFs have changed very little in the recent past. However, as a result of the promulgation of the final rule for MSWLF regulations, all landfills at DOE facilities that receive household wastes are considered MSWLFs. Although the recent DOE Tiger Team assessments did not differentiate MSWLFs from landfills that receive other Subtitle D wastes, such as commercial or industrial wastes, it is evident from a review of the Tiger Team findings that some DOE landfills may be considered MSWLFs. In addition, it is also evident that because of deficiencies discovered during the Tiger Team assessments, some DOE landfills will need to be upgraded to comply with the new 40 CFR Part 258 regulations. Some of the deficiencies noted during the Tiger Team Assessments were relatively minor:

(1) Lack of adequate fencing;
(2) Wastes left uncovered for longer than 24 hours;
(3) Inadequate or improper access restrictions;
(4) Inadequate recordkeeping.

Other noted deficiencies were considerably more serious:

(1) Lack of a valid operating permit;
(2) Placement of bagged asbestos wastes in supposedly non-asbestos areas of a solid waste landfill (also, visible rips in those bags indicated that a release of asbestos was very likely).

To bring its various MSWLFs into compliance with the new regulations, thereby ensuring that solid waste disposal efforts are legally and effectively implemented, DOE will have to determine:

(1) Which of its landfills are considered MSWLFs; and
(2) Whether or not any of these MSWLFs can be exempted under 40 CFR 258.1 from any or all of the regulatory requirements of 40 CFR Part 258. To determine possible exemptions, DOE will have to know, for each of its MSWLFs, the following information:

- Whether an MSWLF received waste after 4/9/94;
- Whether an MSWLF will receive waste after 4/9/94;
- Whether an MSWLF receives 20 tons or more waste daily;
- Whether there is groundwater contamination beneath an MSWLF;
- Whether there is a 3-month or greater interruption in surface transportation of waste in the region;
- Whether the landfill is located in a region that receives, on average, 25 inches or less of precipitation annually; and
- Whether the landfill is located on Indian Lands.

Some units may be eligible for extensions of the deadlines that have been mandated to achieve compliance with certain sections of the regulations. MSWLFs which are eligible for extensions include:

(1) Existing units (including those which are laterally expanding) that disposed of 100 tons per day (TPD) or less of solid waste, that are not on the National Priorities List during a representative period prior to October 9, 1993, and that are located in States that have submitted an application for permit approval to EPA by October 9, 1993; or
(2) MSWLF units located in Iowa.

Once this information is known, DOE will be able to proceed with the retro-fitting, closure, or expansion of existing MSWLFs so that they are managed in compliance with the new regulations. If necessary, DOE will also be able to proceed with the design and construction of new MSWLFs.

## 1.5 Statutory Authority for Federal Facility Compliance with Municipal Solid Waste Landfill Regulations

According to the RCRA Section 6001, Federal facilities are subject to and must comply with all "Federal, State, interstate, and local requirements, both substantive and procedural (including any requirements for permits or reporting . . .) respecting control and abatement of solid or hazardous waste disposal in the same manner, and to the same extent, as any person is subject to such requirements . . . ." It is clear from this legislative citation that DOE must comply with EPA's existing regulations for the management of non-MSWLFs and the regulations governing MSWLFs.

## 1.6 Additional Requirements

This guidance has been designed to be used in conjunction with, and not in lieu of: Federal Facility Agreements; Federal, State, and local regulations; and DOE Orders. In addition, owners and operator should be familiar with the provisions of the State/Tribal Implementation Rule.

State Requirements
States which have authority over their RCRA programs may have requirements which are more stringent than those in unauthorized States. Also, State requirements often supersede Federal requirements. DOE staff need to closely monitor State RCRA programs for changes that may affect landfills at DOE facilities.

Federal Regulatory Changes
EPA and/or the States may expand the regulations governing MSWLFs and other Subtitle D facilities, such as non-hazardous industrial waste and construction demolition and debris landfills. DOE staff need to be aware of any regulatory changes that may affect these landfills.

Federal Facility Agreements
DOE staff should review any consent agreement made between DOE, States, and EPA that may have an impact on the operation of a landfill management program.

DOE Orders
DOE staff and contractors are responsible for complying with all applicable DOE Orders. To date, DOE has not created an Order that specifically addresses MSWLFs. However, careful records of monitoring activities need to be kept for inclusion in the Annual Site Environmental Report required by DOE Order 5400.1. Monitoring and sampling information is also required for inclusion in the Environmental Monitoring Report (EMR) or, if the site is exempted from the EMR, it should be included in the Environmental Summary required by DOE Order 5484.1, "Environmental Protection, Safety, and Health Protection Information Reporting Requirements."

State/Tribal Implementation Rule

The USEPA has drafted the State/Tribal Implementation Rule (STIR) that will provide procedures by which USEPA will approve, or partially approve, State/Tribal landfill permit programs. Approved State/Tribal permit programs provide interaction between States/Tribes and the owner/operator regarding site-specific permit conditions. Only those owners/operators located in States or on Tribal lands with approved permit programs can use the site-specific flexibility provided by 40 CFR Part 258 to the extent that the State/Tribal program allows such flexibility. Regardless of the approval status of the State/Tribe, or permit status of the facility, the revised Federal MSWLF criteria will apply to all permitted and unpermitted facilities.

## 1.7 Chapter Descriptions

**Chapter 2: Identification of Federally Regulated Solid Waste Landfills**
This chapter provides a description of Subtitle D landfills (including MSWLFs) that are regulated by either 40 CFR 241 and 257, or 40 CFR 241 and 258.

**Chapter 3: Design and Operating Criteria for Solid Waste Landfills**
This chapter describes both the required and recommended design criteria from 40 CFR 241. The requirements are mandatory for Federal facilities and recommended to State and local governments for use in their solid waste management programs. Both MSWLFs and non-MSWLFs must comply with this chapter.

**Chapter 4: Evaluation Criteria for Non-Municipal Solid Waste Landfills**
This chapter describes the criteria from 40 CFR 257 that are used under RCRA Section 4005 to determine when landfills (that are not MSWLFs) should be classified as "open dumps." Open dumps are prohibited under RCRA.

**Chapter 5: Introduction to Municipal Solid Waste Landfills**
This chapter explains the applicability of 40 CFR 258 to MSWLFs. Applicability is dependent on several criteria, one of which is the timeframe during which the Municipal Solid Waste Landfill accepts waste for disposal.

**Chapter 6: Location Restrictions for Municipal Solid Waste Landfills**
MSWLFs cannot be constructed without regard for local environmental conditions, such as wetlands, floodplains, and/or geology. This chapter describes how these and other environmental conditions affect the construction of new or laterally expanding MSWLFs.

### Chapter 7: Design and Operating Criteria for Municipal Solid Waste Landfills

Owners and/or operators of MSWLFs must ensure that unauthorized vehicles, people, and materials (such as PCBs) do not enter the MSWLF. They also must operate their MSWLF in a manner that protects human health and the environment. This chapter provides the information from 40 CFR 258 needed to safely operate an MSWLF in compliance with these requirements.

### Chapter 8: Groundwater Monitoring and Corrective Action for Municipal Solid Waste Landfills

According to 40 CFR 258, groundwater at MSWLFs must be monitored and sampled to ensure that leachate from the landfill is not polluting an aquifer. Two levels of monitoring are prescribed in this chapter: detection and assessment monitoring. If groundwater contamination is found, corrective action must be implemented. Consult this chapter before initiating a groundwater monitoring or corrective action program.

### Chapter 9: Closure and Post-Closure Care for Municipal Solid Waste Landfills

Closure of an MSWLF requires careful planning to avoid liabilities under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). This chapter clearly defines responsibilities for closing an MSWLF in compliance with 40 CFR 258.

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# Chapter 2
# Identification of Federally Regulated Solid Waste Landfills

**Contents**

## 2.1 Introduction

### 2.1.1 Background

Federally regulated solid waste landfills can be defined by the type(s) of waste accepted for disposal. To be eligible for regulation under Subtitle D (instead of the more stringent Subtitle C regulations), the landfill **cannot** accept regulated quantities of hazardous waste. However, MSWLFs that are permitted, licensed, or registered by a State **may** accept conditionally exempt small quantity generator hazardous wastes.

One of the most important questions that must be answered before completing this chapter is: Does the landfill accept household waste? If it does, regardless of whether or not it accepts other Subtitle D wastes (i.e., commercial, industrial, or small-quantity generator wastes) the landfill is regulated as an MSWLF. MSWLFs are regulated under 40 CFR 241 and 258.

If the landfill does not accept **any** household waste it is not regulated by 40 CFR 258. However, it must comply with the requirements of 40 CFR 241 and 257.

## 2.2 Module 2A: Identification of Federally Regulated Solid Waste Landfills

### 2.2.1 Introduction

This module, which describes how the requirements of 40 CFR 241, 257, and 258 are applicable to solid waste landfills, will enable the user to identify the landfill unit as either an MSWLF or a non-MSWLF. It also identifies the appropriate 40 CFR sections for each type of landfill.

All solid waste landfill units must comply with the requirements established in 40 CFR 241, which constitute the minimum criteria by which States regulate solid waste landfills.

Any landfill units that meet the definitions for either an MSWLF or a non-MSWLF are subject to 40 CFR 258 or 40 CFR 257, respectively. While any landfill unit that meets the definition for an MSWLF may be subject to Part 258 in whole or in part, a solid waste landfill unit that is not an MSWLF is subject to Part 257 in its entirety.

DOE staff should use this module to determine if landfill units meet either the definition of an MSWLF or a non-MSWLF.

### 2.2.2 Milestones

***Does the landfill meet the definition of a Federally regulated MSWLF or a non-MSWLF?***

The following conditions must apply for the landfill to meet the definition of a non-MSWLF.

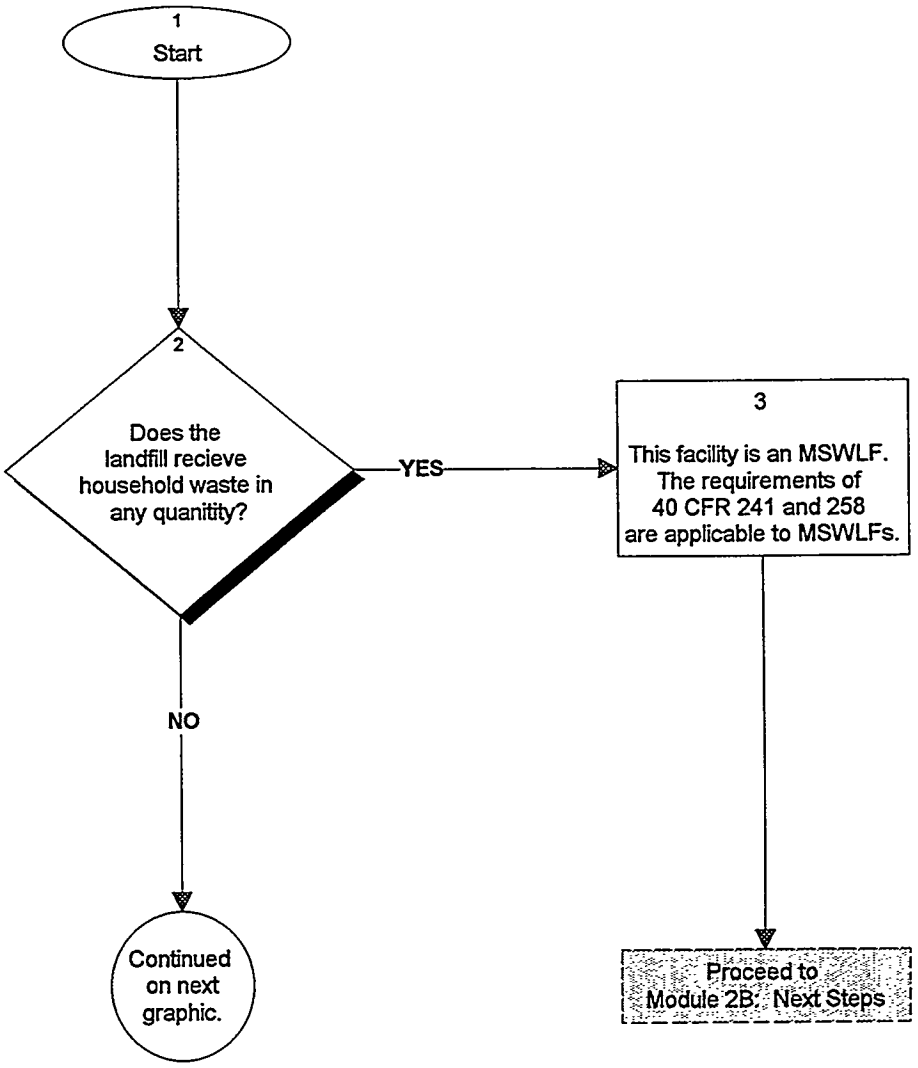
- The landfill receives **only** commercial or industrial waste; or
- The landfill receives **only** other Subtitle D solid wastes that are **not** household waste.

The following conditions must apply for the landfill to meet the definition of a Federally regulated MSWLF.

- The landfill must receive household waste (alone or in combination with other wastes).

[Note, non-MSWLFs and MSWLFs may receive conditionally exempt small quantity generator (CESQG) hazardous waste (40 CFR 258.20(b)).]

## Figure 2A: Identification of Federally Regulated Solid Waste Landfills



**Step 1** Start.

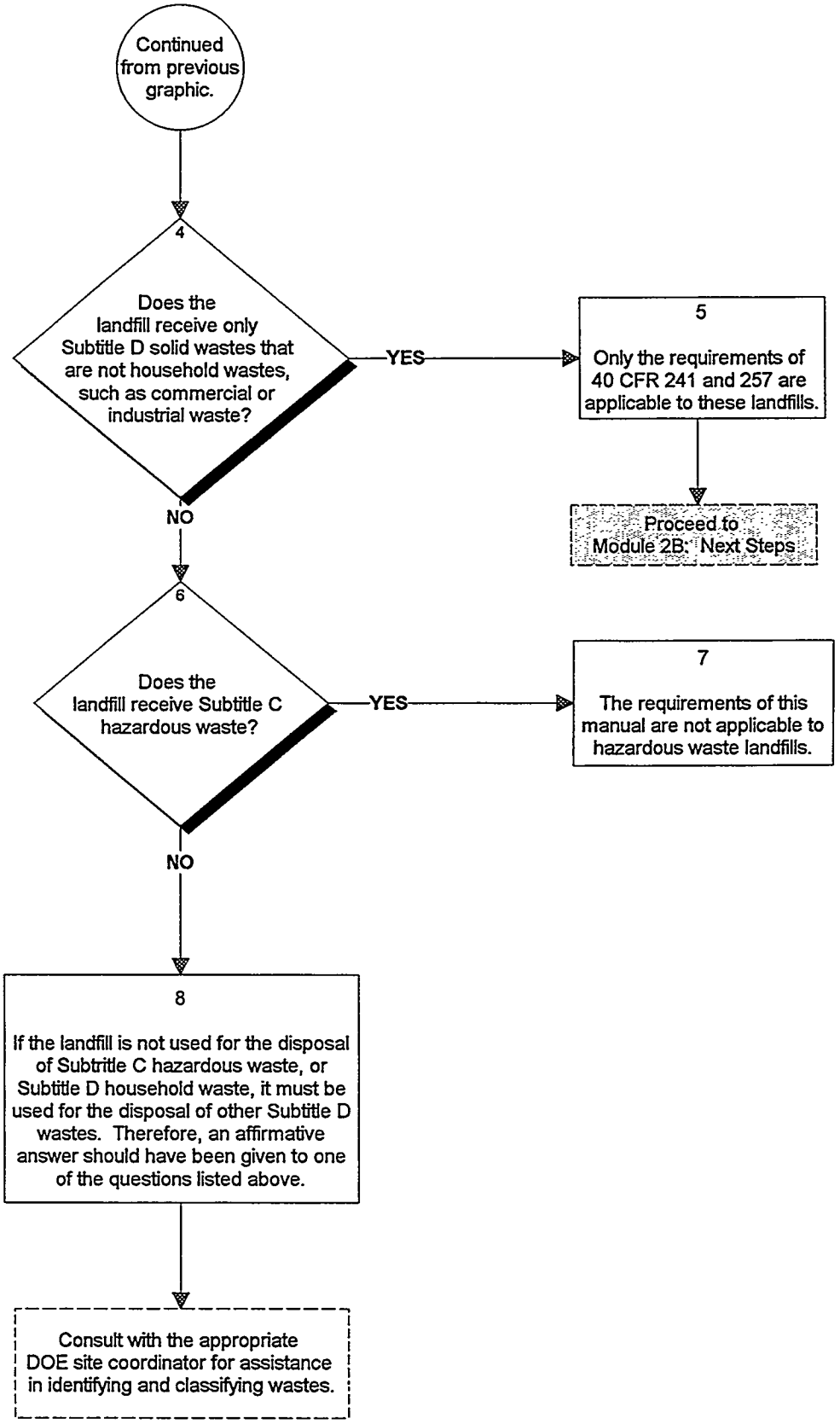
**Step 2** **Landfill** means: an area of land or an excavation in which wastes are placed for permanent disposal and that is not a land application unit, surface impoundment, injection well, or waste pile.

**Household waste** means: any solid waste (including garbage, trash, and sanitary waste in septic tanks) derived from households (including single and multiple residences, hotels and motels, bunkhouses, ranger stations, crew quarters, campgrounds, picnic grounds, and day-use recreation areas).

The presence of household waste in the landfill requires that the landfill be regulated as an MSWLF. MSWLFs may receive other Subtitle D wastes, although those wastes do not define the landfill as an MSWLF.

[NOTE: EPA **has not** set a *de minimis* level at which a landfill can accept household waste and still be exempt from the MSWLF regulations.]

**Step 3** The landfill meets the definition of an MSWLF under 40 CFR Part 258. The requirements of both 40 CFR 241 and 258 are applicable to an MSWLF. Proceed to Module 2B to determine which chapters cover requirements applicable to MSWLFs.


Continued from previous graphic.
4
Does the landfill receive only Subtitle D solid wastes that are not household wastes, such as commercial or industrial waste?
YES
5
Only the requirements of 40 CFR 241 and 257 are applicable to these landfills.
Proceed to Module 2B: Next Steps
NO
6
Does the landfill receive Subtitle C hazardous waste?
YES
7
The requirements of this manual are not applicable to hazardous waste landfills.
NO
8
If the landfill is not used for the disposal of Subtitle C hazardous waste, or Subtitle D household waste, it must be used for the disposal of other Subtitle D wastes. Therefore, an affirmative answer should have been given to one of the questions listed above.
Consult with the appropriate DOE site coordinator for assistance in identifying and classifying wastes.

**Step 4** **Solid waste** means: garbage; refuse; sludge from a wastewater treatment plant, water supply treatment plant, or air pollution control facility; and other discarded material, including solid, liquid, semi-solid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations, and from community activities.

**Commercial waste** means: all types of solid waste generated by stores, offices, restaurants, warehouses, and other non-manufacturing activities excluding residential and industrial wastes.

**Industrial solid waste** means: solid waste generated by manufacturing or industrial processes that is **not** a hazardous waste regulated under Subtitle C of RCRA. Such waste may include, but is not limited to, waste resulting from various manufacturing processes.

**Step 5** **Only** the requirements for 40 CFR 241 and 257 are applicable to solid waste landfills that are **not** MSWLFs. Proceed to Module 2B to define the necessary steps to comply with 40 CFR 241 and 257.

**Step 6** **Hazardous waste** is defined by the RCRA statute as a solid waste, or combination of solid wastes, which because of its quantity, concentration, or physical, chemical, or infectious characteristics may cause or significantly contribute to an increase in mortality or an increase in serious irreversible or incapacitating reversible illness; or may pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of, or otherwise managed. 40 CFR 261.3 provides the regulatory definition for hazardous waste.

For further guidance on how to define RCRA-regulated wastes, refer to the guidance manual published by the DOE Office of Environmental Policy and Assistance "Definition of Solid and Hazardous Waste" (DOE/EH-273-8/92).

**Step 7** Hazardous waste landfills are regulated by RCRA Subtitle C. The requirements in this guidance do **not** apply to hazardous waste landfills.

**Step 8** Return to Step 1, or consult with the DOE compliance coordinator, to determine the regulatory status of the landfill.

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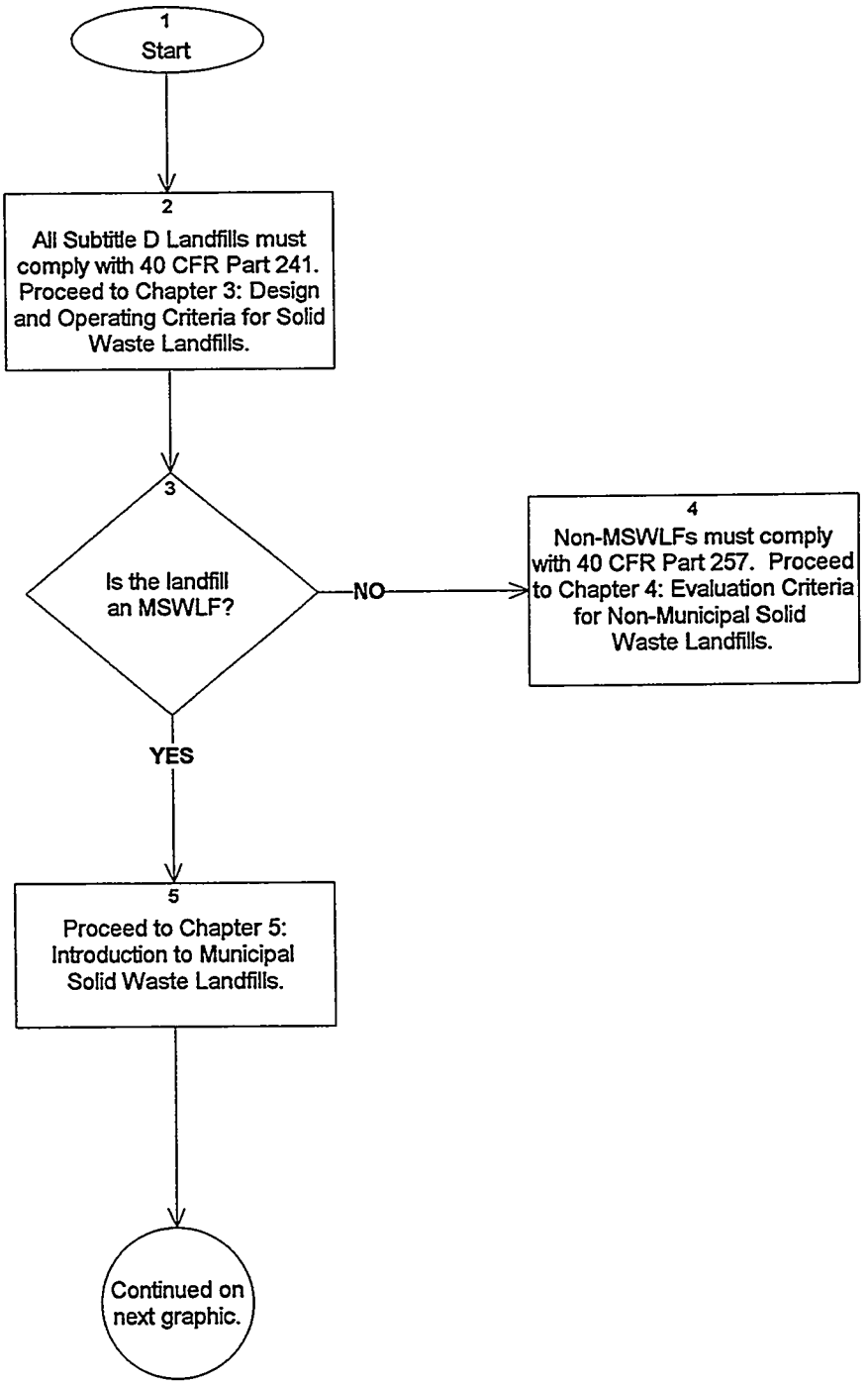
## 2.3 Module 2B: Next Steps

### 2.3.1 Introduction

After the landfill unit has been determined to be either an MSWLF or a non-MSWLF, use the flowchart in this module as a map to the other chapters of this guidance. The rectangles shown in this flowchart identify the various chapters for the design, operation, closure and post-closure procedures to be implemented for the applicable landfill unit. After determining the applicable chapter(s), proceed as necessary to obtain the required guidance. In the case of the requirements for 40 CFR 257, "The Criteria for Classification of Solid Waste Disposal Facilities and Practices," all of the requirements are contained in one chapter.

# Figure 2B: Next Steps



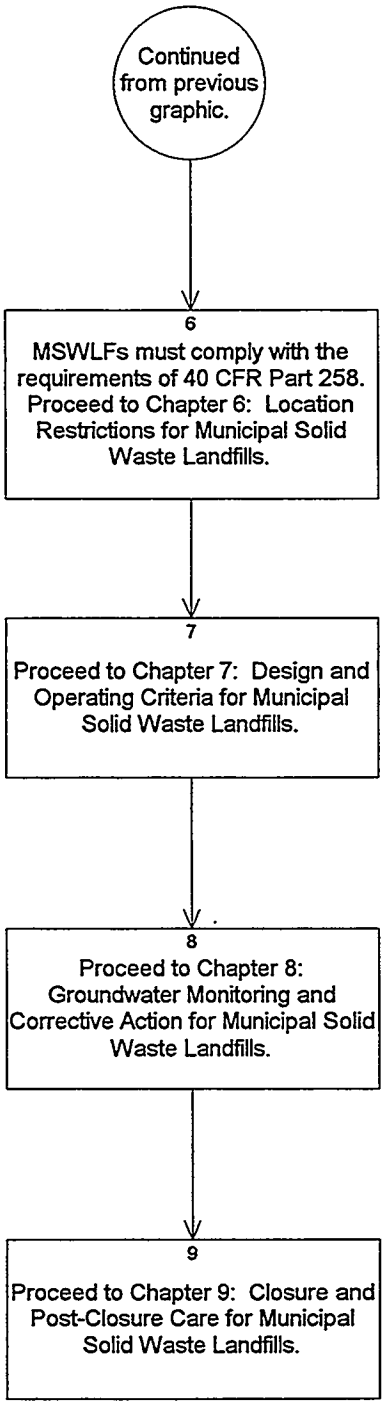
**Step 1** Start.

**Step 2** **Chapter 3: Design and Operating Criteria for Solid Waste Landfills**
This chapter describes both the required and recommended design criteria from 40 CFR 241. Both MSWLFs and non-MSWLFs must comply with this chapter. The criteria provided in this chapter generally apply to the land disposal of all solid waste materials. When 40 CFR 241 is employed with the applicable companion regulation (i.e., 40 CFR 257 or 258), the requirements become magnified and more clearly defined for the specific landfill unit.

**Step 3** The owner or operator should have been able to determine the regulatory status of his/her landfill after completing Module A. Contact the DOE compliance coordinator if additional assistance is needed.

**Step 4** **Chapter 4: Evaluation Criteria for Non-Municipal Solid Waste Landfills**
This chapter describes the criteria from 40 CFR 257 that are used pursuant to RCRA Section 4005 to determine when landfills (that are not MSWLFs) should be classified as "open dumps". The evaluation criteria are employed by the States during routine landfill inspections. Open dumps are prohibited under RCRA.

**Step 5** **Chapter 5: Introduction to Municipal Solid Waste Landfills**
This chapter defines the applicability of 40 CFR 258 to MSWLFs. Applicability of certain sections is dependent on several criteria, one of which is the timeframe during which the MSWLF accepts waste for disposal. The other criteria illustrated in this chapter define whether all or only part of 40 CFR 258 will be applicable to the MSWLF.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6
MSWLFs must comply with the requirements of 40 CFR Part 258. Proceed to Chapter 6: Location Restrictions for Municipal Solid Waste Landfills.
7
Proceed to Chapter 7: Design and Operating Criteria for Municipal Solid Waste Landfills.
8
Proceed to Chapter 8: Groundwater Monitoring and Corrective Action for Municipal Solid Waste Landfills.
9
Proceed to Chapter 9: Closure and Post-Closure Care for Municipal Solid Waste Landfills.

**Step 6** **Chapter 6: Location Restrictions for Municipal Solid Waste Landfills**
MSWLFs cannot be constructed without regard for local environmental conditions, such as wetlands, floodplains, and/or geology. This chapter describes how these and other environmental conditions specified in 40 CFR 258 affect the construction of new MSWLFs or expansion of existing MSWLFs.

**Step 7** **Chapter 7: Design and Operating Criteria for Municipal Solid Waste Landfills**
Owners and/or operators of MSWLFs must ensure that the design, operation, and recordkeeping requirements established in 40 CFR Part 258 are met.

**Step 8** **Chapter 8: Groundwater Monitoring and Corrective Action for Municipal Solid Waste Landfills**
According to 40 CFR 258, groundwater at MSWLFs must be monitored and sampled to ensure that leachate from the landfill is not polluting the aquifer. If groundwater contamination is found, corrective action must be implemented. Consult this chapter before initiating a groundwater monitoring or corrective action program.

**Step 9** **Chapter 9: Closure and Post-Closure Care for Municipal Solid Waste Landfills**
Closure of an MSWLF requires careful planning to avoid liabilities under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). This chapter clearly defines responsibilities for closing an MSWLF in compliance with 40 CFR 258. This chapter also defines closure and post-closure care requirements for MSWLFs in compliance with 40 CFR 258.

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# Chapter 3
# Design and Operating Criteria for Solid Waste Landfills

**Contents**

## 3.1 Introduction

### 3.1.1 Background

The guidelines presented in 40 CFR Part 241, promulgated pursuant to Section 209 of the Solid Waste Disposal Act of 1965 (SWDA), represent an early attempt by the Environmental Protection Agency (EPA) to codify environmentally acceptable methods for managing the land disposal of solid waste. The guidelines do not establish new standards, but set forth requirements and recommended procedures to ensure that the design, construction, and operation of both existing and future land disposal facilities meet the environmental and health standards for the area in which they are located. Adherence to the requirements set forth in 40 CFR Part 241 are mandatory only for Federal agencies, but they are recommended for use by State, interstate, regional, and local government agencies as a means of managing their own solid waste activities in a responsible manner.

The guidelines are intended to be applied equally to all solid waste generated by:

(1) Federal agencies, regardless of whether it is processed or disposed of on or off Federal property; and
(2) Non-Federal entities that ultimately process or dispose of their solid wastes on Federal property.

The requirements established in 40 CFR Part 241 are intended to create a standard for minimum acceptable levels of performance and environmental safety. The authority to assure compliance with the requirements set forth in the guidelines rests solely with the responsible agency (i.e. State and/or local regulatory authorities).

EPA has developed suggested methods by which the objectives of each requirement may be realized. These preferred methods, based on the practice of sanitary landfilling of solid wastes, are not necessarily an end unto themselves. New or different designs and operating techniques may be used as a means of achieving any requirement identified in the guidelines. Techniques or practices intended for use in lieu of those identified must be shown by the facility's owner/operator to be at least as effective in reaching the stated requirement as those procedures recommended by EPA. This obligation to demonstrate the effectiveness of the proposed alternative method(s) to the applicable responsible agency must be satisfied in advance of implementing the alternative technique or design in the land disposal unit.

In general, the guidelines presented in 40 CFR Part 241 are applicable to a wide range of solid wastes. The definition of solid waste, as presented in 40 CFR 241.101, states that ". . . garbage, refuse, sludges, and other discarded solid materials resulting from industrial and commercial operations and community activities . . ." are to be considered subject to the guidelines.

Three categories of solid wastes are specifically excluded from the scope of this regulation. They are: hazardous, agricultural, and mining wastes, all of which are governed by other regulatory and statutory vehicles.

Readers of this chapter should note that unlike most sections of the environmental regulations codified at 40 CFR, EPA has included both **required** and **recommended** actions in 40 CFR 241.

## 3.2 Module 3A: Waste Acceptance and General Operating Procedures

### 3.2.1 Introduction

Owners/operators and their regulators must determine what wastes will be accepted by the landfill. Normally, the types of waste to be accepted will be governed by the design capabilities of the facility; however, other factors, such as waste toxicity or biological hazard, are also evaluated. Some common solid waste streams can pose a significant threat to human health and the environment. Once the wastes to be accepted (and excluded) have been determined, the operator can begin to develop the general operating procedures for a site.

General operating procedures include such elements as providing for an effective litter control program, prohibiting scavenging, and developing procedures for the disposal of dead animal carcasses. Land disposal units are, by their nature, rapidly changing, unsightly, and often aromatic operations that do not lend themselves easily to aesthetic remedies. However, there is a general operating requirement that addresses the protection of the aesthetic value of a solid waste landfill. Protection of a site's aesthetic value is intrinsically bound to other vital site programs and procedures such as dust and litter control, disease vector control, and wastewater treatment sludge management techniques.

While some design and operating guidelines can be standardized for all land disposal units, there will be other geographic, climatic, geologic, and cultural conditions that will require consideration of unique approaches or alternatives in order to fulfill the aesthetic requirement. Selection of appropriate alternatives is left to the discretion of the owner/operator, in consultation with local land use planning and zoning organizations.

### 3.2.2 Milestones

***Have all wastes that are excluded from disposal in the landfill been determined?***

Wastes may be excluded based on:

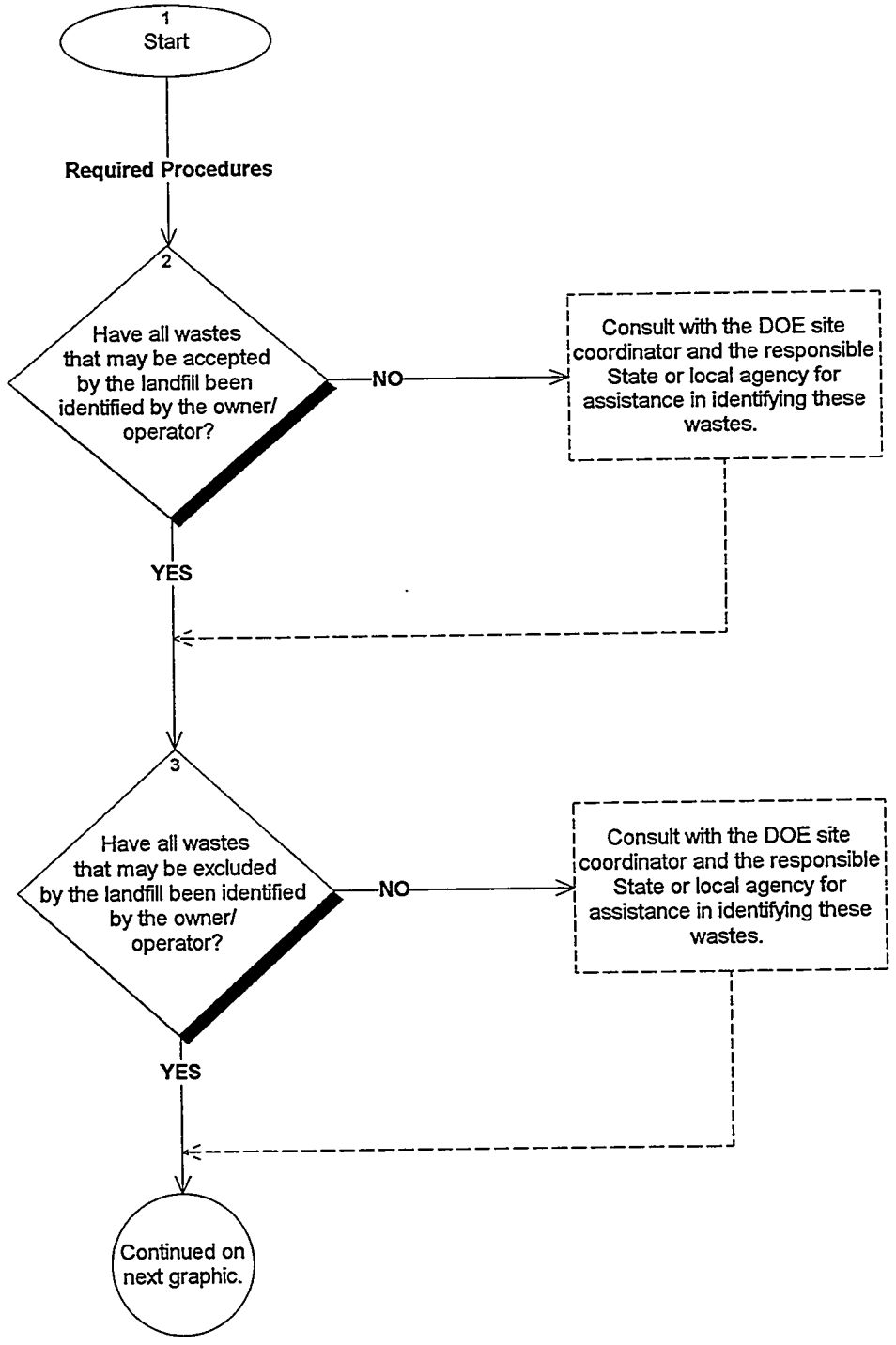
- Toxicity;
- Biohazard; or
- Limitations in the physical setting of the site.

***Have the general operating requirements for the site been selected?***

The owner/operator must develop general operating requirements for:

- Handling "special wastes;"
- Keeping certain wastes out of the landfill; and
- Developing a litter control program.

# Figure 3A: Waste Acceptance and General Operating Procedures



**Step 1** Start.

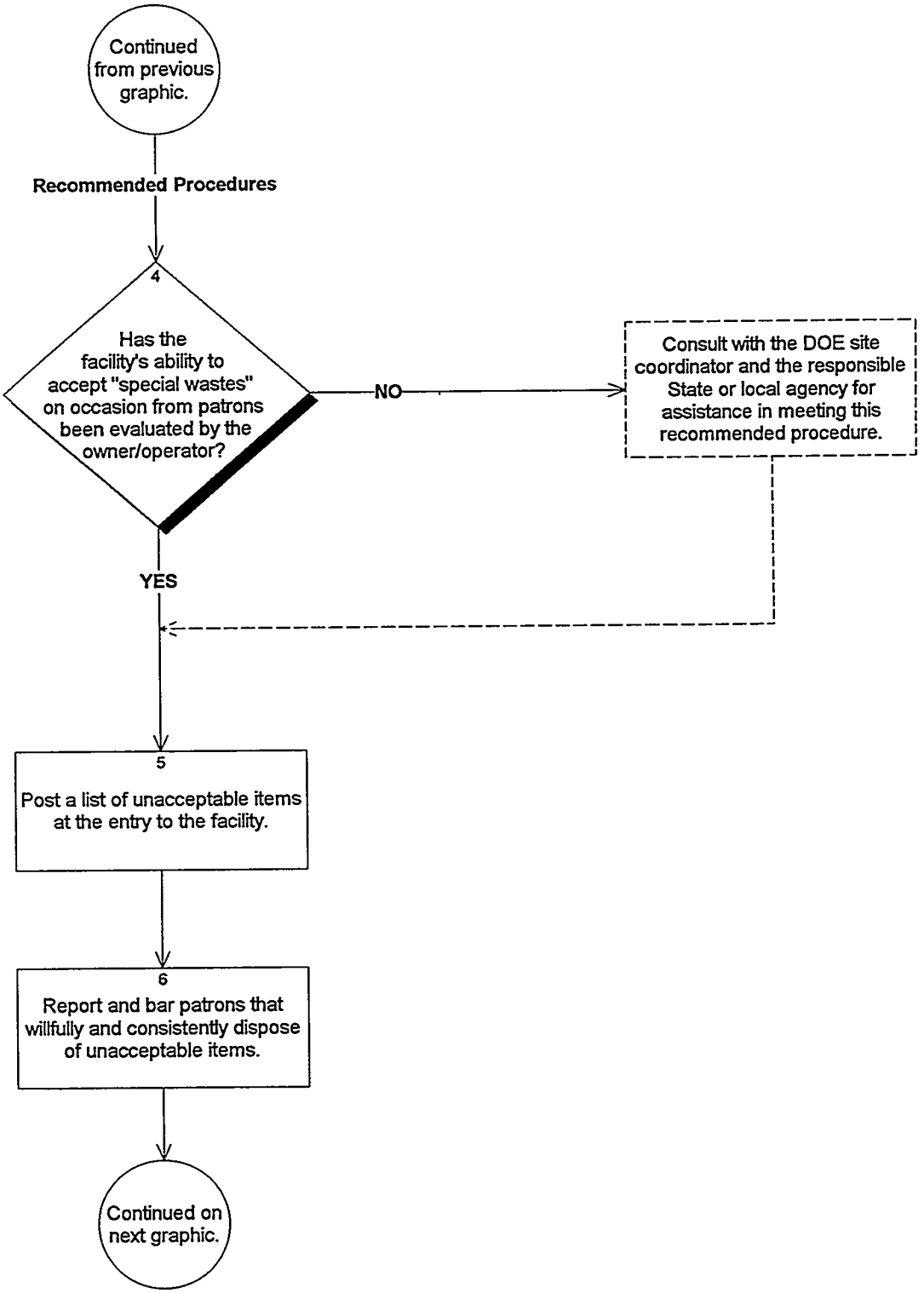
## A. REQUIRED PROCEDURES

**Step 2** Generally, these wastes include non-hazardous or non-toxic materials commonly generated in a household, commercial, or industrial setting. These sources generate large amounts of paper, plastic, glass, metal, food, vegetation, and construction wastes.

Other solid wastes not previously identified during the consultation phase may be accepted, but only after it has been demonstrated to the responsible agency that the waste is compatible with existing design criteria or after modifications to the facility have been conducted. These wastes may include new waste streams from new or existing commercial or industrial processes.

**Step 3** Specific criteria that may be used to determine which waste streams should be excluded from a facility include: the site's hydrogeology, chemical and biological characteristics of the waste, alternative disposal or reuse/recycling methods available, and environmental and health effects.

In addition, the guidelines indicate that pesticides and pesticide containers will be disposed of in accordance with procedures and regulations identified in the Federal Environmental Pesticides Control Act of 1972 (statutory amendments to FIFRA). Disposal instructions are normally identified in the instructional field of all pesticide and herbicide labels.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Recommended Procedures
4
Has the facility's ability to accept "special wastes" on occasion from patrons been evaluated by the owner/operator?
NO
Consult with the DOE site coordinator and the responsible State or local agency for assistance in meeting this recommended procedure.
YES
5
Post a list of unacceptable items at the entry to the facility.
6
Report and bar patrons that willfully and consistently dispose of unacceptable items.
Continued on next graphic.

## B. RECOMMENDED PROCEDURES

**Step 4** Facility planning documents should specify procedures to be employed in handling "special wastes". Generally, they include those groups of solid wastes characterized as having a hazardous chemical and/or biological nature or having high liquid content. Normally this type of waste would be excluded from these types of land disposal units. However, under certain circumstances it may be necessary to accept certain types of "special wastes." Special wastes are identified as:

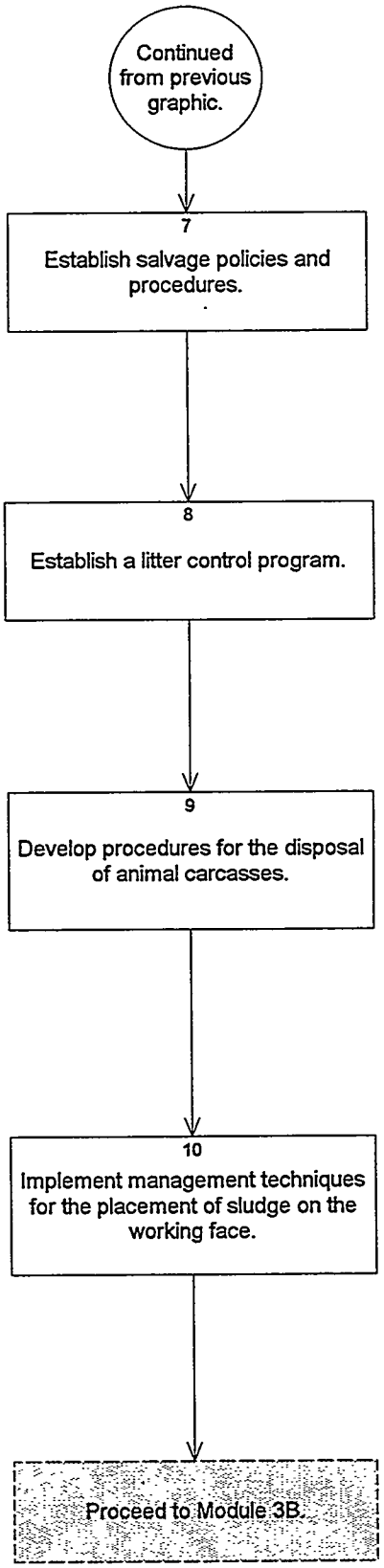
(1) RCRA hazardous wastes from conditionally exempt small quantity generators;
(2) Infectious institutional wastes;
(3) Sludges containing free moisture;
(4) Bulk liquids and semi-liquids;
(5) Highly flammable or volatile substances;
(6) Raw animal manure;
(7) Septic tank pumpings;
(8) Raw sewage sludge; and
(9) Certain industrial process wastes.

These special wastes require specific approval from the responsible agency before they may be introduced into the land disposal unit. In those situations where special wastes are planned to be received, a special assessment is required of the following items: site characteristics, the nature and quantities of the waste, and design and operational precautions to be implemented to ensure environmentally safe disposal.

The owner should be aware that, under RCRA, conditionally exempt small quantity generators are allowed to dispose of RCRA hazardous wastes in MSWLFs.

**Step 5** Post the list in a prominent location at the site entrance so all patrons, whether frequent or infrequent users, are aware of items to be excluded.

**Step 6** In those situations where persistent deliveries of unacceptable materials by regular patrons are identified, the guidelines recommend that the individual(s) be barred from the site and reported to the responsible agency.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7
Establish salvage policies and procedures.
8
Establish a litter control program.
9
Develop procedures for the disposal of animal carcasses.
10
Implement management techniques for the placement of sludge on the working face.
Proceed to Module 3B.

**Step 7** Establish salvage policy and procedures for certain bulky wastes such as auto bodies, furniture, and appliances in areas away from the active working face of the landfill. If salvage operations are not to be conducted, these types of materials should be crushed or compacted to the greatest extent possible and disposed of, along with other bulky construction and vegetation wastes, at the foot of the working face. Conduct of salvage operations (where authorized) should be undertaken in such a manner as not to detract from the overall appearance of the land disposal site. These materials should be removed frequently to prevent salvage areas from becoming unmanageable and unsightly.

**Step 8** An effective litter control program may include installing portable litter fences or similar devices to capture blowing litter that escapes from the working face and disposal cell. Recovered litter should be placed in the disposal cell on a daily basis to maintain the unit's appearance.

**Step 9** Develop procedures for the disposal of dead animal carcasses in accordance with State regulations. Generally this involves placing small carcasses on the working face and immediately applying cover material over the bodies. Where State laws do not identify specific procedures for disposing of large animal carcasses, use of a burial pit and suitable cover to encourage precipitation runoff is recommended.

**Step 10** Implement management techniques for the application of water treatment sludges, waste water treatment sludges, and incinerator residues (all of which must be free of moisture) to the working face. Sludges should be accepted and placed on the working face only in volumes that do not impair the flow of wastes to the face or the operation of equipment manipulating the waste. Soil or municipal solid waste should be used to cover this material. Similarly, cover should be placed over incinerator residue as necessary to prevent this material from becoming airborne.

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## 3.3 Module 3B: Site Selection

### 3.3.1 Introduction

The selection of a site for a solid waste landfill must be conducted in a manner that is consistent with the local community's health and welfare concerns. Other factors that are involved include the site's geologic, hydrogeologic, and meteorologic setting. To ensure that the schedule for approval is not hindered, these factors must be considered at the earliest stage of the planning process.

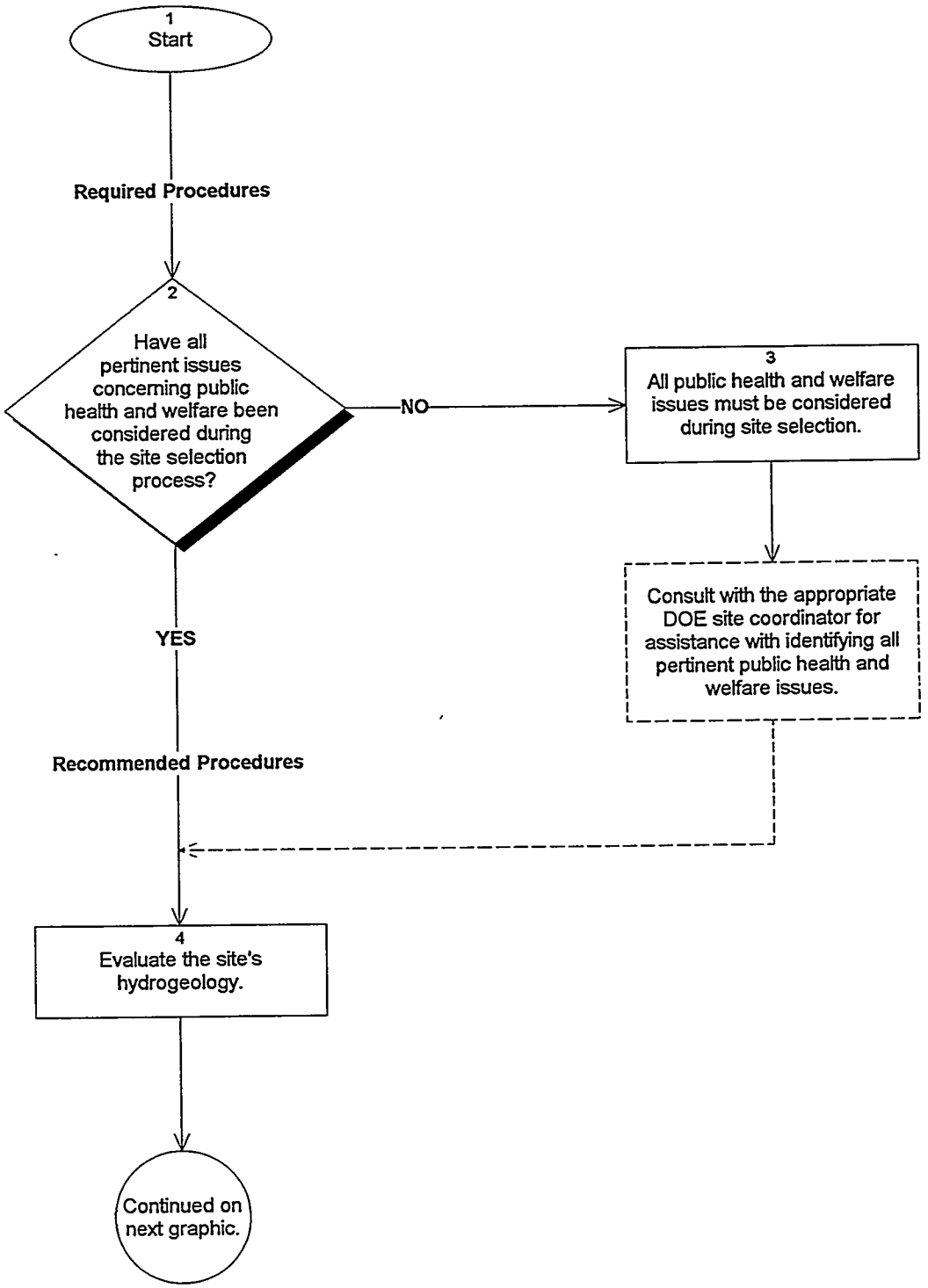
### 3.3.2 Milestones

***Have all site selection factors been determined?***

Selection factors that may cause the selection of one site over another include the site's:

- Geology;
- Hydrogeology;
- Soil type;
- Climate; and
- Proximity to wetlands, floodplains, or residential areas.

# Figure 3B: Site Selection



**Step 1** Start.

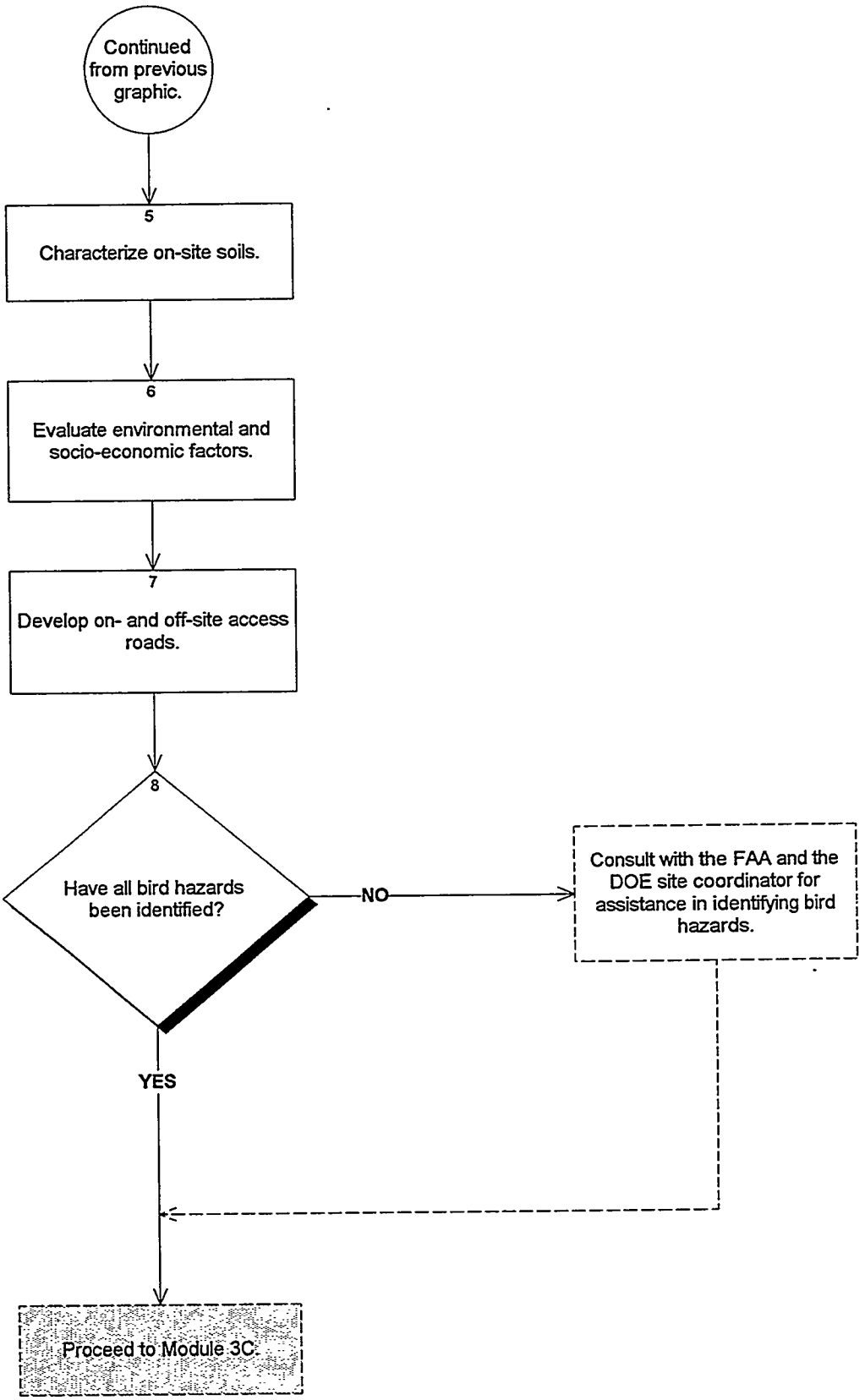
## A. REQUIRED PROCEDURES

**Step 2** The selection of a land disposal site must be consistent with issues concerning public health and welfare. Protection of public health and welfare will be the primary consideration in locating a new, or modifying an existing, land disposal unit. Adequate protection, however, will differ significantly from site to site depending on a number of factors including demographics, geologic characteristics, water resources, types of wastes accepted, and subsurface gas generation potential. A second major deciding factor in siting land disposal units will be local or regional land use planning requirements. These requirements generally consider issues of risk and community acceptance. In addition, regulatory requirements designed to protect various environmental media will also affect siting considerations.

**Step 3** Those locations that require extensive engineering activities or exhibit sensitive environmental conditions that would make adherence to regulatory requirements difficult normally will not be considered.

## B. RECOMMENDED PROCEDURES

**Step 4** Evaluate the hydrogeology of the site to determine appropriate design parameters for protection of groundwater resources. Unacceptable hydrogeologic conditions may be altered to render the site acceptable, but such alterations should be detailed in planning documents. Similarly, precipitation, evapotranspiration, and other climatological conditions should also be evaluated as considerations affecting site selection.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5
Characterize on-site soils.
6
Evaluate environmental and socio-economic factors.
7
Develop on- and off-site access roads.
8
Have all bird hazards been identified?
NO
Consult with the FAA and the DOE site coordinator for assistance in identifying bird hazards.
YES
Proceed to Module 3C.

**Step 5** Characterize on-site soils as a means of assessing the effects native soils may have on vehicle mobility as well as their suitability for use as cover material.

**Step 6** Evaluate environmental and socioeconomic factors to determine whether the proposed location of a new, or extension of an old, land disposal unit is an appropriate land use option.

**Step 7** Develop all-weather roads, leading from the public road system, to service all vehicles which the facility is designed to serve. Temporary intra-site roads to provide access to the working face(s) are also recommended.

**Step 8** Evaluate the potential threat posed by birds to low-flying aircraft. The Federal Aviation Administration (FAA) has issued guidance identifying acceptable distance limits for siting land disposal units in the vicinity of public-use airfields. These limits do not prohibit the siting of land disposal units, but instead define a danger zone within which particular care must be taken to assure that no bird hazard arises.

These and any other issues associated with locating a land disposal unit should be evaluated in the early stages of creating proposed development plans. These plans, in turn, will be submitted to the responsible agency for review and approval, as required.

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## 3.4 Module 3C: Site Design

### 3.4.1 Introduction

The site design of the solid waste landfill must include all appropriate design considerations and must be based on sound engineering data and accepted site operation practices.

As part of the site design, post land-use plans for the site should be developed. In addition to monitoring and maintenance programs for the closed facility, the post land-use plans should provide for a restriction against the construction of "major" structures on top of the land disposal unit.

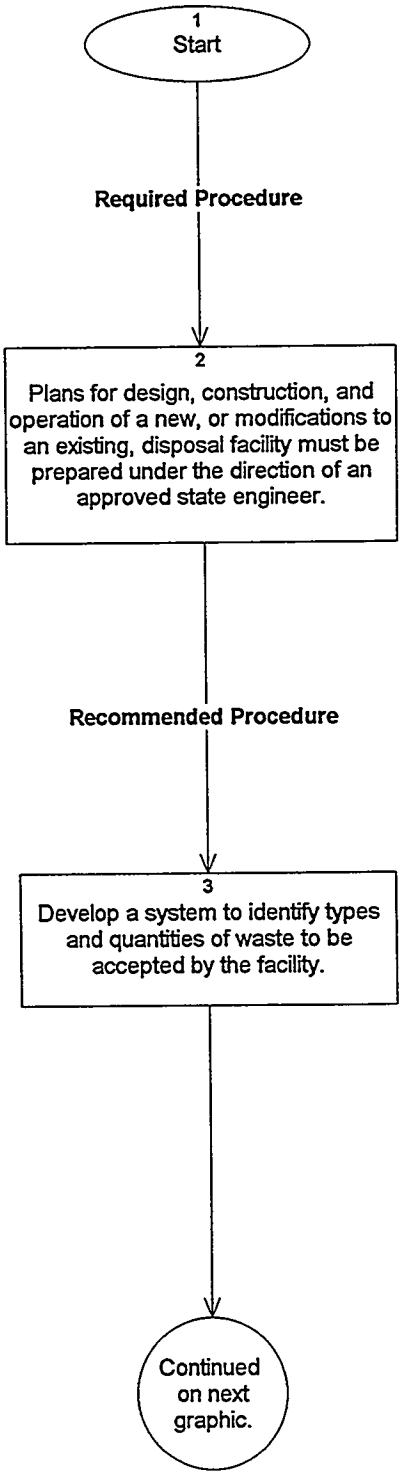
### 3.4.2 Milestones

***Is the design of the landfill complete?***

To be complete, the landfill design must include:

- All elements specific to the development and operation of the site.

# Figure 3C: Site Design



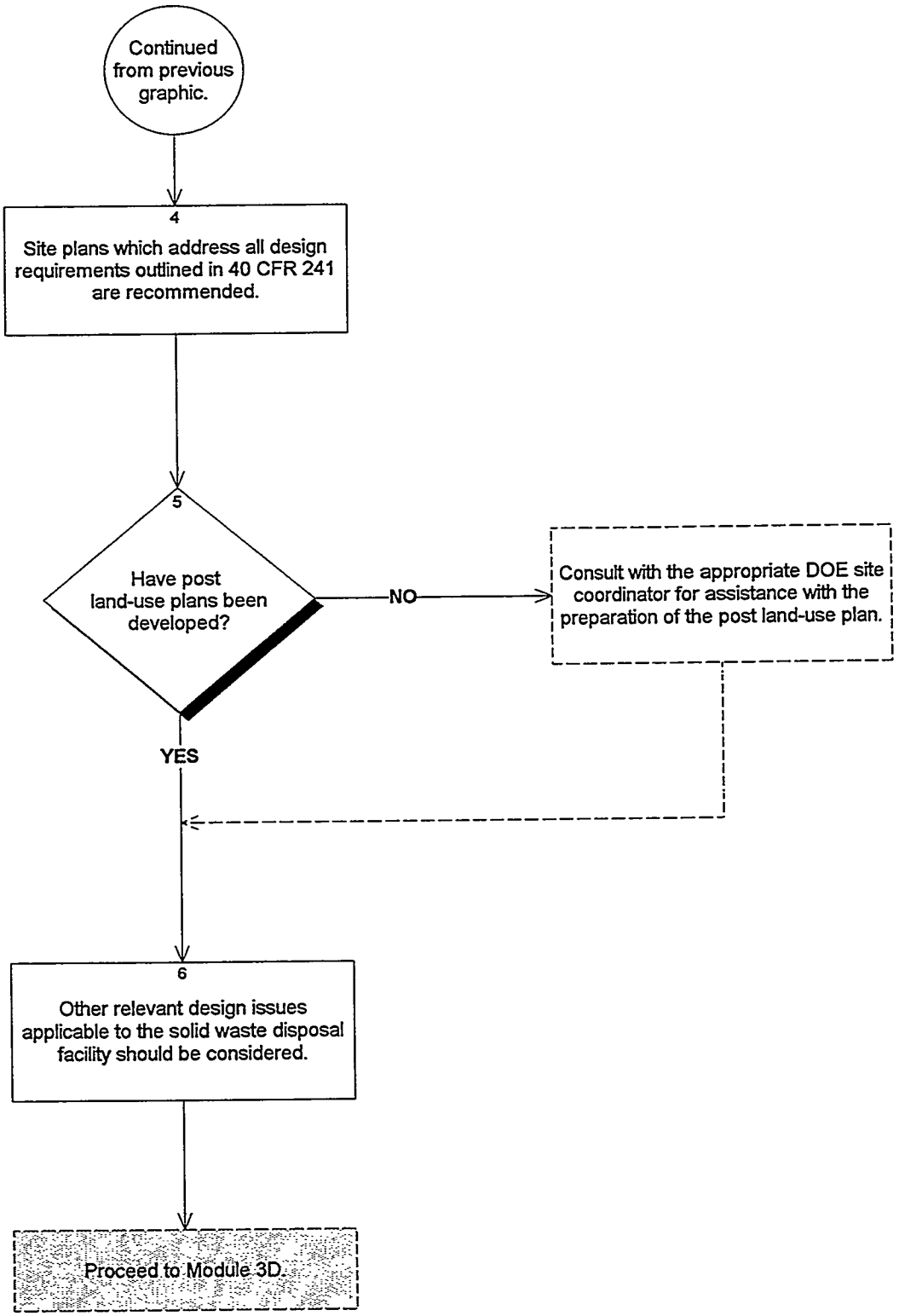
**Step 1** Start.

## A. REQUIRED PROCEDURES

**Step 2** The plans for the design, construction, and operation of new facilities or modifications to existing facilities must be prepared under the direction and approval of a State-licensed professional engineer. These plans must include all aspects of the development and operation of the land disposal unit and must be based on sound engineering data and accepted operating practices. The plans should be as complete and current as possible before being submitted for evaluation. Upon completion, the plans shall be submitted to the responsible agency for review and, if required, agency approval. If corrections or modifications to the plans are required by the responsible agency, the responsible agency could require that they be made under the direction and approval of a State licensed professional engineer.

## B. RECOMMENDED PROCEDURES

**Step 3** Consider the development of a system to identify the types and quantities of waste to be accepted by the facility. This information should be readily available if the requirements governing the acceptance of non-hazardous and non-toxic wastes and the exclusion, where applicable, of "special wastes" (e.g., bulk liquids, septic tank pumpings, and sewage sludges) have been met. These requirements are presented in Module 3A.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4
Site plans which address all design requirements outlined in 40 CFR 241 are recommended.
5
Have post land-use plans been developed?
NO
Consult with the appropriate DOE site coordinator for assistance with the preparation of the post land-use plan.
YES
6
Other relevant design issues applicable to the solid waste disposal facility should be considered.
Proceed to Module 3D.

**Step 4**

Development of site plans which address all of the design requirements outlined throughout this module is recommended. Elements of the site plan specifically outlined here include:

(1) Initial and final topographic information at contour intervals of five feet or less;
(2) Land use and zoning within one-quarter mile of the facility;
(3) Location of all utilities within 500 feet of the facility;
(4) Employee convenience and equipment maintenance facilities; and
(5) Narrative descriptions and associated drawings indicating facility development and operating procedures.

**Step 5**

These post land-use plans should include, but are not necessarily limited to, the establishment of:

(1) Maintenance programs for the closed facility;
(2) Monitoring and control programs for decomposition gases and leachate;
(3) Safeguards for the integrity of the final cover or cap material should cultivation activities be conducted atop the site; and
(4) Restrictions against construction of "major" structures atop the land disposal unit. EPA does not encourage such construction. However, if such structures are contemplated, a professional engineer should approve their design and construction and include provisions for protection against potential hazards associated with solid waste decomposition gases.

[NOTE: The regulations do not provide a definition of the term "major" in reference to structure size.]

These plans are designed to protect the integrity of the final cover. If cultivation is intended for the future, a sufficient depth of cover material to allow cultivation and to support vegetation should be applied in addition to that recommended for the final cover.

**Step 6**

The recommendations given in the regulations are by no means intended to be comprehensive or exhaustive in nature. The specifics required by these plans will vary from State to State but should present, in extensive detail, all aspects of the design, development and operation of the unit. Close consultation with the responsible agency and contracting with a reputable and experienced professional engineer familiar with solid waste issues will be invaluable in successfully completing this portion of the overall development process.

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## 3.5 Module 3D: Water Quality

### 3.5.1 Introduction

The location, design, construction, and operation of the solid waste landfill unit must conform to applicable water quality standards established under provisions of the Federal Water Pollution Control Act, (otherwise known as the Clean Water Act). This requirement includes all current and future amendments to the Act. The Oak Ridge Office of Scientific and Technical Information periodically publishes a compilation of all of the recent environmental laws and regulations, including the Clean Water Act (CWA).

In addition to the requirements pertaining to the CWA, aquifers, wells, and other water resources in the facility's zone of influence must be identified.

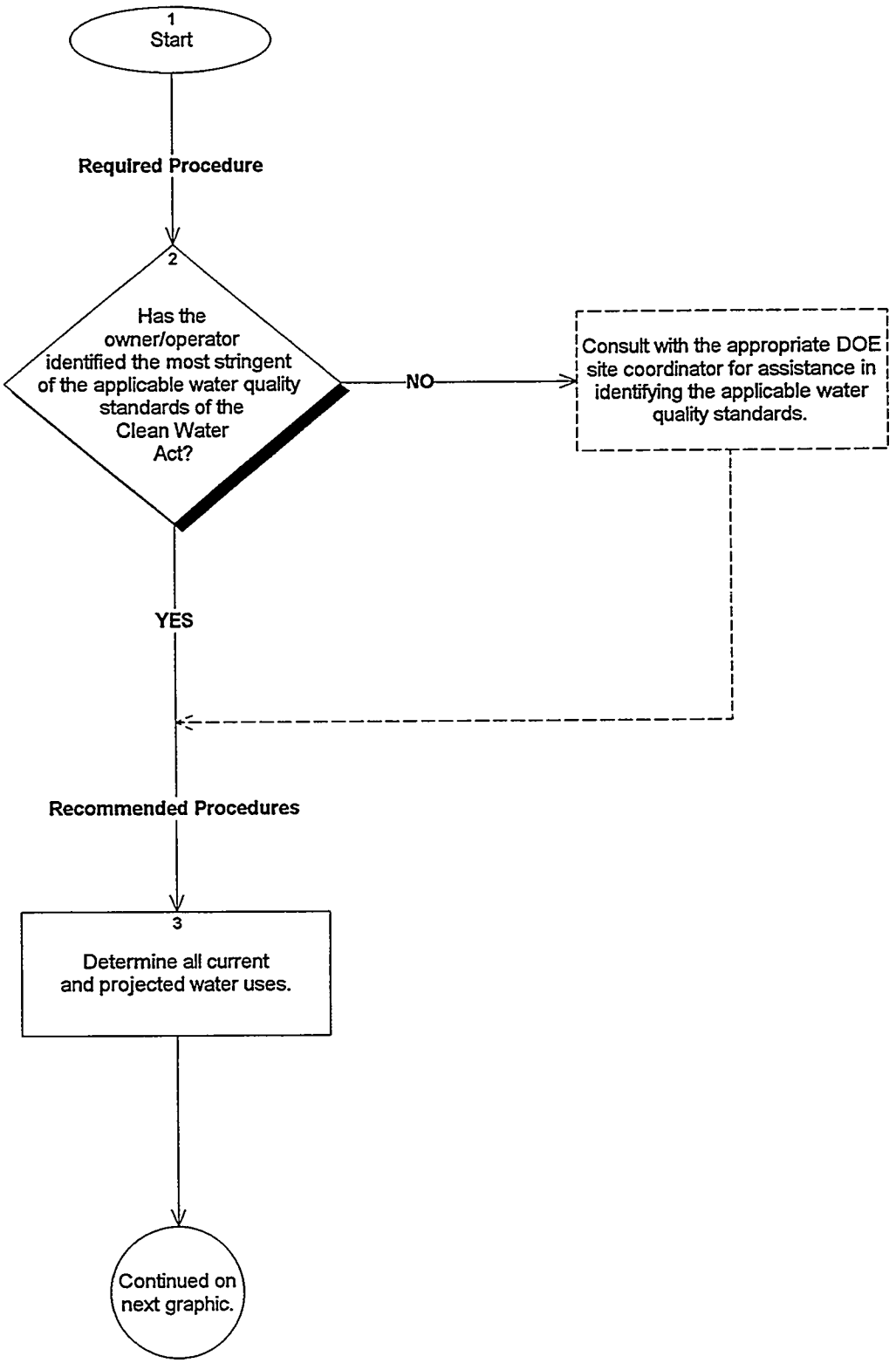
### 3.5.2 Milestones

***Have all of the applicable Clean Water Act regulations been identified and met?***

Applicable Clean Water Act regulations may include:

- NPDES permit requirements; and
- Stormwater discharge permit requirements.

# Figure 3D: Water Quality



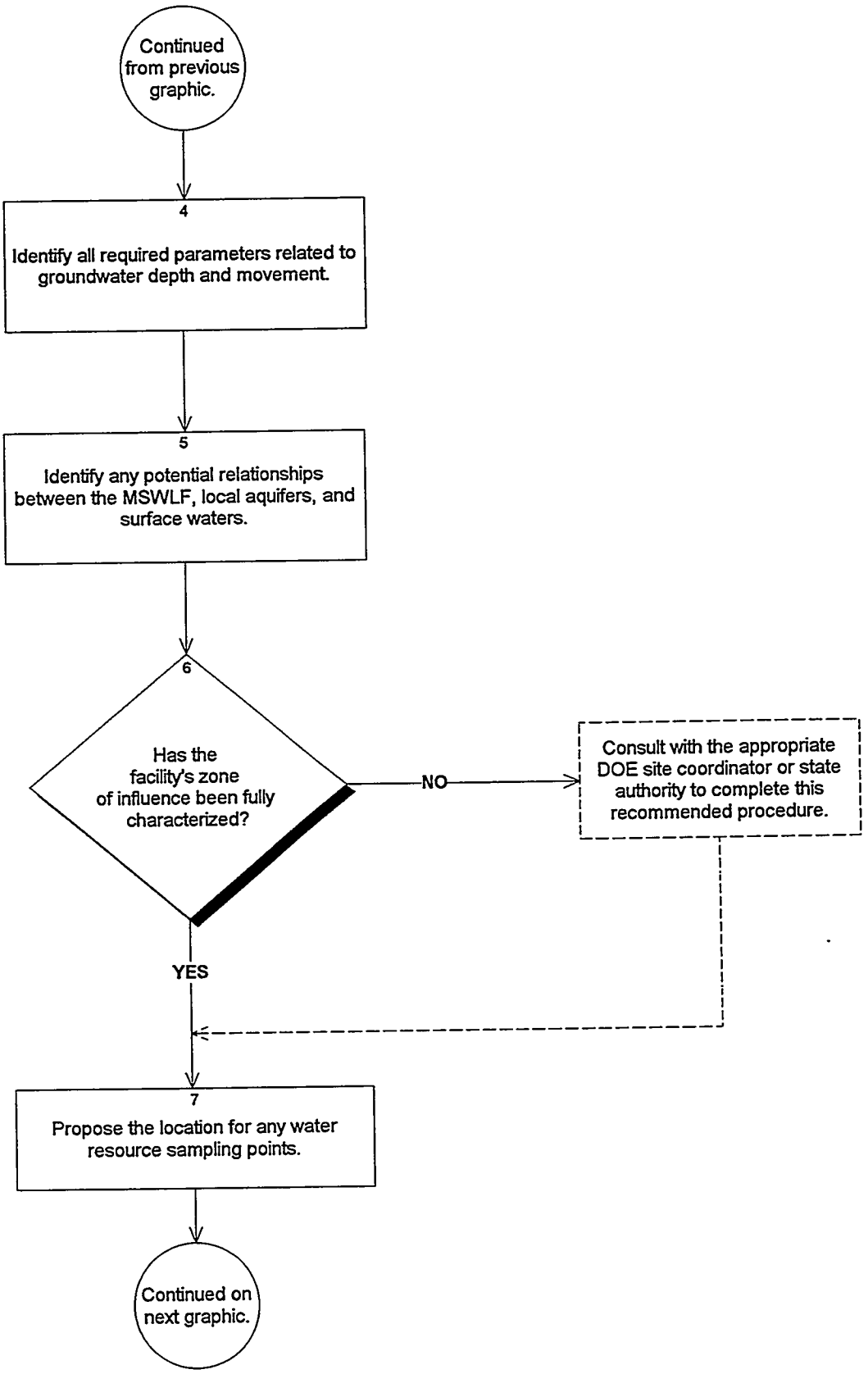
**Step 1** Start.

## A. REQUIRED PROCEDURES

**Step 2** The location, design, construction, and operation of a land disposal unit shall conform to the most stringent of applicable water quality standards established under provisions of the CWA. In the absence of such standards, the facility must provide adequate protection to ground and surface waters used for drinking water supplies. This mandate requires that all applicable discharge permit requirements and applicable water quality and effluent standards be met in all cases where water quality is potentially impacted by the operation of the site. In addition, other applicable safeguards (including the use of liners, leachate collection systems, and monitoring wells) must be employed to protect and adequately monitor surface and subsurface waters used for potable purposes.

## B. RECOMMENDED PROCEDURES

**Step 3** Plans for the site should identify the current and projected use of water resources in the potential zone of influence of the land disposal facility.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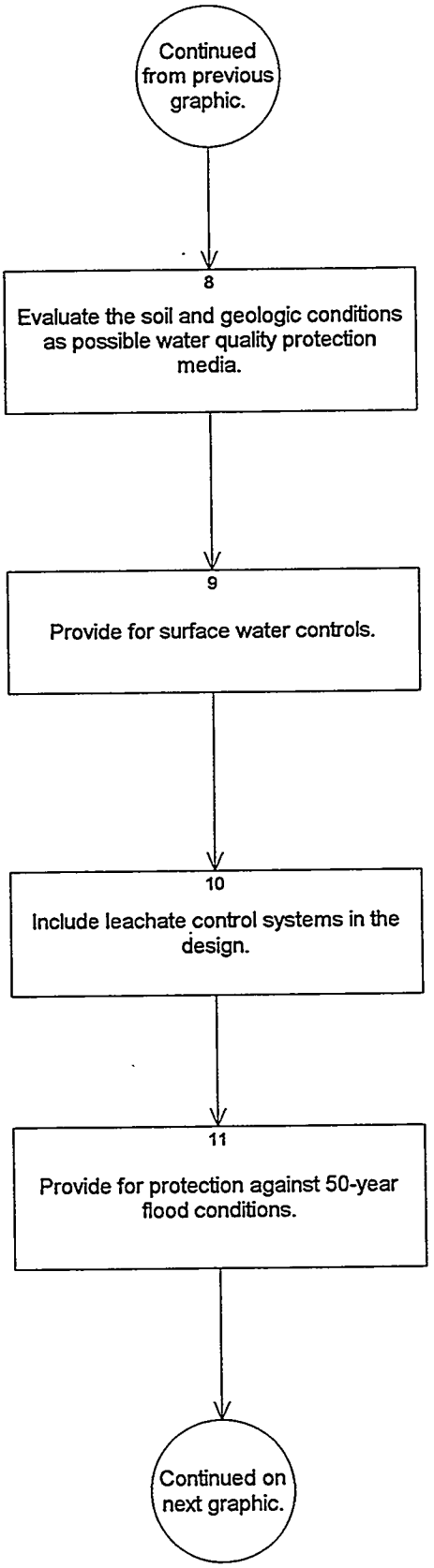
4
Identify all required parameters related to groundwater depth and movement.
5
Identify any potential relationships between the MSWLF, local aquifers, and surface waters.
6
Has the facility's zone of influence been fully characterized?
NO
Consult with the appropriate DOE site coordinator or state authority to complete this recommended procedure.
YES
7
Propose the location for any water resource sampling points.
Continued on next graphic.

**Step 4** Identify the groundwater depth and movement as well as the proposed distance between the lowest point of the land disposal unit and the maximum water table elevation.

**Step 5** Conduct an historical evaluation of local aquifers and surface waters, and determine their potential relationship with the disposal unit.

**Step 6** Characterize the initial quality of water resources in the facility's zone of influence.

**Step 7** The owner/operator must propose the location of any wells and sampling stations needed to monitor the MSWLF's water resources in compliance with the requirements of 40 CFR Part 258, Subpart E, Ground-water Monitoring and Corrective Action.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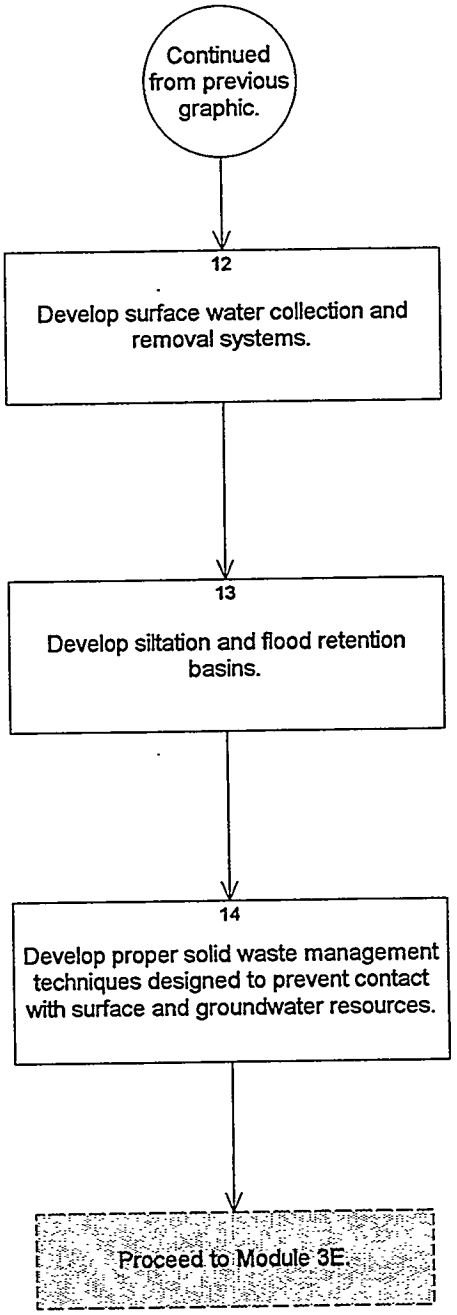
8
Evaluate the soil and geologic conditions as possible water quality protection media.
9
Provide for surface water controls.
10
Include leachate control systems in the design.
11
Provide for protection against 50-year flood conditions.
Continued on next graphic.

**Step 8** Describe the soil and other geologic material to a depth adequate to allow for evaluation of the water quality protection provided by the soil and other geologic material.

**Step 9** Provide for surface water runoff controls that may include: ponds, drains, and catchment basins.

**Step 10** Propose leachate control systems designed to protect surface and groundwater resources.

**Step 11** If the land disposal facility is located in the flood plain, it should be protected against at least the 50-year design flood by a dike. The potential for erosion and wash out of wastes buried within the unit may pose a serious threat to the public health and welfare and therefore should be guarded against. Avoidance of low-lying or floodplain locations is preferable if several location options are available.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12
Develop surface water collection and removal systems.
13
Develop siltation and flood retention basins.
14
Develop proper solid waste management techniques designed to prevent contact with surface and groundwater resources.
Proceed to Module 3E.

**Step 12** Divert surface water courses and runoff away from the land disposal unit through the use of trenches, conduits, and proper grading. The overall surface of the unit itself should be constructed so that during its active life, as well as after completion, it promotes rapid runoff without excessive erosion.

**Step 13** Use siltation or retention basins or other approved methods to guard against excessive siltation or flooding problems in nearby streams.

**Step 14** Manage all solid wastes and any derived leachates properly so that they are not allowed to contact or impair in any way the use of ground and surface water resources.

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## 3.6 Module 3E: Air Quality

### 3.6.1 Introduction

The design, construction, and operation of a solid waste landfill must conform to the applicable ambient air quality standards and source control regulations established under the Clean Air Act (CAA). This includes all current and future amendments to the Act.

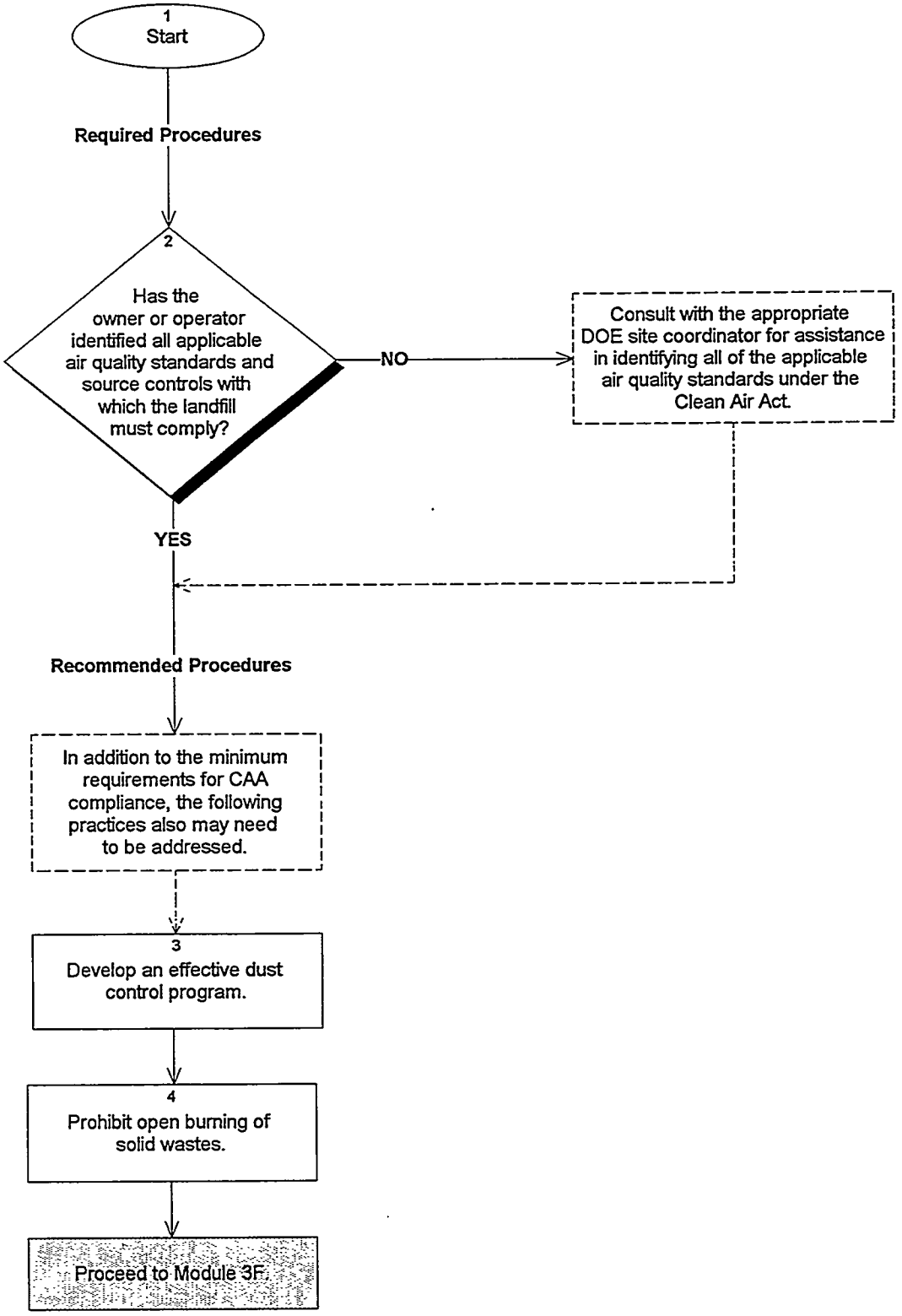
### 3.6.2 Milestones

***Have all applicable Clean Air Act regulations been identified?***

Applicable Clean Air Act regulations may include:

- Ambient air quality standards; and
- Source control regulations

# Figure 3E: Air Quality



**Step 1** Start.

## A. REQUIRED PROCEDURES

**Step 2** The design, construction, and operation of a land disposal facility shall conform to applicable ambient air quality standards and source control regulations established under the CAA, or State and local standards effective under the Act, if the latter are more stringent.

The owner or operator of the solid waste landfill must be aware of any changes to the applicable air quality standards, including those instituted by the enactment of amendments to the CAA.

## B. RECOMMENDED PROCEDURES

**Step 3** The specifics of the dust control program are to be incorporated into the planning documentation for the unit in question.

**Step 4** Open burning is defined as the burning of solid wastes in an uncontrolled or unconfined manner. Open burning is often already prohibited by many State regulations and local zoning ordinances.

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## 3.7 Module 3F: Gas Control

### 3.7.1 Introduction

Steps must be taken by owners and operators of landfills to ensure that gases (such as methane) generated by the decomposition of wastes on-site do not present a threat of explosion or inhalation toxicity to the public. This threat can be alleviated through the use of accepted design practices. Methane is an odorless, tasteless, colorless gas. It is also flammable when exposed to heat or flame.

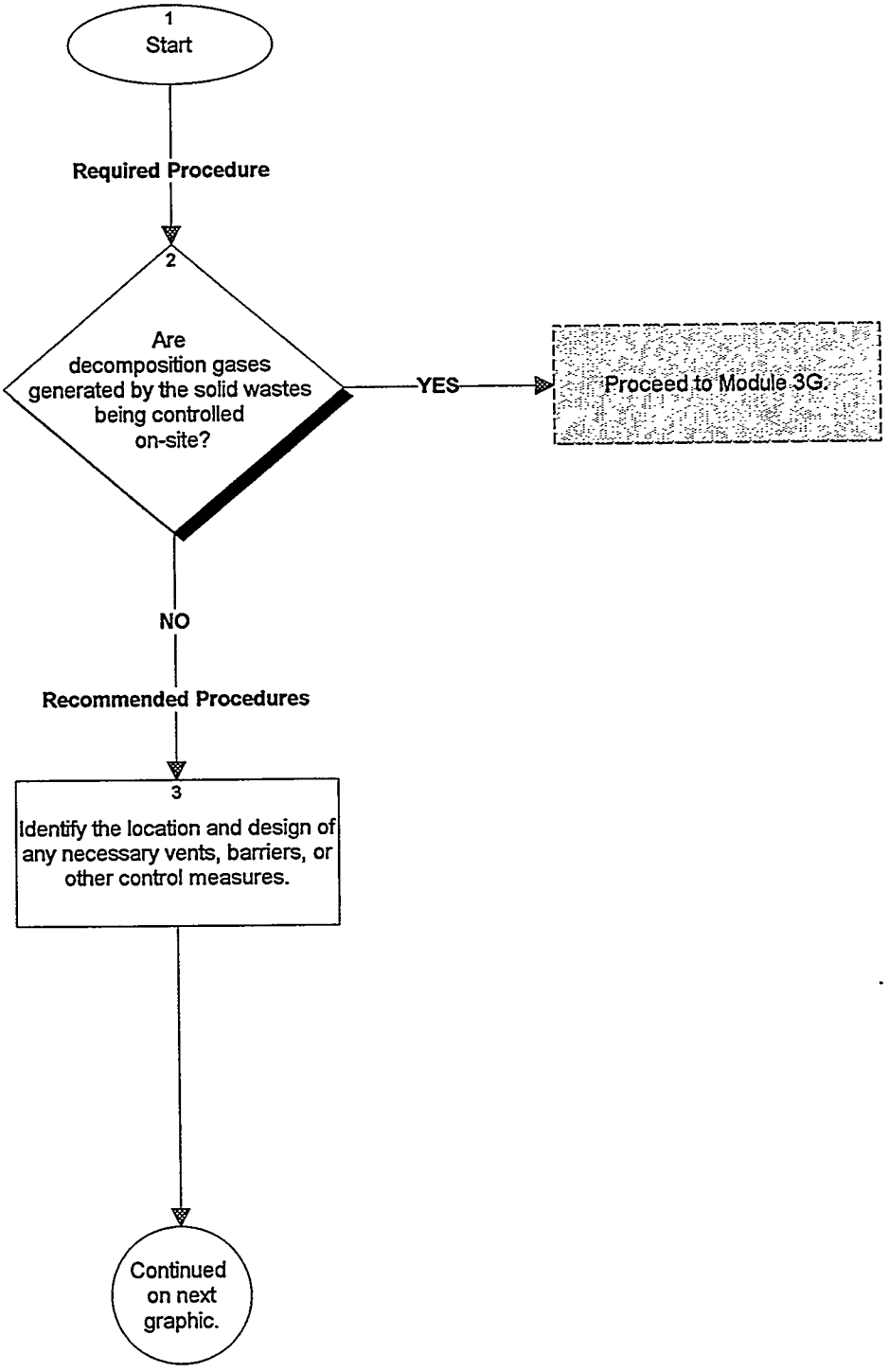
### 3.7.2 Milestones

***Have design features been chosen to alleviate the accumulation of toxic gases?***

These design features might include:

- Vents;
- Barriers; and
- Cutoff trenches.

# Figure 3F: Gas Control



**Step 1** Start.

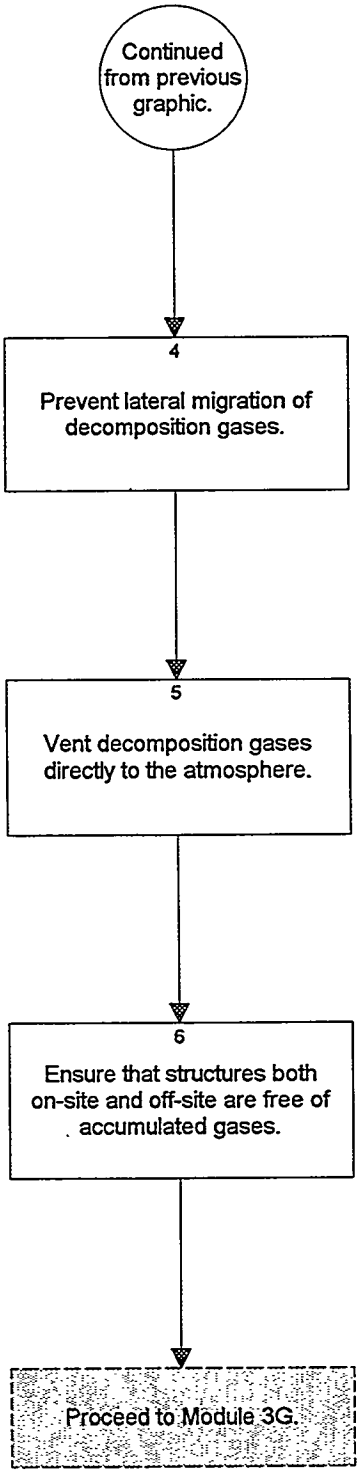
## A. REQUIRED PROCEDURES

**Step 2** Decomposition gases generated within the disposal unit must be controlled on-site to alleviate any potential threat to the public.

## B. RECOMMENDED PROCEDURES

**Step 3** Occupants of properties adjacent to the disposal unit might be exposed to explosive and/or toxic concentrations of gas(es). Similar threats to on-site personnel and disposal patrons also should be identified and evaluated.

The recommended design guidelines suggest that planning documents for the unit discuss the need for gas control and that the location and design of any necessary vents, barriers, or other control measures be identified.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4
Prevent lateral migration of decomposition gases.
5
Vent decomposition gases directly to the atmosphere.
6
Ensure that structures both on-site and off-site are free of accumulated gases.
Proceed to Module 3G.

**Step 4** Decomposition gases should not be allowed to migrate laterally from the unit, as such migration could lead to the endangerment of occupants of adjacent properties.

**Step 5** Decomposition gases should be vented directly to the atmosphere through the cover material, cutoff trenches, or ventilation systems.

**Step 6** Particular precautions should be taken to ensure that structures both on- and off-site are free of accumulated gases which may pose a threat of explosion or inhalation toxicity.

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## 3.8 Module 3G: Disease Vector Control and Site Aesthetics

### 3.8.1 Introduction

To discourage disease vectors from becoming established, the owner or operator of a landfill site must institute a control program. This program must be applied daily to discourage the establishment of rodents, birds, and insects. This program to control disease vectors can often be conducted simultaneously with some of the operating procedures instituted to maintain the sites' aesthetic value.

### 3.8.2 Milestones

***Have all disease vectors been identified and controlled?***

Disease vectors include:

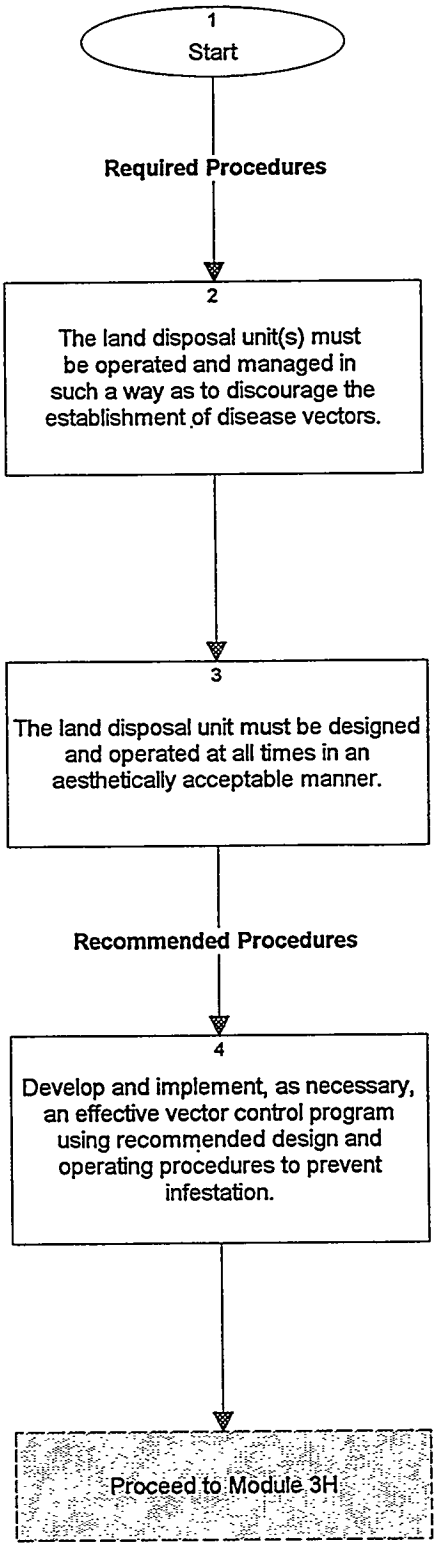
- Birds;
- Rodents; and
- Insects.

***Have steps been taken to protect the aesthetic value of the site?***

Such steps may include:

- Litter control; and
- Odor control.

# Figure 3G: Disease Vector Control and Site Aesthetics



**Step 1** Start.

## A. REQUIRED PROCEDURES

**Step 2** The primary vectors of concern to the owner/operator are insects, rodents, birds, and to a lesser extent, large, scavenging mammals. Effective daily application of earthen cover materials and proper grading to prevent ponding of precipitation should prevent most vector threats from establishing themselves within the unit. Where such cover and grading procedures fail to discourage certain types of vectors (particularly burrowing rodents), additional vector control programs will need to be implemented.

**Step 3** The land disposal unit must be designed and operated in such a manner as to make it as aesthetically appealing as possible. At a minimum, the owner/operator should assure that the unit be operated in an organized, efficient manner that presents some sense of order and control. Some recommended actions that can be taken include:

(1) Directing incoming wastes to specific, focused areas for disposal;
(2) Application of cover materials to control the spread of wind-borne litter;
(3) Prohibiting scavenging of materials; and
(4) Landscaping techniques.

Examples of landscaping techniques include: contouring of final cover materials to conform to surrounding or previously existing topography. Also, existing natural vegetation, both within the site as well as around its perimeter, should be preserved, maintained, and improved as a means of disrupting the wind and to provide a visual screen for disposal operations. Additional plantings should also be considered to screen areas that are readily visible to nearby residents or roadways. This vegetative cover can also minimize dust generated by vehicular traffic and breaking of new ground.

## B. RECOMMENDED PROCEDURES

**Step 4** An effective, easily implemented vector control program(s) should be developed and included in the site's operational plans. For example, a litter control program can reduce the number and proliferation of disease vectors at a landfill and improve the aesthetics of a site. Vector control programs will vary depending on the type of vector and may not automatically require killing the animal(s). This is particularly the case when birds or large mammals pose an infestation problem. Use of noise-making devices or perimeter fencing might act as a deterrent to such animals. More drastic measures should be implemented where more significant problems arise, especially as it applies to insect or rodent vectors.

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## 3.9 Module 3H: Cover Material and Compaction

### 3.9.1 Introduction

The application of cover material to a sufficient depth and with sufficient frequency is vital to the site's control of blowing litter, disease vectors, and odors.

Compaction is important not only to reduce the volume of wastes being disposed of in the landfill, but also to secure the cover material after it has been applied. The process of compaction conserves available disposal capacity. It also preserves land resources and minimizes moisture infiltration and settling, thereby helping to alleviate or moderate future costs associated with maintaining the unit once it has closed.

### 3.9.2 Milestones

***Does the cover material application plan meet all of the applicable requirements?***

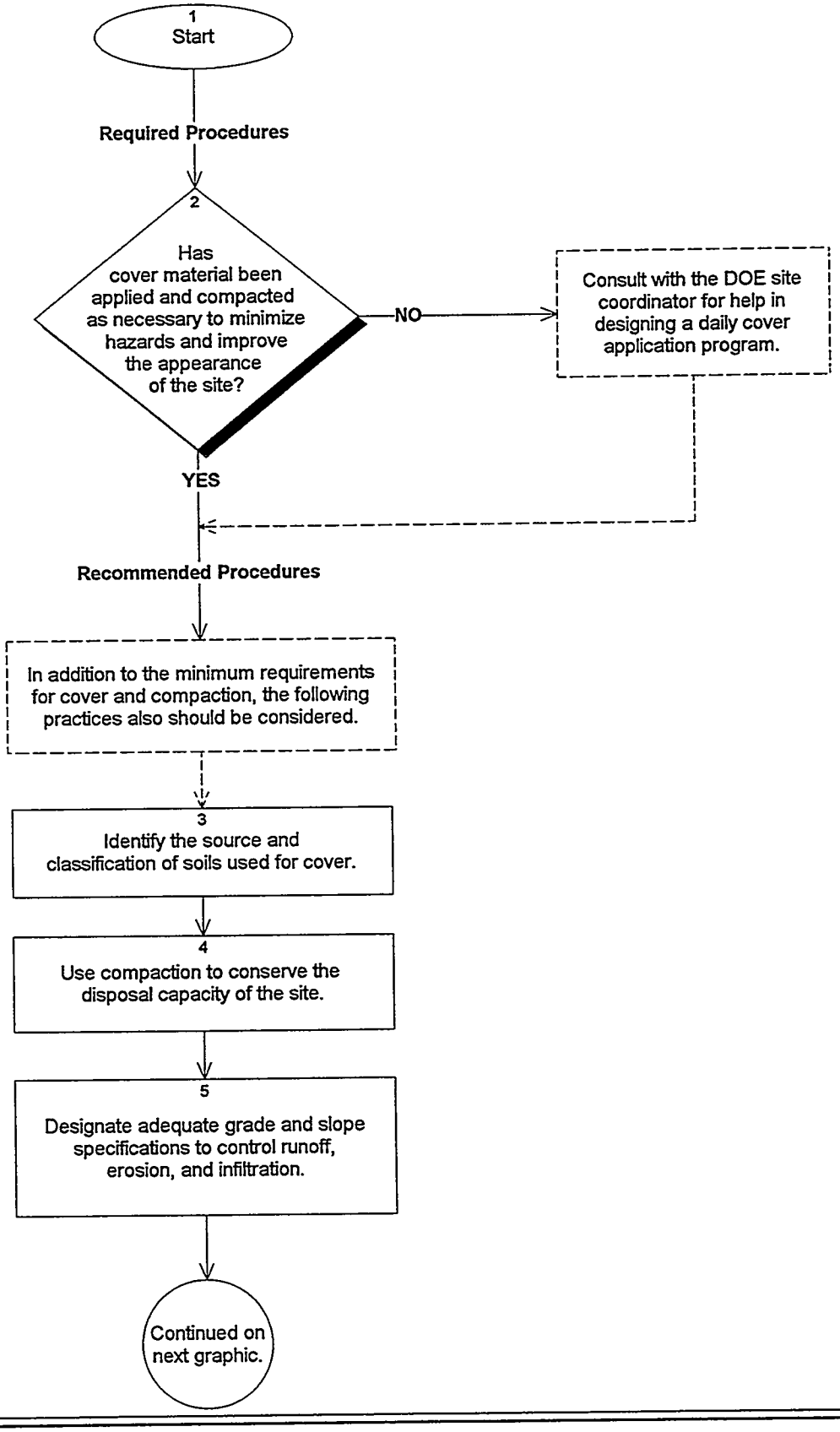
There are three categories of cover material that should be applied to a landfill site. These are:

- Daily cover;
- Intermediate cover; and
- Final cover.

There are three basic elements which are needed to ensure the effective daily compaction of wastes and cover materials. They are:

- Procurement and maintenance of suitable equipment;
- Employee training in the use of the equipment; and
- Placement of the waste in layers no more than two feet thick and confined to the smallest possible area.

# Figure 3H: Cover Material and Compaction



**Step 1** Start.

## A. REQUIRED PROCEDURES

**Step 2** 40 CFR 241.209-1 requires that cover material be applied as necessary (or in accordance with regulatory requirements) and compacted to minimize:

(1) Fire hazards;
(2) Infiltration of precipitation;
(3) Odors;
(4) Blowing litter;
(5) Gas venting;
(6) Disease vectors; and
(7) Scavenging.

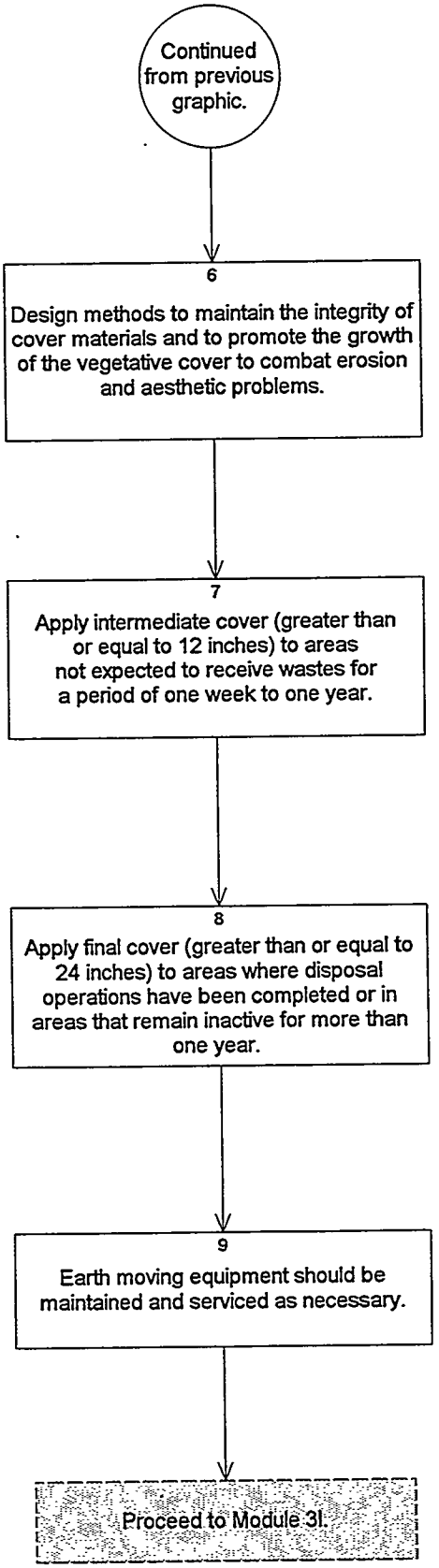
No specific engineering specifications or physical qualities of the cover material are identified in the guidelines. However, it is assumed that materials having a reasonably impermeable nature that are not subject to excessive wind and water erosion are most desirable. This is especially important when application of the final cover is anticipated.

## B. RECOMMENDED PROCEDURES

**Step 3** The source and classification of soil (based on the Unified Soil Classification System or the U.S. Department of Agriculture Classification System) used as cover material should be specified.

**Step 4** In addition to conserving land disposal site capacity, compaction minimizes moisture infiltration and settlement. Solid waste and cover material should be compacted to the smallest practicable volume.

**Step 5** The unit's planning documents should detail grading and slope specifications needed to promote maximum runoff, inhibit excessive erosion, and minimize infiltration.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6
Design methods to maintain the integrity of cover materials and to promote the growth of the vegetative cover to combat erosion and aesthetic problems.
7
Apply intermediate cover (greater than or equal to 12 inches) to areas not expected to receive wastes for a period of one week to one year.
8
Apply final cover (greater than or equal to 24 inches) to areas where disposal operations have been completed or in areas that remain inactive for more than one year.
9
Earth moving equipment should be maintained and serviced as necessary.
Proceed to Module 3I.

**Step 6** Procedures to be employed in maintaining the integrity of cover materials and promoting prompt growth of a vegetative cover to combat erosion and improve the outward appearance of idle or completed areas should be developed and placed in the unit's planning documents. This could include re-grading, re-covering, compacting, and re-seeding activities. Other relevant or pertinent requirements that uniquely affect a given land disposal unit should also be identified in the plans. These might include specific permeability rates or compaction specifications that are designed to insure the integrity of the unit in years to come.

Daily cover should be applied every day the unit accepts waste material, no matter the weather conditions. Therefore, access and availability of suitable cover should be assured each operational day. The thickness of the compacted soil to be applied to the daily volume of waste received should be no less than six inches. The waste itself should be spread in layers not more than two feet thick, confined, and compacted into the smallest possible area (several such compacted layers will form a cell). States may approve an alternative daily cover.

**Step 7** Intermediate cover. This type of cover is intended to be applied to those areas that are not expected to receive additional quantities of solid waste for an extended period of time. Normally, this period would be considered to be anywhere from one week to one year. The thickness of the compacted soil to be applied to these idle areas should be no less than one foot.

**Step 8** Final cover. This type of cover should be applied to each area where land disposal activity has been completed or in areas that are to remain inactive for more than one year. The thickness of the compacted soil applied to these areas should be no less than two feet.

[NOTE: The depth of cover for each of the three categories presented above are commonly accepted landfilling practices and should be considered as minimum application (including compaction) rates. More stringent requirements issued by the responsible agency or requirements that are broader in scope must be observed in lieu of the recommendations presented in this guidance.]

**Step 9** The owner or operator should be able to provide:

(1) Substitute equipment to provide uninterrupted service during routine equipment maintenance periods or equipment break-downs;
(2) On-site maintenance facilities and expertise or contractual agreements with off-site service representatives capable of maintaining and servicing all equipment;
(3) Appropriate equipment manuals, catalogs, and spare parts (stored on-site) necessary for promptly servicing and maintaining all equipment; and
(4) A preventative maintenance program and manuals describing various tasks that must be performed during a typical shift (readily available to on-site personnel) to insure that equipment is properly used, maintained, and operated.

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## 3.10 Module 3I: Safety

### 3.10.1 Introduction

In addition to providing for the site's design, construction, operation, and closure, the owner or operator must provide for the health and safety of all of the site's employees and patrons. This module explains all of those requirements and recommended procedures. Implementation of a safety program in a potentially dangerous environment like a land disposal unit is critical if injury and damage to personnel, patrons, and equipment is to be avoided.

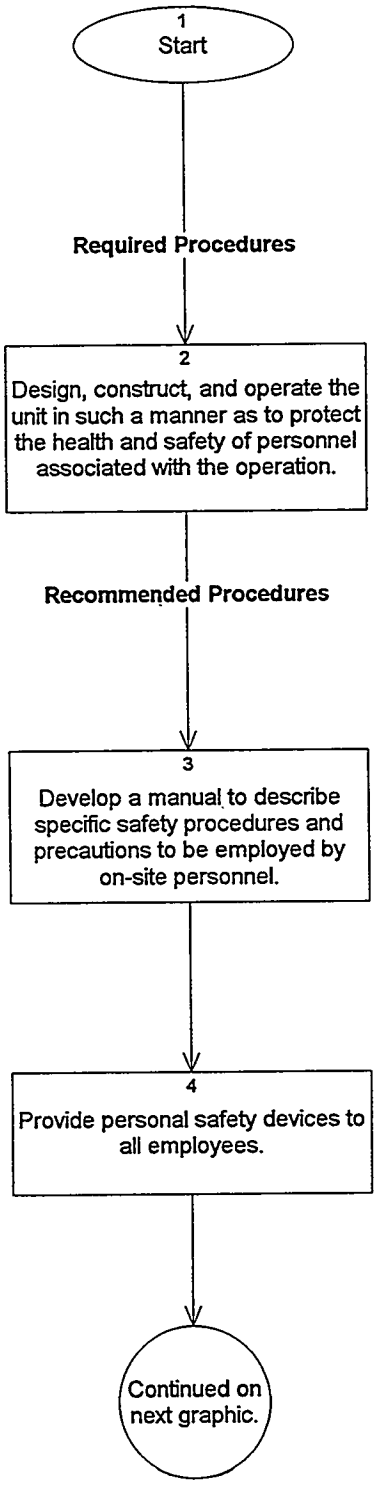
### 3.10.2 Milestones

***Is the site operated in a manner that protects the health and safety of all employees and patrons?***

The following steps should be implemented to protect the health and safety of employees and patrons:

- Provide employees with personnel safety devices;
- Provide safety devices on all spreading and compacting equipment;
- Provide communications equipment for use in emergencies;
- Control access to the facilities; and
- Control the flow of traffic on-site.

# Figure 3I: Safety



**Step 1** Start.

## A. REQUIRED PROCEDURES

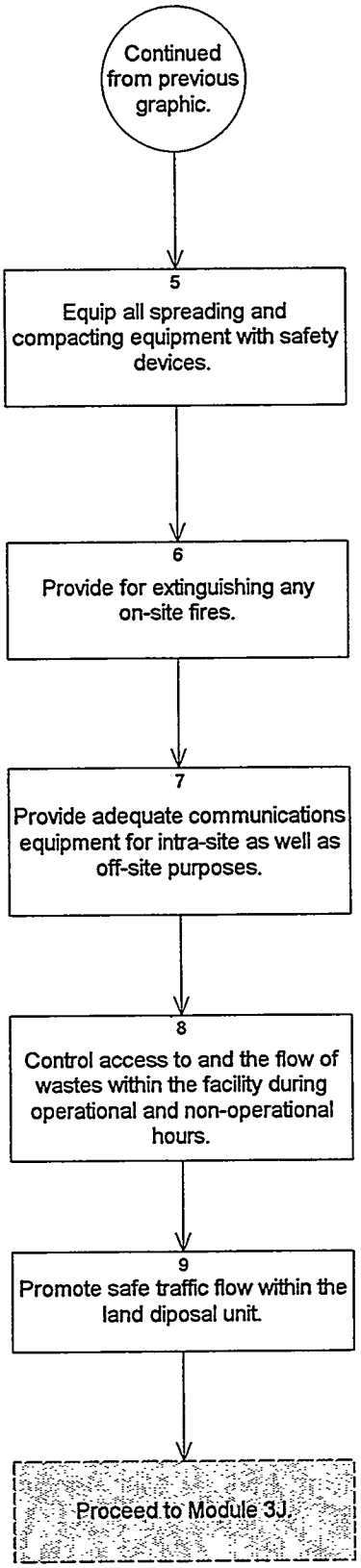
**Step 2** Land disposal units must be designed, constructed, and operated in such a manner as to protect the health and safety of personnel associated with the operation. The basis for developing these safety guidelines and requirements is provided by pertinent provisions of the Occupational Safety and Health Act of 1970 and any relevant regulations promulgated by Federal, State, or local regulatory agencies. In addition to the safety of on-site personnel, it is also the responsibility of the owner/operator to insure that patrons are safeguarded from potentially dangerous or life-threatening conditions.

## B. RECOMMENDED PROCEDURES

**Step 3** A manual should be developed to describe specific safety procedures and precautions to be employed by all on-site personnel. The manual should be written in such a way as to make it concise and readily understandable to all employees, regardless of educational background or experience. It should clearly demonstrate precautions and/or operational procedures that all employees are expected to know and be proficient in implementing, especially in emergency situations, to insure that the workplace constitutes a safe and secure environment. Copies of the safety manual should be made available to all employees, as should instructional training in the application of all procedures.

**Step 4** Personal safety devices should be provided to all employees. These devices may include:

(1) Hardhats;
(2) Gloves;
(3) Safety glasses; and
(4) Proper footwear.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5
Equip all spreading and compacting equipment with safety devices.
6
Provide for extinguishing any on-site fires.
7
Provide adequate communications equipment for intra-site as well as off-site purposes.
8
Control access to and the flow of wastes within the facility during operational and non-operational hours.
9
Promote safe traffic flow within the land diposal unit.
Proceed to Module 3J.

**Step 5** Equip all waste and cover spreading and compacting equipment with safety devices. These devices should include, but are not limited to:

(1) Rollover protective structures (e.g., "roll-bars");
(2) Seatbelts;
(3) Audible reverse warning devices; and
(4) Fire extinguishers.

**Step 6** Provide for extinguishing any fires that may be kindled by wastes being brought on-site and which may occur at the working face, in vehicular equipment, or in on-site personnel facilities.

**Step 7** Provide adequate communications equipment for intra-site as well as off-site use. This is particularly important for identifying and supporting emergency situations.

**Step 8** Control access to the facility and the flow of wastes within the unit during operational and non-operational hours. This includes, but is not limited to establishing:

(1) Perimeter access points to allow for the delivery of wastes to the working face(s);
(2) Intra-site roadways to assure the safe and controlled delivery of wastes to the working face(s);
(3) A continuous presence of on-site personnel qualified to monitor and operate the unit during operating hours;
(4) Physical security measures and programs designed to deny access to the unit during non-operational hours;
(5) A drop-off facility at the unit's access gate(s) to allow patrons to properly dispose of waste materials during non-operational hours (these materials can then be disposed on the next day's working face or disposal cell); and
(6) Sanitary and litter control programs for the non-operational hours drop-off facility.

**Step 9** Promote orderly and safe traffic flow within the land disposal unit. This includes, but is not necessarily limited to:

(1) Providing traffic signs or signals to promote traffic flow;
(2) Maintaining an efficient system for off-loading of wastes at or on the working face;
(3) Insuring the prompt discharge of wastes from manual and mechanically discharging vehicles; and
(4) Monitoring patron safety while on-site.

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## 3.11 Module 3J: Recordkeeping

### 3.11.1 Introduction

The maintenance of complete records is vital to prove compliance with all of the requirements applicable to the design and operation of a solid waste landfill. These records should be checked on a periodic basis for completeness and accuracy.

The Guidelines for the Land Disposal of Solid Wastes (40 CFR Part 241) do not indicate how long records should be retained by the owner/operator, but it would be prudent to store all such data generated during the life of the unit until the responsible regulatory agency establishes the period of retention. Federal regulations promulgated pursuant to RCRA for Subtitle C facilities normally require a three-to five-year record retention period; a similar retention period for municipal (Subtitle D) wastes would also seem likely. Retention of records longer than specified by regulatory requirements is considered a prudent practice. In addition, under CERCLA Section 120(h)(3), transfers of real property from one party to another requires that a deed entry be made to alert the purchasing party that hazardous substances were stored, released, or disposed of on the property. Records concerning wastes accepted by the facility would aid in determining whether such a deed entry is necessary.

[NOTE: The reference to CERCLA Section 120(h)(3) was made because the owner/operator of a solid waste landfill may, under certain approved circumstances, need to accommodate RCRA hazardous wastes, infectious wastes, or flammable or volatile substances (see Module 3A).]

DOE facilities must also maintain accurate records to meet the reporting requirements of DOE Order 5400.1, General Environmental Protection Program.

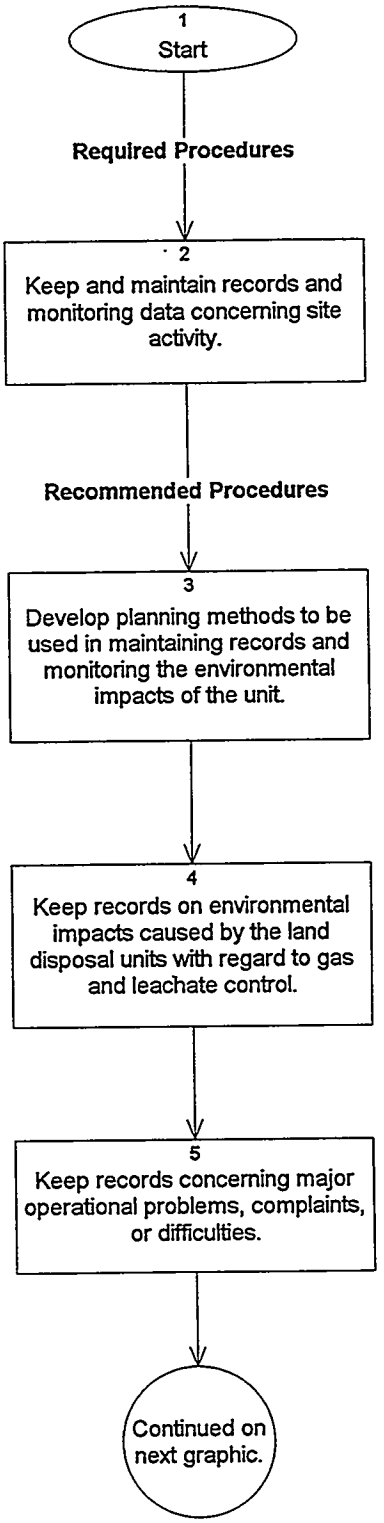
### 3.11.2 Milestones

***Have all of the recordkeeping requirements been met for activities conducted at the solid waste landfill?***

Records must be kept for all:

- Monitoring activities;
- Types of wastes received;
- Quantities of waste received; and
- Vector, dust, and litter control efforts.

# Figure 3J: Recordkeeping



**Step 1** Start.

### A. REQUIRED PROCEDURES

**Step 2** The owner/operator must keep and maintain records and monitoring data in the event that they need to be inspected and evaluated by the responsible agency.

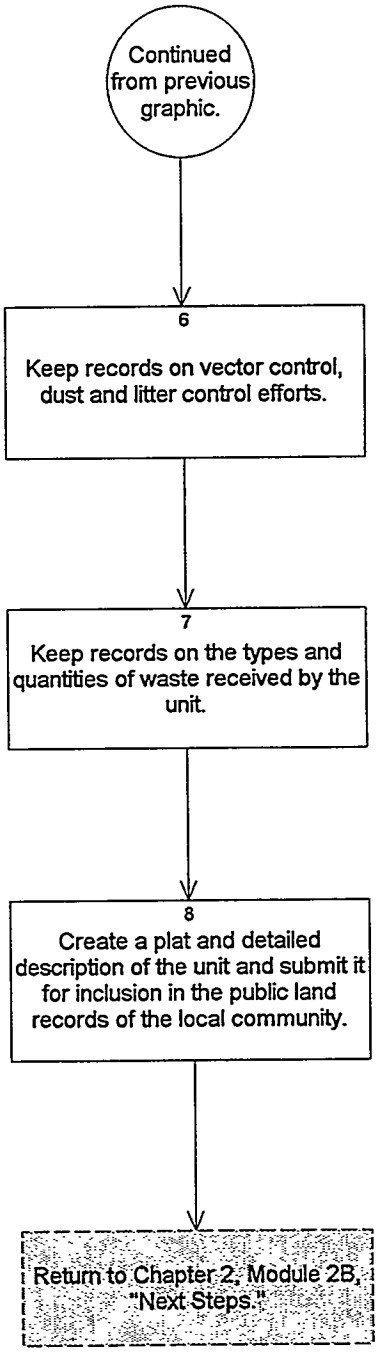
### B. RECOMMENDED PROCEDURES

**Step 3** Where appropriate, planning documents should prescribe methods to be used in maintaining records and monitoring the environmental impact of the unit. Specific information on recording and monitoring requirements should be obtained from the responsible agency.

**Step 4** These records should include both a qualitative and quantitative evaluation of the environmental impact of the land disposal site with regard to the effectiveness of gas and leachate control, including results of:

(1) Leachate sampling and analyses;
(2) Gas sampling and analyses; and
(3) Ground and surface water quality sampling and analyses upstream and downstream of the site.

**Step 5** Major operational problems, complaints, or difficulties should be recorded and kept in the operating record.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6
Keep records on vector control, dust and litter control efforts.
7
Keep records on the types and quantities of waste received by the unit.
8
Create a plat and detailed description of the unit and submit it for inclusion in the public land records of the local community.
Return to Chapter 2, Module 2B, "Next Steps."

**Step 6** Vector control efforts should be recorded and kept in the operating record. Dust and litter control efforts should also be recorded and kept in the operating record.

**Step 7** This information should be collected from routine or periodic scale readings or topographic surveys of the unit. The records should also contain a description of the types of solid wastes received at the unit, including the sources of these waste streams.

**Step 8** Upon closure of the unit, the owner/operator should create a plat of the unit and attach a detailed description of the unit's past history. This description should, at a minimum, indicate the general types of wastes disposed, where particular wastes have been buried or otherwise disposed, and the depth(s) of the unit. Other pertinent information that may be of use to future owners of the property or regulatory agencies should also be included in the document. The completed plat should then be taken to the local recording authority for inclusion in the public land records.

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# Chapter 4
# Evaluation Criteria for Non-Municipal Solid Waste Landfills

**Contents**

## 4.1 Introduction

### 4.1.1 Background

The criteria set forth in 40 CFR 257 address broad classes of health and environmental effects that may be caused by solid waste disposal activities. This regulation, promulgated on September 13, 1979 under the authority of Sections 1008(a) and 4004 of RCRA and Section 405(d) of the CWA, as amended, is composed of eight criteria structured to define unacceptable solid waste disposal practices and operating procedures. These minimum criteria were designed by EPA to be as specific as possible without sacrificing the necessary flexibility required by State and local solid waste management and enforcement agencies to implement the standards. Flexibility is key to implementing and enforcing these criteria because of the diverse nature and physical manifestations that solid waste disposal facilities may assume.

The enabling statutory language of the aforementioned RCRA and CWA sections require that solid waste facilities failing to comply with the criteria be found in violation of State solid waste management plans. Violations of State plans potentially subject a facility to enforcement actions by applicable State authorities. Those owners or operators whose facilities fail the criteria based on the two RCRA statutory sections will be considered to be operating an "open dump," an activity expressly prohibited under Subtitle D of the RCRA statute. Facilities that fail the criteria governing the application or incorporation of sewage sludges (to include septic tank pumpings) on or into lands owned or controlled by the facility will likewise be found in violation of CWA requirements and thus will be subject to potential enforcement actions and possible CWA permit revocation.

Unlike the previously discussed 40 CFR 241 "Guidelines for the Disposal of Solid Wastes," the criteria of 40 CFR 257 apply to the entire universe of solid waste disposal facilities, whereas the 40 CFR Part 241 regulations are mandatory only for Federal agencies and recommended for State, interstate, regional, and local government agencies for use in their activities.

Exceptions to the applicability clause of the 40 CFR 257 criteria are found in Section 257.1, which identifies specific types of disposal facilities and practices excepted from the regulation. These excepted solid waste facilities and practices include:

(1) MSWLF units, which are regulated under the criteria of 40 CFR 258 of RCRA;
(2) Agricultural wastes, including manures and crop residues returned to the soil as fertilizers or soil conditioners;
(3) Overburden from mining operations intended to be returned to the mine site;

(4) Land application of domestic sewage or treated domestic sewage. Disposal of sludges generated by the treatment of domestic sewage is, however, subject to the 40 CFR 257 criteria;
(5) Locating and operating septic tank systems. Disposal of sludges generated by septic systems is, however, subject to the 40 CFR 257 criteria;
(6) Point source industrial discharges which are subject to permits and permit conditions of Section 402 of the CWA, as amended;
(7) Source, special nuclear, or byproduct material as defined by the Atomic Energy Act, as amended (68 Stat. 923);
(8) Hazardous waste treatment, storage, and disposal facilities (TSDFs) which are subject to the regulatory requirements of Subtitle C of RCRA; and
(9) Solid wastes disposed by injection into underground injection wells which are subject to the regulations of the Underground Injection Control Program (40 CFR 146) of the Safe Drinking Water Act, as amended (42 U.S.C. 3007 et seq.).

DOE facilities that own/operate solid waste disposal facilities must comply with the criteria of 40 CFR 257 **and** the guidelines of 40 CFR 241, even though they appear in many cases to be duplicative or redundant in some instances. Special care should be taken, however, to accurately classify the type of disposal facility being operated. Those facilities deemed to be solely industrial or commercial units will need to comply with the 40 CFR 257/241 regulations. If the facility also receives household wastes, the recently promulgated and considerably more stringent criteria of 40 CFR 258 (for MSWLFs) will apply, in lieu of 40 CFR 257.

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## 4.2 Module 4A: Floodplains

### 4.2.1 Introduction

The impetus for developing the floodplain criterion rests in Executive Order 11988, "Floodplain Management" (42 *FR* 26951, 5/24/77), which requires that Federal agencies, in carrying out their responsibilities, take actions to: reduce the risk of flood loss; minimize the impact of floods on human safety, health, and welfare; and restore and preserve the natural and beneficial values served by floodplains. Neither Order 11988 nor the floodplain criterion identified in Step 2 preclude the development of new, or the extension of existing, solid waste disposal units within a floodplain. The order and regulations require only that those disposal activities conducted in a floodplain be protective of that environment and surrounding areas. Generally, it is considered good practice to locate disposal facilities outside of floodplains.

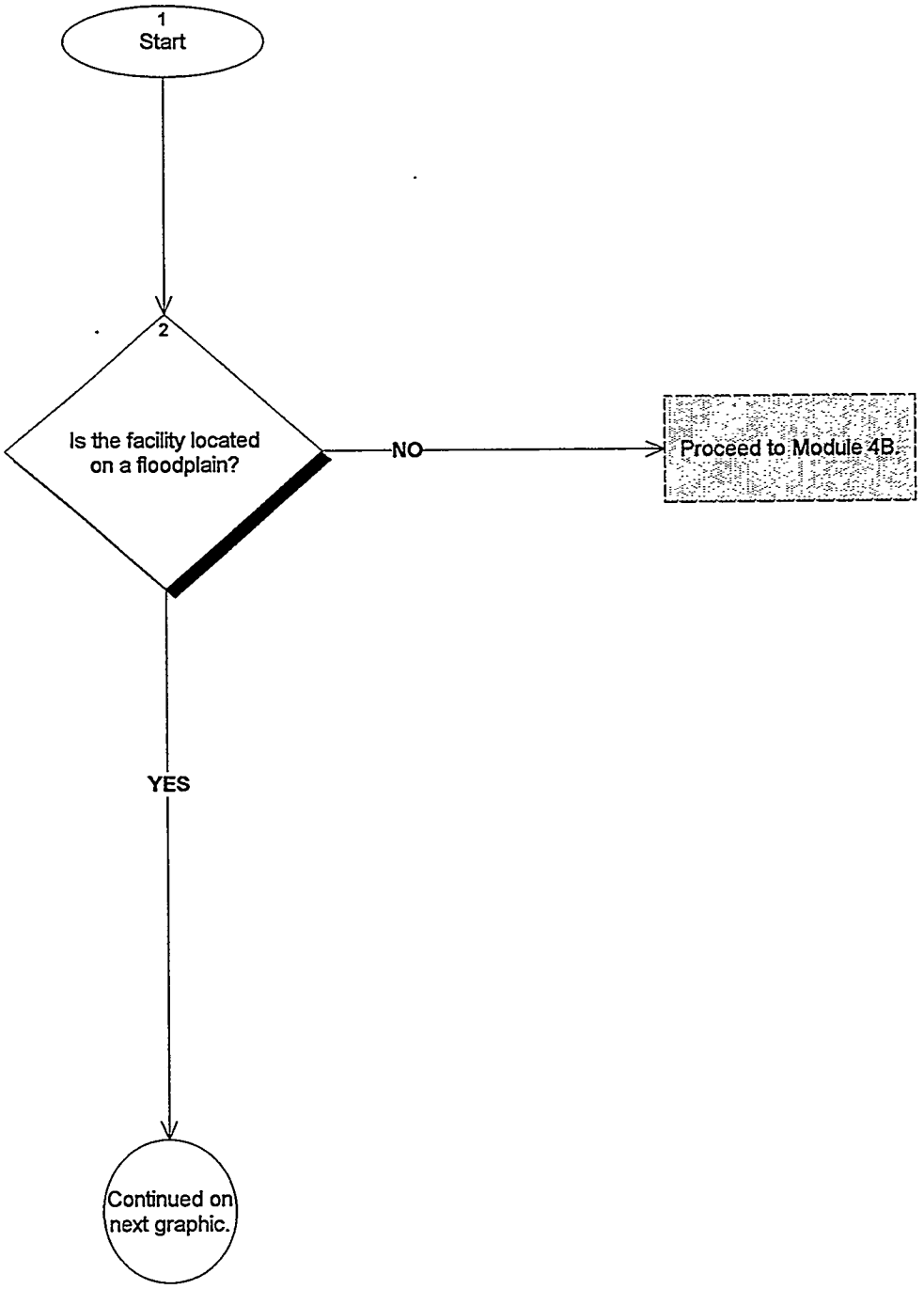
### 4.2.2 Milestones

***Have the owners/operators of the solid waste disposal facility demonstrated compliance with the applicable floodplain requirements?***

Facilities in floodplains must be able to demonstrate that they will not:

- Restrict the flow of the base flood; or
- Negatively impact the temporary storage capacity of the floodplain.

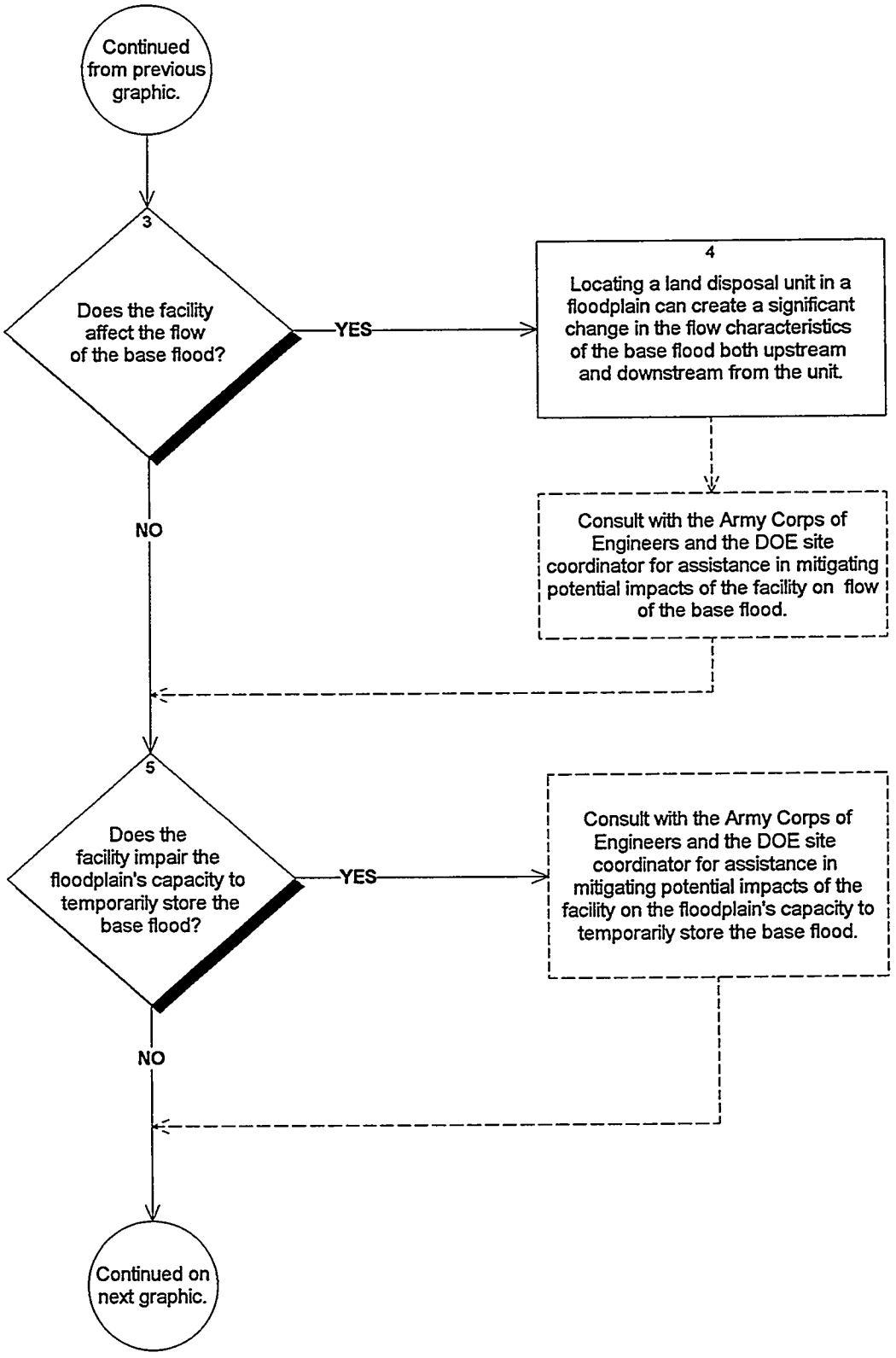
# Figure 4A: Floodplains



**Step 1** Start.

**Step 2** Facilities or practices in floodplains shall not restrict the flow of the base flood, reduce the temporary water storage capacity of the floodplain, or result in washout of solid waste so as to pose a hazard to human life, wildlife, or land or water resources.

This criterion applies to those land disposal facilities that are planned or are currently located in geographic areas designated as floodplains. Floodplains are "lowland and relatively flat areas adjoining inland and coastal waters, including flood-prone areas of offshore islands, which are inundated by the base flood." Because the definition of this term is broad and inexact, owners/operators of land disposal facilities should consult Flood Insurance Rate Maps (FIRMs) published by the Federal Emergency Management Agency (FEMA) for further location information concerning the lateral extent of floodplains.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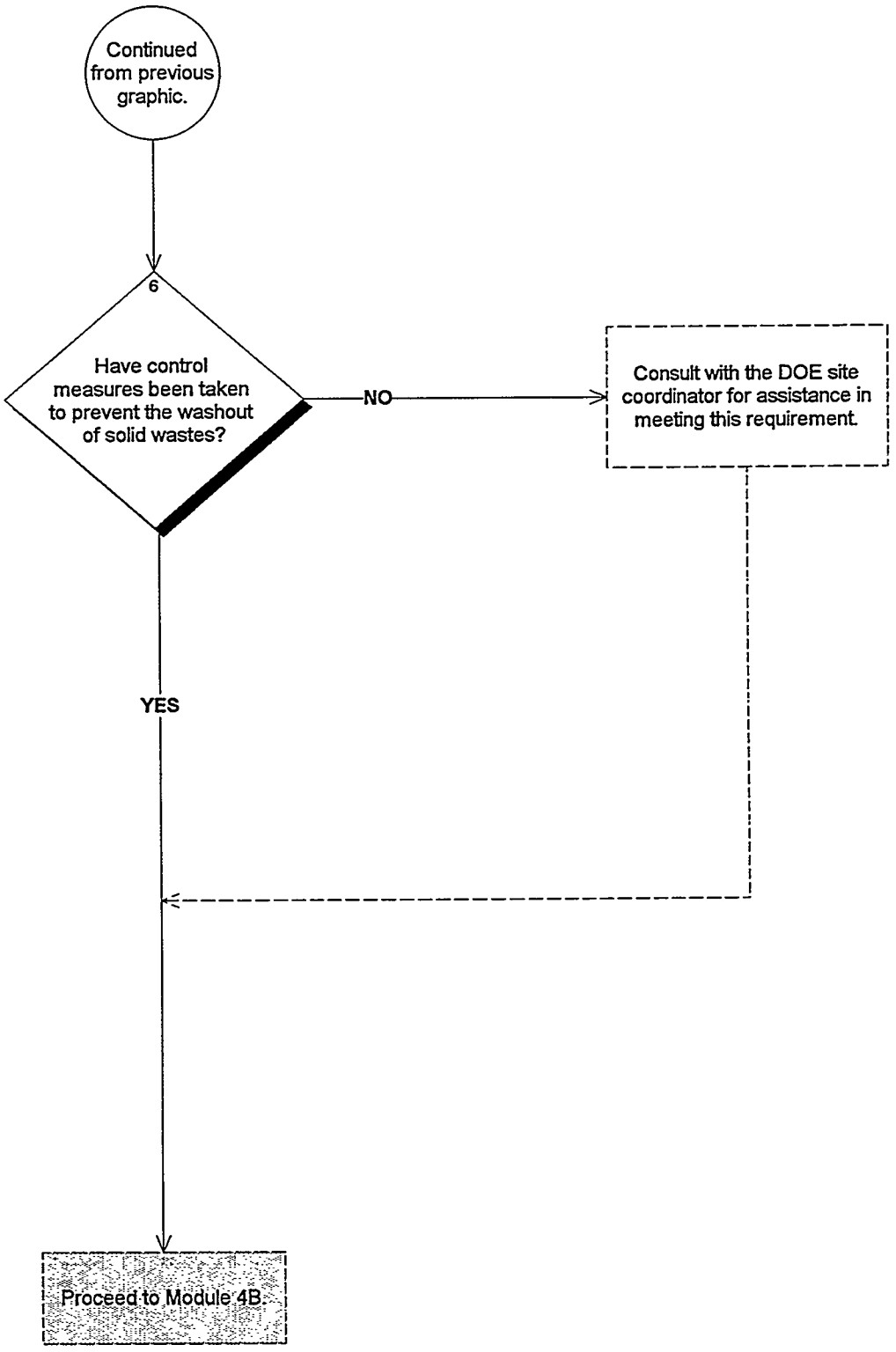
3
Does the facility affect the flow of the base flood?
YES
4
Locating a land disposal unit in a floodplain can create a significant change in the flow characteristics of the base flood both upstream and downstream from the unit.
Consult with the Army Corps of Engineers and the DOE site coordinator for assistance in mitigating potential impacts of the facility on flow of the base flood.
NO
5
Does the facility impair the floodplain's capacity to temporarily store the base flood?
YES
Consult with the Army Corps of Engineers and the DOE site coordinator for assistance in mitigating potential impacts of the facility on the floodplain's capacity to temporarily store the base flood.
NO
Continued on next graphic.

**Step 3** The base flood as defined by 40 CFR 257.3-1(b)(1) is a "flood that has a 1 percent or greater chance of recurring in any year, or a flood of a magnitude equalled or exceeded once in 100 years on the average over a significantly long period."

**Step 4** Removing a portion of the 100-year floodplain through filling or diking operations can produce significant hydraulic changes in the characteristics of the floodplain. The impact of such a change on the base flood will vary depending on the width, size of watershed, vegetative cover, and existing natural and manmade obstacles and structures present in, or associated with, the floodplain. The addition of a new structure (e.g., a land disposal unit) will generally result in upstream and downstream changes in the character of the floodwaters, generally resulting in higher flood levels, changes in flow dynamics ( i.e., increased erosion potential), and additional damage and danger to human and animal populations and the surrounding natural environment.

**Step 5** In addition to changes in the base flood's flow characteristics, a land disposal unit located in the 100-year floodplain can have a significant effect on the floodplain's ability to store floodwaters. During flood events, a floodplain temporarily stores excess waters that cannot be conducted by the main channel of the river or stream. In the case of a relatively narrow (bank to bank) floodplain, a land disposal unit that encroaches on the floodplain displaces some of this storage capacity. This displacement in turn creates further upstream flooding by raising the elevation (level) of the base flood, creating an enlarged or widened floodplain. The impounding effects of this increase in base flood elevation can have adverse impacts on other man-made features, human safety, and the natural environment. To alleviate such potential upstream flooding threats, it may be necessary to engineer compensatory storage capacity or to enhance flow characteristics for those periods when flooding may pose a hazard. New facilities that are to be located within the 100-year floodplain should be designed to compensate for the changes in the floodplain's carrying capacity. The potential consequences of these impacts must be considered in light of the individual setting of the unit in order to assess potential flood effects and alternative management techniques to be employed to minimize these threats.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6
Have control measures been taken to prevent the washout of solid wastes?
NO
Consult with the DOE site coordinator for assistance in meeting this requirement.
YES
Proceed to Module 4B

**Step 6** Land disposal facilities located on floodplains are potentially subject to washout by flooding. Washout is defined in 40 CFR 257.3-1(b) as the "carrying away of solid waste by water of the base flood." To prevent the exhumation of wastes, EPA recommends that proper control measures be taken where such a threat is likely. Engineered structures such as dikes or erosion control systems sufficient to avoid this problem are recommended; however, such structures do not necessarily have to prevent inundation of the waste unit.

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## 4.3 Module 4B: Endangered and Threatened Species

### 4.3.1 Background

General, conceptual requirements designed to mitigate the impact that disposal operations have on the well being and habitat of threatened or endangered species are presented in 40 CFR 257.3-2. Solid waste disposal activities can adversely affect endangered and threatened plants, fish, and wildlife by releasing toxic constituents into the environment and by disrupting the ecosystem in which such species live. The impetus for developing this criterion is found in Section 7 of the Endangered Species Act, as amended (16 U.S.C. 1536). Section 7 requires all Federal agencies, in consultation with the Secretary of the Interior or the Secretary of Commerce, to utilize their authorities in furtherance of the purposes of the Act. A complete listing of those threatened and endangered species that could potentially be jeopardized by human activities is found in 50 CFR Part 17.

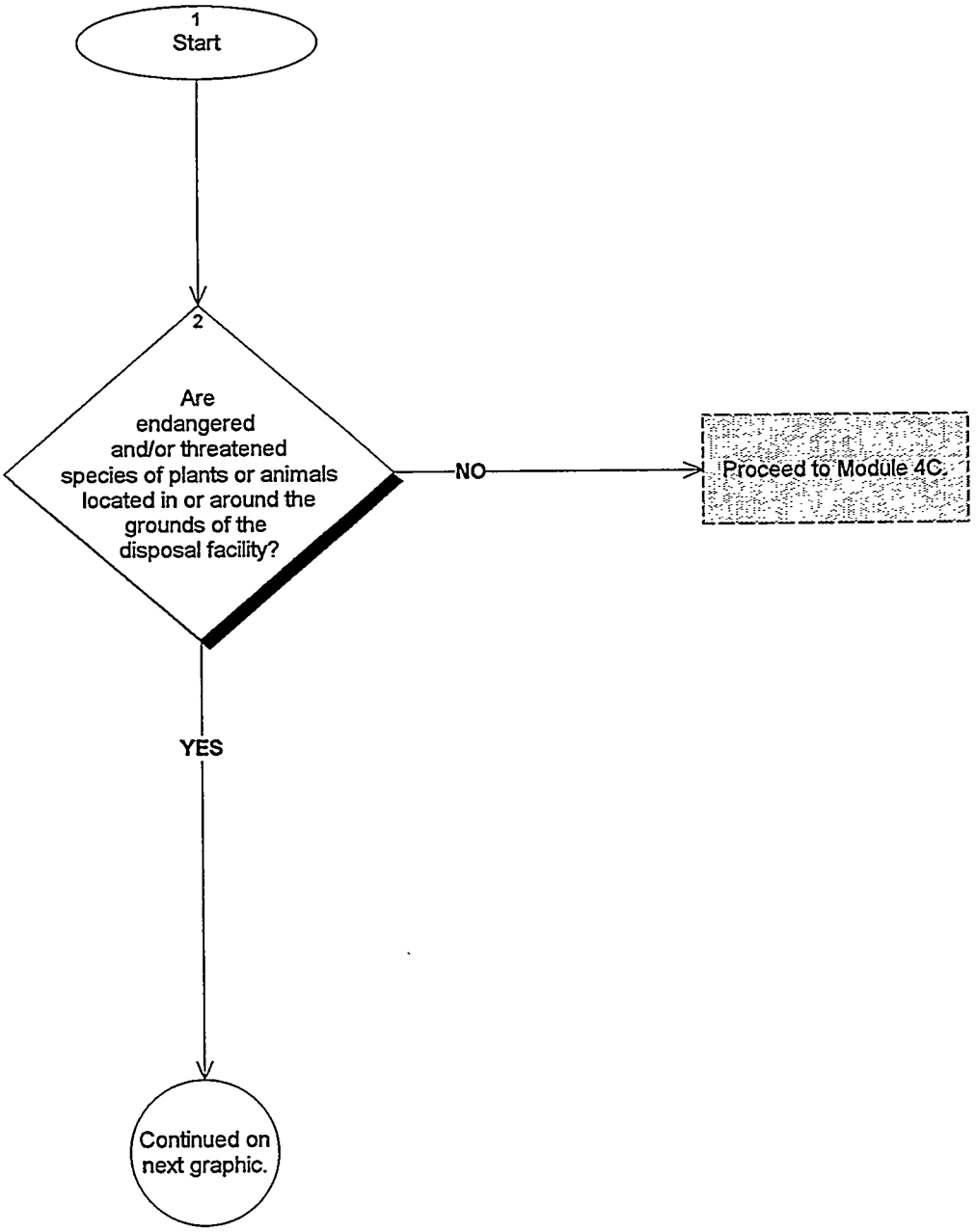
### 4.3.2 Milestones

***Have all appropriate steps been taken to protect endangered and threatened species?***

There are two basic steps that are appropriate for the protection of endangered or threatened species. These steps are:

- The taking of endangered or threatened species must be prevented; and
- The destruction or modification of critical habitats must also be prevented.

# Figure 4B: Endangered and Threatened Species



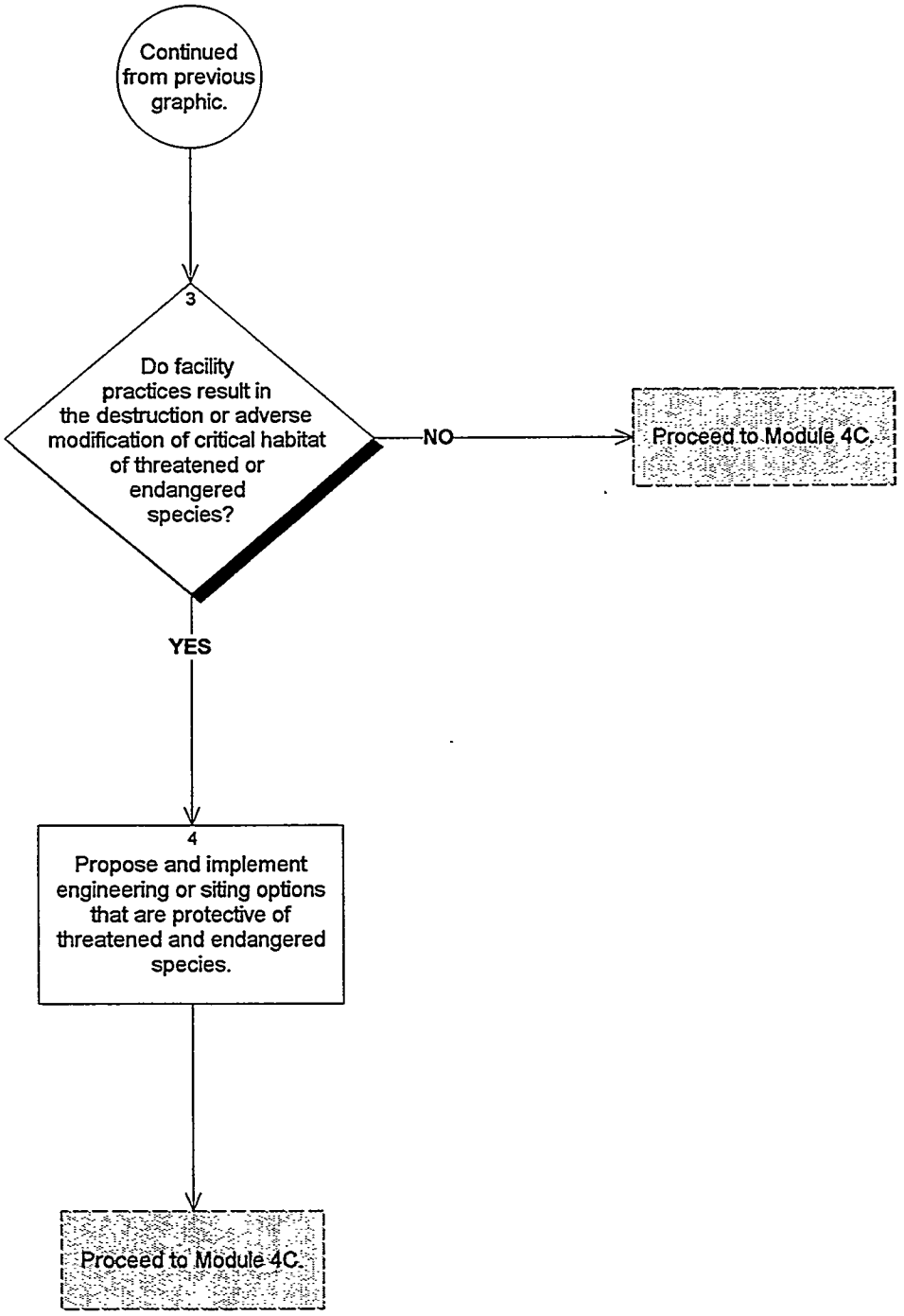
**Step 1** Start.

**Step 2** The endangered and threatened species performance criterion requires that:

(1) Facilities or practices shall not cause or contribute to the taking of any endangered or threatened species of plants, fish, or wildlife; and
(2) The facility or practice shall not result in the destruction or adverse modification of the critical habitat of endangered or threatened species as identified in 50 CFR Part 17.

This applies to land disposal facilities that occupy properties known or suspected of harboring species of plant and animal life that are threatened or endangered.

Owner/operators of land disposal units should undertake a survey(s) of local flora and fauna to determine whether such species are present. In the event endangered or threatened species of fauna or flora are identified, an assessment of facility practices should be undertaken to establish whether the taking of such lifeforms results from these practices. Taking, as defined in 40 CFR 257.3-2(c), is a broadly stated term that encompasses a variety of actions including: harassing, harming, pursuing, hunting, wounding, killing, trapping, capturing, or collecting or attempting to engage in such conduct. Solid waste disposal units, while not intentionally designed or operated in such a manner as to pose a threat, can easily contribute to, or be responsible for the taking of threatened or endangered species. This is primarily due to the nature of the wastes the site accepts and modifications to the local environmental conditions. Owners/operators of planned or existing disposal units must therefore consider and implement management plans that will not cause or contribute to the taking of animal life. In the case of endangered or threatened flora, physical modifications to the facility, wholesale transplantation, or other appropriate safeguards must be taken to protect these types of species. The plans and options undertaken to ensure the safety and continued good health of such lifeforms will of course vary from site to site depending on the applicability of the criterion, the specific wildlife at issue, and the nature of the threat posed to that species. For that reason, EPA did not develop specific regulatory requirements for achieving a national standard of protection. Instead, EPA-designated officials charged with implementing the criterion as well as parties engaged in solid waste disposal activities will determine what is necessary and most effective in achieving compliance. [44 *FR* 53443, 9/13/79]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3
Do facility practices result in the destruction or adverse modification of critical habitat of threatened or endangered species?
NO
Proceed to Module 4C.
YES
4
Propose and implement engineering or siting options that are protective of threatened and endangered species.
Proceed to Module 4C.

**Step 3** Protection of critical habitat from destruction or adverse modification also plays an important role in assuring the continued safety and well being of threatened or endangered fauna and flora. The habitat protection requirement of 40 CFR 257.3-2(b) can be construed as a further strengthening of the taking prohibition in that critical habitat is essential for the well being of any species of wildlife. Section 257.3-2(c) defines destruction or adverse modification of habitat as the "direct or indirect alteration of critical habitat which appreciably diminishes the likelihood of the survival and recovery of threatened or endangered species using that habitat." Most land disposal activities by nature result in extensive modifications to the local environment. In setting this criterion for the protection of critical habitat, however, EPA did not preclude all disposal activities that might occur. The preamble language to the final 40 CFR Part 257 regulations (44 *FR* 53442, 9/13/79) notes that in consultation with the Department of Interior, EPA determined that only disposal activities that appreciably diminish the likelihood of the survival and recovery of threatened or endangered species using the habitat would be considered a violation of this criterion. Presumably, this decision is aimed at allowing other types of land use to occur in those areas where critical habitat(s) cover large areal expanses. Development of a land disposal unit therefore could occur without significantly impacting or threatening the habitat as a whole. The habitat would in essence be open to reasonable amounts of development, compatible with the stated goal of preserving the overall vigor and survival of the specie(s) in question.

The endangered and threatened species requirement of 40 CFR 257.3-2 does not apply to those land disposal facilities not located in areas that contain such species.

**Step 4** Propose and implement engineering or siting options for locating new or laterally expanding existing land disposal units that are protective of threatened or endangered species. Planning for the development of such units should be coordinated with responsible regulatory agencies implementing the Endangered Species Act to assure that such development does not violate the safeguards or prohibitions of the Act.

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## 4.4 Module 4C: Surface Water

### 4.4.1 Introduction

The implementation and enforcement of statutory and regulatory requirements of the CWA are not granted or intended to be administered under the provisions of RCRA. What is intended and expressly required by Section 1006 of RCRA is the integration, to the maximum extent practicable, of the provisions of RCRA with other statutory requirements such as the CWA. In the preamble discussion of this issue (44 *FR* 53444, 9/13/79), EPA stated its belief that the goals of restoring and maintaining the quality of the nation's water under the provisions of the CWA are legitimate objectives for the Agency's regulatory activity under RCRA. In view of this and in the spirit of Section 1006, EPA intends to use its authority to see that the goals of the CWA are achieved. Implementation of these CWA requirements, however, will be left to those regulatory entities responsible for those programs.

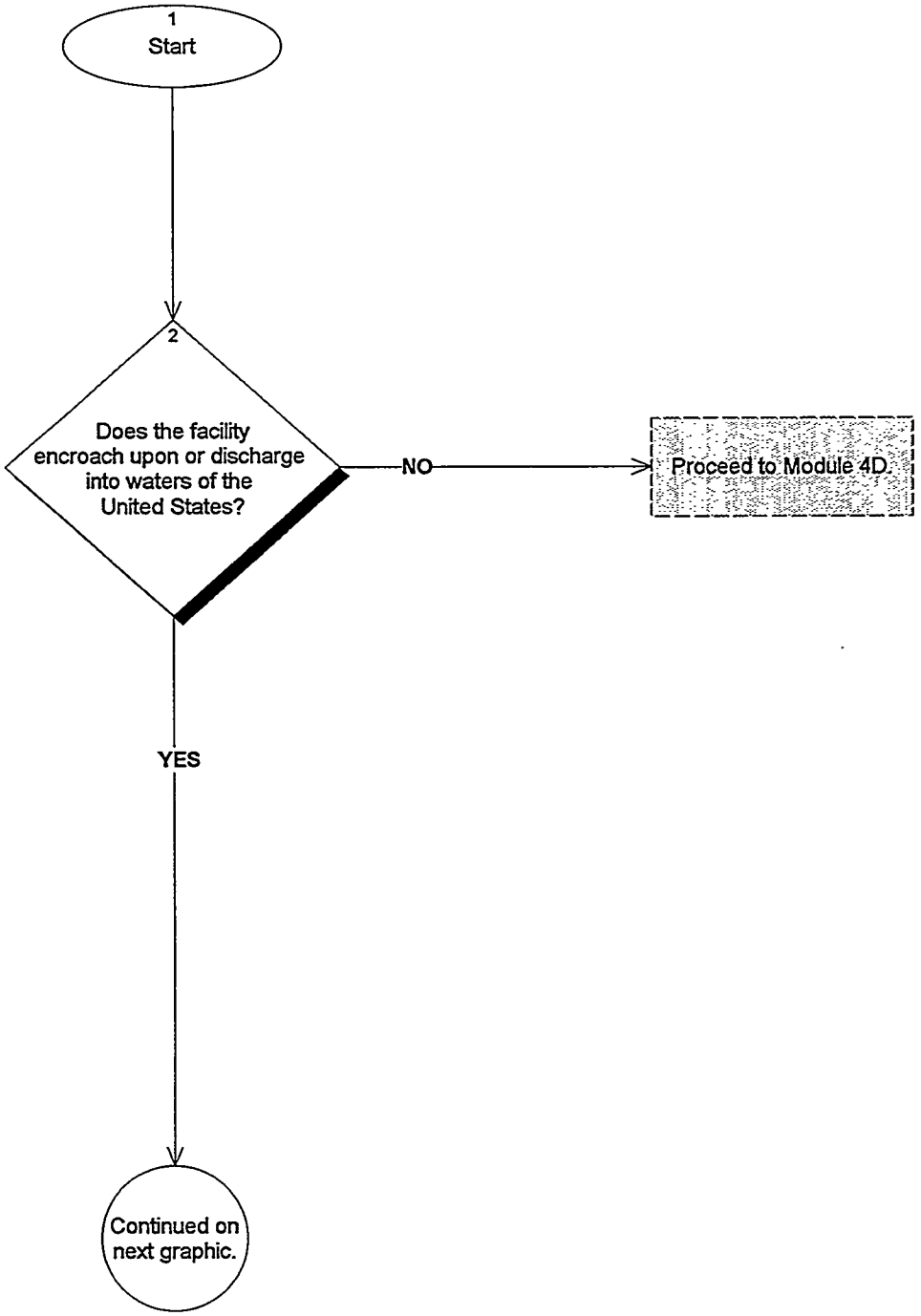
### 4.4.2 Milestones

***Is the surface water at the site being protected in compliance with the applicable CWA requirements?***

The applicable requirements are embodied in the:

- NPDES permit;
- Stormwater discharge permit; and
- Section 404 dredge and fill permit.

# Figure 4C: Surface Water



**Step 1** Start.

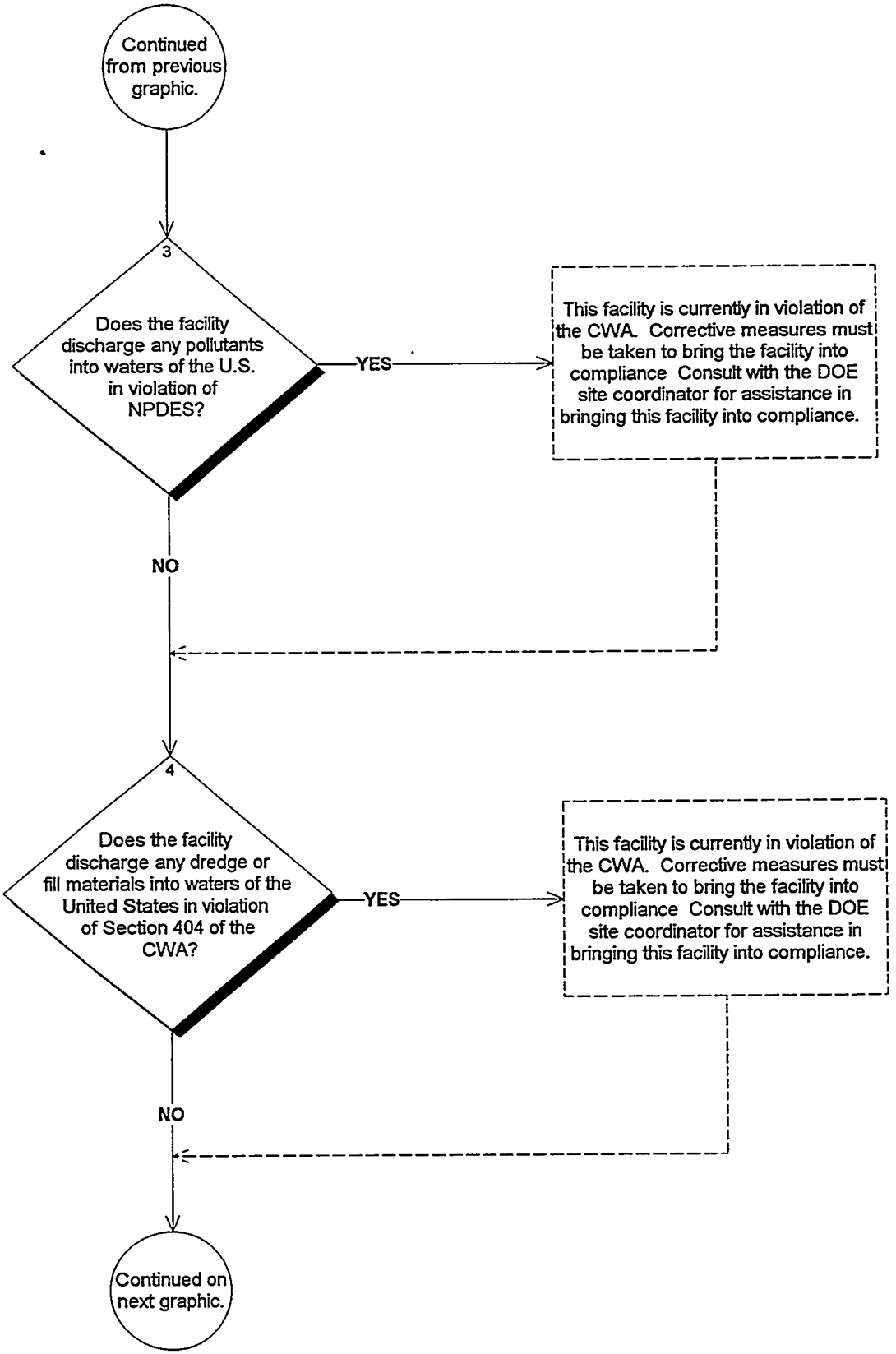
**Step 2** For purposes of Section 4004(a) of the CWA, a facility shall not cause a discharge of pollutants into waters of the United States that is in violation of the requirements of the National Pollutant Discharge Elimination System (NPDES) under Section 402 of the CWA. A facility also shall not cause a discharge of dredged material or fill material to waters of the United States that is in violation of the requirements under Section 404 of the CWA.

A facility or practice shall not cause non-point source pollution of waters of the United States that violates applicable legal requirements implementing an area-wide or Statewide water quality management plan that has been approved by the Administrator under Section 208 of the CWA.

Solid waste disposal facilities must not adversely affect the quality of the nation's surface waters. Measures must be taken to protect surface waters of the United States from unauthorized discharges of pollutants and other extraneous materials. Section 257.3-3(d) of 40 CFR includes, but does not define, several terms important for understanding and complying with the CWA requirements. Among the most important of these terms is "Waters of the United States" which is used in each of the requirements of 40 CFR 257.3-3, and is defined in 40 CFR 122.2 as:

(1) Navigable waters;
(2) Tributaries of navigable waters;
(3) Interstate waters; and
(4) Intrastate lakes, rivers and streams used for:
    (i) interstate travel for recreation and other purposes, or;
    (ii) sources of fish or shellfish sold in interstate commerce, or;
    (iii) industrial purposes by industries engaged in interstate commerce.

This definition provides the Federal government with the broadest jurisdictional authority possible for enforcing the requirements of the CWA. Very few surface water bodies fail to meet the criteria of this definition. The 40 CFR Part 257 preamble discussion (44 *FR* 53444, 9/13/79) cites exceptions to this definition (i.e., certain kinds of cooling ponds, waste treatment lagoons), but specifically identifies wetlands as subject to the intent of these regulations. Wetlands, which are broadly defined features whose limits are subject to extensive scientific controversy, have been upheld by the U.S. Supreme Court as meeting the definition of waters of the United States.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3
Does the facility discharge any pollutants into waters of the U.S. in violation of NPDES?
YES
This facility is currently in violation of the CWA. Corrective measures must be taken to bring the facility into compliance Consult with the DOE site coordinator for assistance in bringing this facility into compliance.
NO
4
Does the facility discharge any dredge or fill materials into waters of the United States in violation of Section 404 of the CWA?
YES
This facility is currently in violation of the CWA. Corrective measures must be taken to bring the facility into compliance Consult with the DOE site coordinator for assistance in bringing this facility into compliance.
NO
Continued on next graphic.

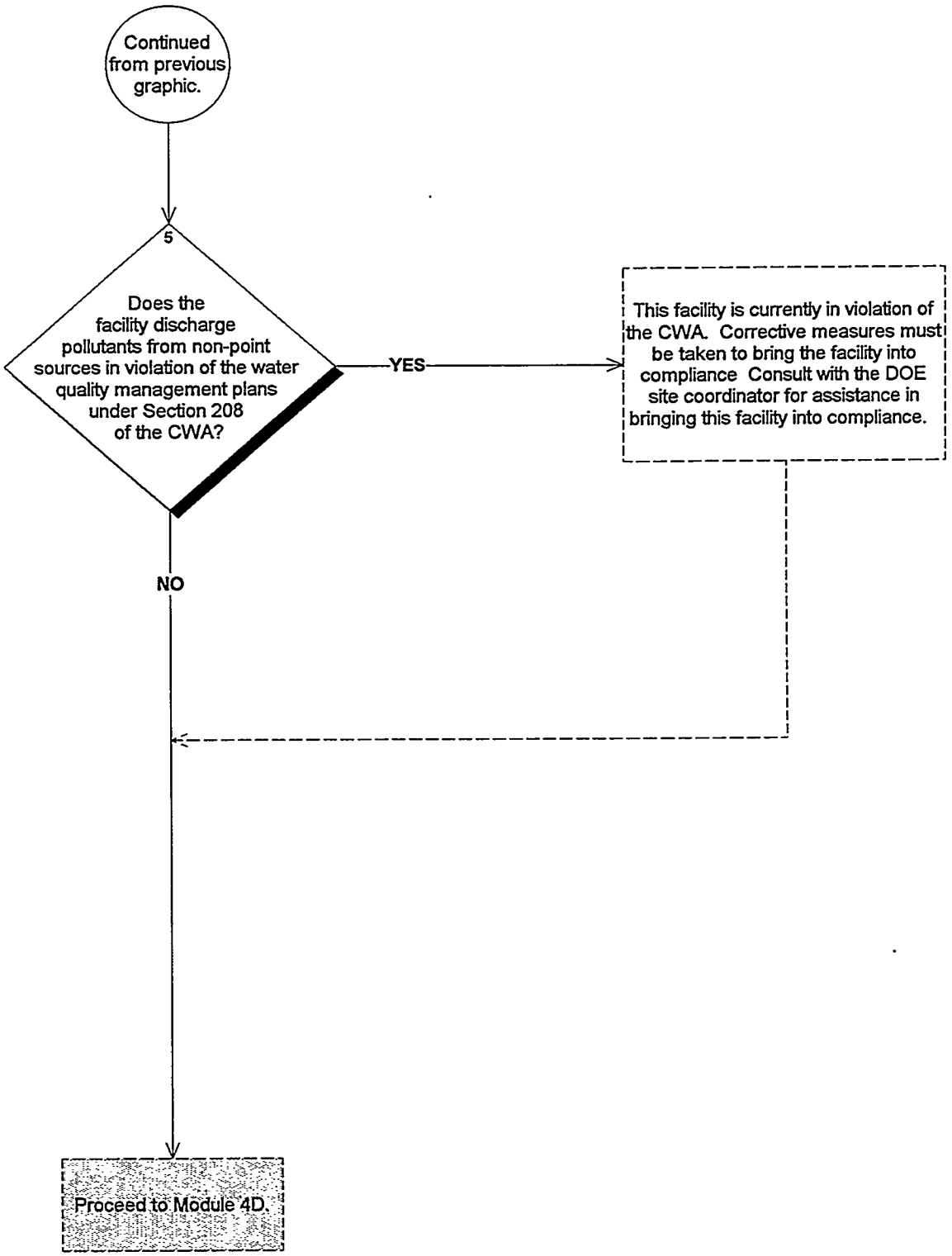
**Step 3** Owners/operators of solid waste disposal facilities must insure that any pollutants discharged to waters of the United States are permitted under the NPDES requirements of Section 402 of the CWA. [40 CFR 257.3-3] NPDES discharge permits govern specific point sources from which pollutants are introduced into waters of the U.S. [Clean Water Act, Section 402] The term "pollutant" is defined by 40 CFR 122.2 (Definitions applicable to the NPDES) to mean dredged spoil, solid waste, incinerator residue, filter backwash, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials (except those regulated under the Atomic Energy Act of 1954, as amended), heat, wrecked or discarded equipment, rock, sand, cellar dirt, and industrial, municipal, and agricultural waste discharged into water. It does **not** mean:

(1) Sewage from vessels; or
(2) Water, gas, or other material which is injected into a well to facilitate production of oil or gas, or water derived in association with oil and gas production and disposed of in a well, if the well used either to facilitate production or for disposal purposes is approved by authority of the State in which the well is located, and if the State determines that the injection or disposal will not result in the degradation of ground or surface water resources.

[NOTE: Radioactive materials covered by the Atomic Energy Act are those encompassed in its definition of source, byproduct, or special nuclear materials. Examples of radioactive material **not** covered include: radium and accelerator produced isotopes.]

The CWA defines point sources to include any discernable, confined, and discrete conveyance. These include pipes, culverts, ditches, or any other conveyance that delivers materials to surface waters. [40 CFR 122.2] Discharges of leachates or controlled surface water runoff that has been in contact with solid wastes are the most likely forms of discharge associated with a solid waste disposal facility. These discharges may be subject to technology-based treatment requirements as a condition of the permit.

**Step 4** The discharge of dredge or fill materials into waters of the United States requires that a permit be obtained under Section 404 of the CWA before such activity may commence. [Clean Water Act, Section 404] Dredge and fill permits, issued by the U.S. Army Corps of Engineers, not only cover the disposal of these materials but also address their use as fill materials for developmental purposes. [Clean Water Act, Section 404(f)(1),(2)] This requirement is of particular significance to owners/operators of solid waste disposal operations who intend to fill areas designated as wetlands. Wetlands, as noted above, are considered to be waters of the United States as defined by 40 CFR 122.2. Because many existing land disposal units are situated in or adjacent to wetland environments, lateral expansions to these units would be subject to the permit and development restrictions of the Section 404 permit programs.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5
Does the facility discharge pollutants from non-point sources in violation of the water quality management plans under Section 208 of the CWA?
YES
This facility is currently in violation of the CWA. Corrective measures must be taken to bring the facility into compliance Consult with the DOE site coordinator for assistance in bringing this facility into compliance.
NO
Proceed to Module 4D.

**Step 5** In addition to meeting the NPDES requirement of Section 404 of the CWA, owners/operators of solid waste disposal units must also prevent the release of pollutants from non-point sources. Non-point sources associated with land disposal units include uncontrolled storm water runoff and accidental or unanticipated discharges of wastes that escape into surface waters. Although sometimes difficult to accomplish, preventing such discharges must be conducted in accordance with requirements stipulated in area-wide or State-wide water quality management plans approved under Section 208 of the CWA. [40 CFR 122.26]

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## 4.5 Module 4D: Groundwater

### 4.5.1 Introduction

Groundwater, generally a high quality, low cost, and readily available source of water, is the primary drinking water resource for at least half of the population of the United States. Often it is the only economical water source available that is suitable for human consumption. Because of the tremendous value and irreplaceable nature of this resource, the RCRA statute and its legislative history clearly reflect Congressional intent that protection of groundwater be a prime concern of the criteria set forth in 40 CFR Part 257.

Groundwater contamination results in the most expensive and technically difficult remediation task posed by solid waste disposal operations. Effective screening of the waste streams received at the unit, frequent and effective use of cover material to minimize leachate production potential, and use of liners or leachate collection systems are the best preventative measures that can be taken to avoid this type of contamination threat. In lieu of such safeguards, frequent monitoring of groundwater quality, especially at older sites where past management controls may have been lax, should be considered.

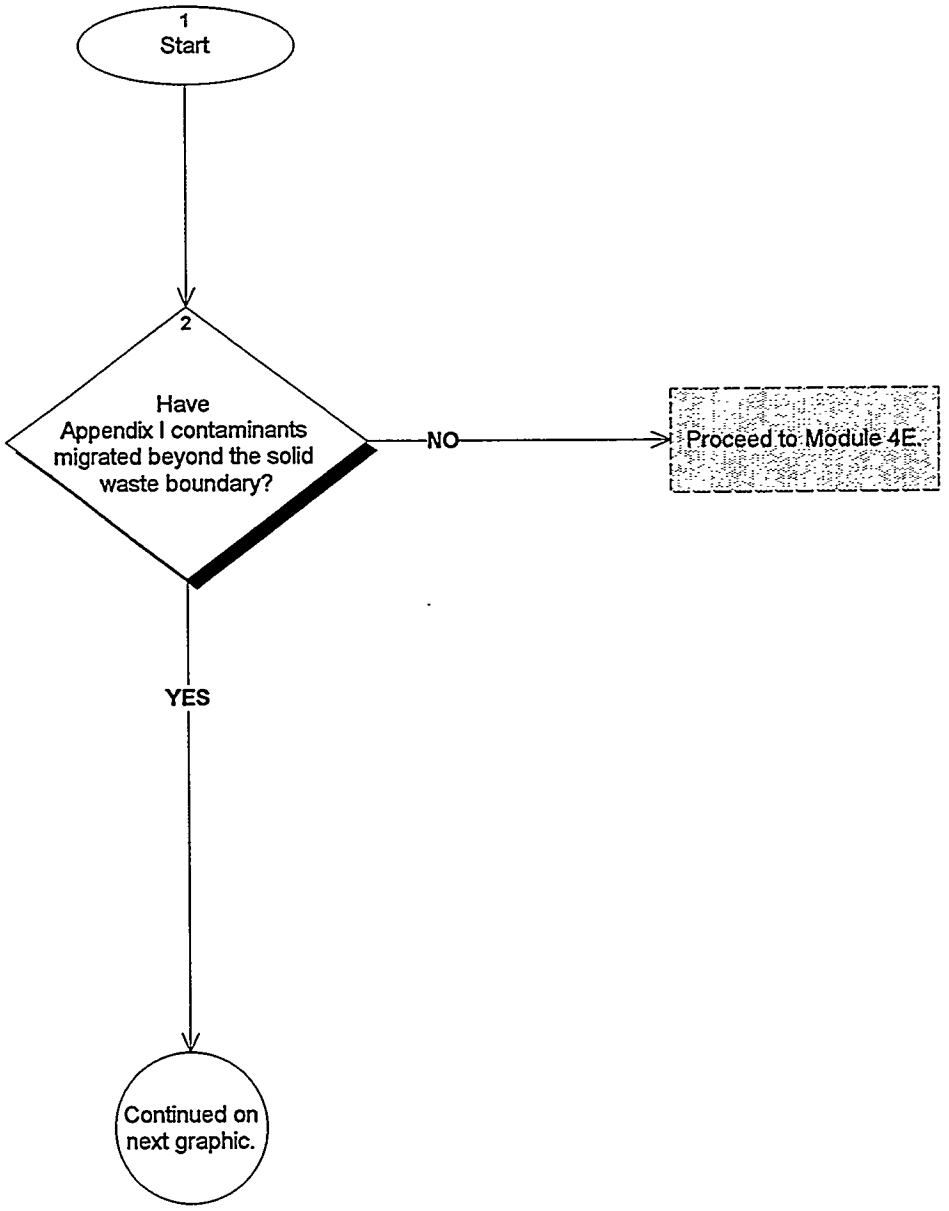
### 4.5.2 Milestones

***Are adequate steps being taken to protect the groundwater at the solid waste disposal facility?***

Protection of the groundwater should be based upon:

- Adequate characterization of the hydrology and geology of the site.

# Figure 4D: Groundwater



**Step 1** Start.

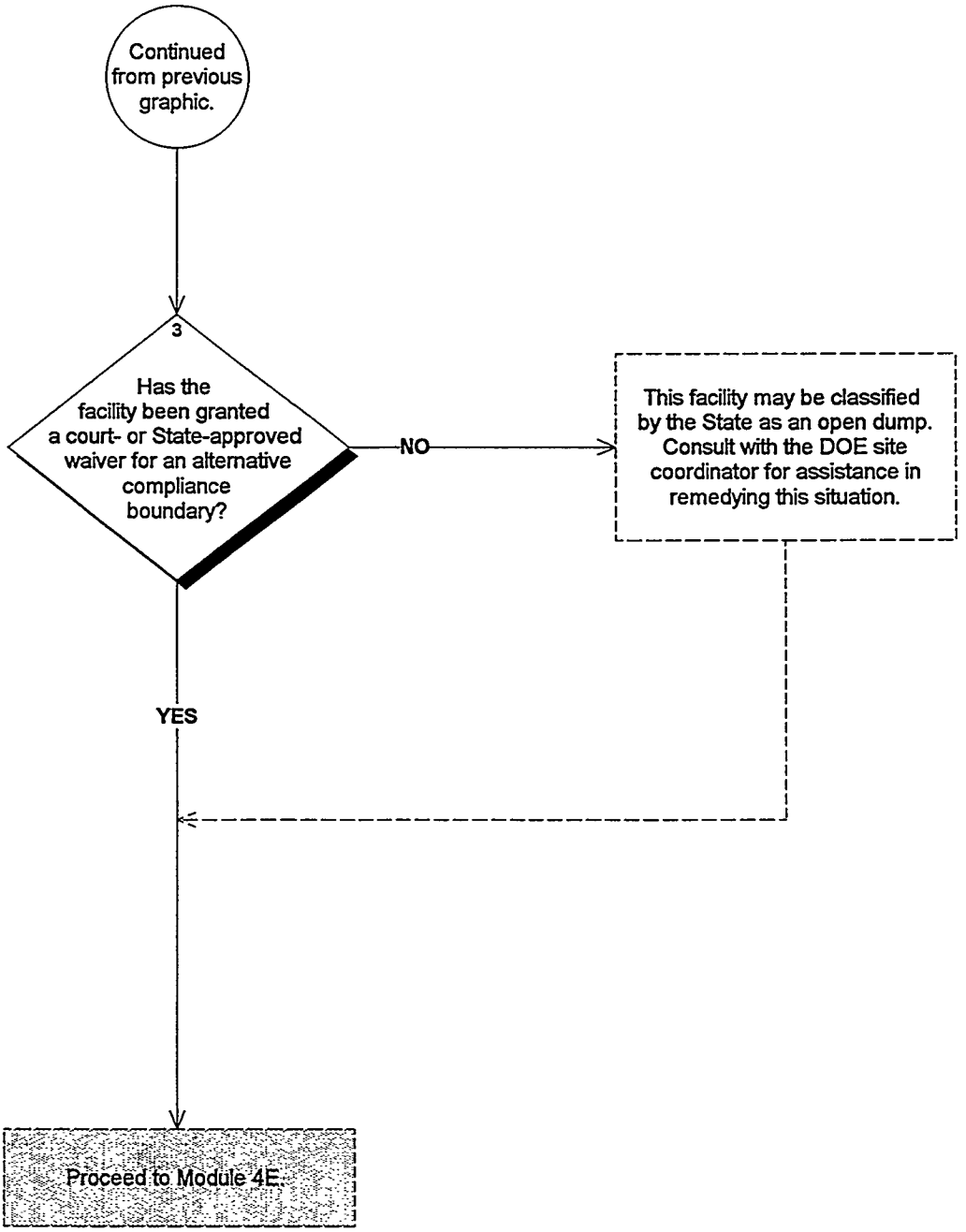
**Step 2** For purposes of this criterion, the term "contamination" is defined as meaning the introduction of substances into groundwater that:

(1) Exceed the maximum contaminant level(s) (MCLs) specified in Appendix I of 40 CFR Part 257; or
(2) Cause increases in existing concentrations of substances already present in the groundwater.

The contaminants identified in Appendix I include:

(1) A relatively short list of metals (e.g., lead, cadmium, chromium, etc.);
(2) Fluoride; and
(3) Chlorinated hydrocarbons and chlorophenoxy compounds.

Many of these substances are likely to be present in varying quantities in solid waste streams typically received by landfilling operations. Leaching of these contaminants through subsoils of the disposal unit, especially where synthetic or clay liners have not been employed, is the primary avenue for contamination of groundwater aquifers located beneath a disposal unit.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3
Has the facility been granted a court- or State-approved waiver for an alternative compliance boundary?
NO
This facility may be classified by the State as an open dump. Consult with the DOE site coordinator for assistance in remedying this situation.
YES
Proceed to Module 4E.

**Step 3** In the preamble discussion to 44 *FR* 53448, 9/13/79, EPA has identified a point (projected in a horizontal plane) beyond which waste migration from a land disposal unit would be considered out of compliance. This "point of compliance," the solid waste boundary, is the physical boundary of the outermost perimeter of the solid waste (the waste itself and not the unit) as it would exist at completion of the disposal activity. In most cases, the solid waste boundary would correspond with the design and operating plans which are provided to and approved by the State agency as part of the State's facility permitting or certification program. Where such plans do not exist to designate the perimeter at completion, especially where indiscriminate or unauthorized disposal has occurred, the boundary would be defined as the current perimeter of the waste disposed.

For purposes of Section 1008(a)(3) of RCRA or Section 405(d) (unlawful disposal of sewage sludge) of the CWA, a party charged with open dumping or a violation of Section 405(e) may demonstrate that compliance should be determined at an alternative boundary in lieu of the solid waste boundary. The court shall establish such an alternative boundary only if it finds that such a change would not result in contamination of groundwater that may be needed or used for human consumption. This finding shall be based on analysis and consideration of all of the following factors that are relevant:

(1) The hydrogeologic characteristics of the facility and surrounding land, including any natural attenuation and dilution characteristics of the aquifer;
(2) The volume and physical and chemical characteristics of the leachate;
(3) The quantity, quality, and direction of flow of groundwater underlying the facility;
(4) The proximity and withdrawal rates of groundwater users;
(5) The availability of alternative drinking water supplies;
(6) The existing quality of the groundwater, including other sources of contamination and their cumulative impacts on the groundwater; and
(7) Public health, safety, and welfare effects.

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## 4.6 Module 4E: Disease Vector Control

### 4.6.1 Introduction

There are many opportunities for disease vectors to become established and multiply at solid waste landfills. To reduce these opportunities, EPA developed some general requirements, as well as some requirements specific to sewage sludge and septic tank pumpings.

Sewage sludge and septic tank pumpings contain various types of pathogenic bacteria, viruses, and parasites. The ability of these organisms to survive outside their host's environment can vary from several hours to several weeks or even months. Those longer-lived organisms, which have prompted the interim final requirements of this disease criterion, are typically parasites. Parasitic ova or cysts, which require an extended free-living existence in an environmental medium such as soil, are the primary pathogenic health threat to human populations. Surface applications or incorporation of sludges and tank pumpings to soils that may be used to produce food destined for human consumption can be a significant source of such pathogens if appropriate management precautions are not observed.

Regulations for the application of sewage sludge and/or septic pumpings contain protective provisions if the waste is to be applied on or incorporated into soils used to grow human food-chain crops. In those situations where crops are grown within 18 months of application or incorporation, the wastes must undergo a "Process to Further Reduce Pathogens" (PFRP). If crops are not grown within the 18-month time frame, then a PFRP treatment technique is not required. These wastes will, however, be subject to a "Process to Significantly Reduce Pathogens" (PSRP) and access control requirements. It should be noted that a PFRP can be utilized whether or not the sludge has undergone a PSRP. While it is unlikely that such agricultural activities occur on DOE property, this discussion is included here for completeness.

Techniques use to achieve the PSRP standard include:

(1) Aerobic digestion;
(2) Air drying;
(3) Anaerobic digestion;
(4) Composting (three techniques);
(5) Lime stabilization; and
(6) Other equivalent techniques.

The preamble language (44 *FR* 53457, 9/13/79) defines PFRP to encompass those processes that essentially destroy all bacteria and viruses and greatly reduce the number of parasites in the waste material. Two sets of processes are permitted. The first of these are techniques that are sufficient to meet the objectives of PFRP. The five options available for meeting this objective are:

(1) High-temperature composting;
(2) Heat drying;
(3) Heat treatment;
(4) Thermophilic aerobic digestion; and
(5) Other methods.

The second process that may be utilized is a supplemental technology that may be applied to wastes that have already undergone a previous PSRP technique. The four follow-up technologies approved by EPA for meeting the requirement include:

(1) Beta ray irradiation;
(2) Gamma ray irradiation;
(3) Pasteurization; and
(4) Other methods.

In situations where crops intended for human consumption are not exposed to, or are not likely to come in contact with, sewage sludge or septic pumpings (e.g., citrus fruits, corn), there is no need to treat the wastes to meet the PFRP standard. These wastes will be subject to the less stringent PSRP standards, the access control limitations, and the preventative animal grazing measures.

Facilities that permit agricultural activities on waste-amended soils must comply with treatment and time requirements of 40 CFR Part 257.3-6(b) or terminate such activity until they can be instituted. Any foodstuffs currently being grown or produced from these lands that have not complied with these requirements must be disposed of or otherwise not be distributed for human consumption.

EPA issued the sewage and septic waste standards as interim final. EPA acknowledged that additional data might be forthcoming that would tend to modify or otherwise change these standards; however, they have remained unchanged since being promulgated in 1979.

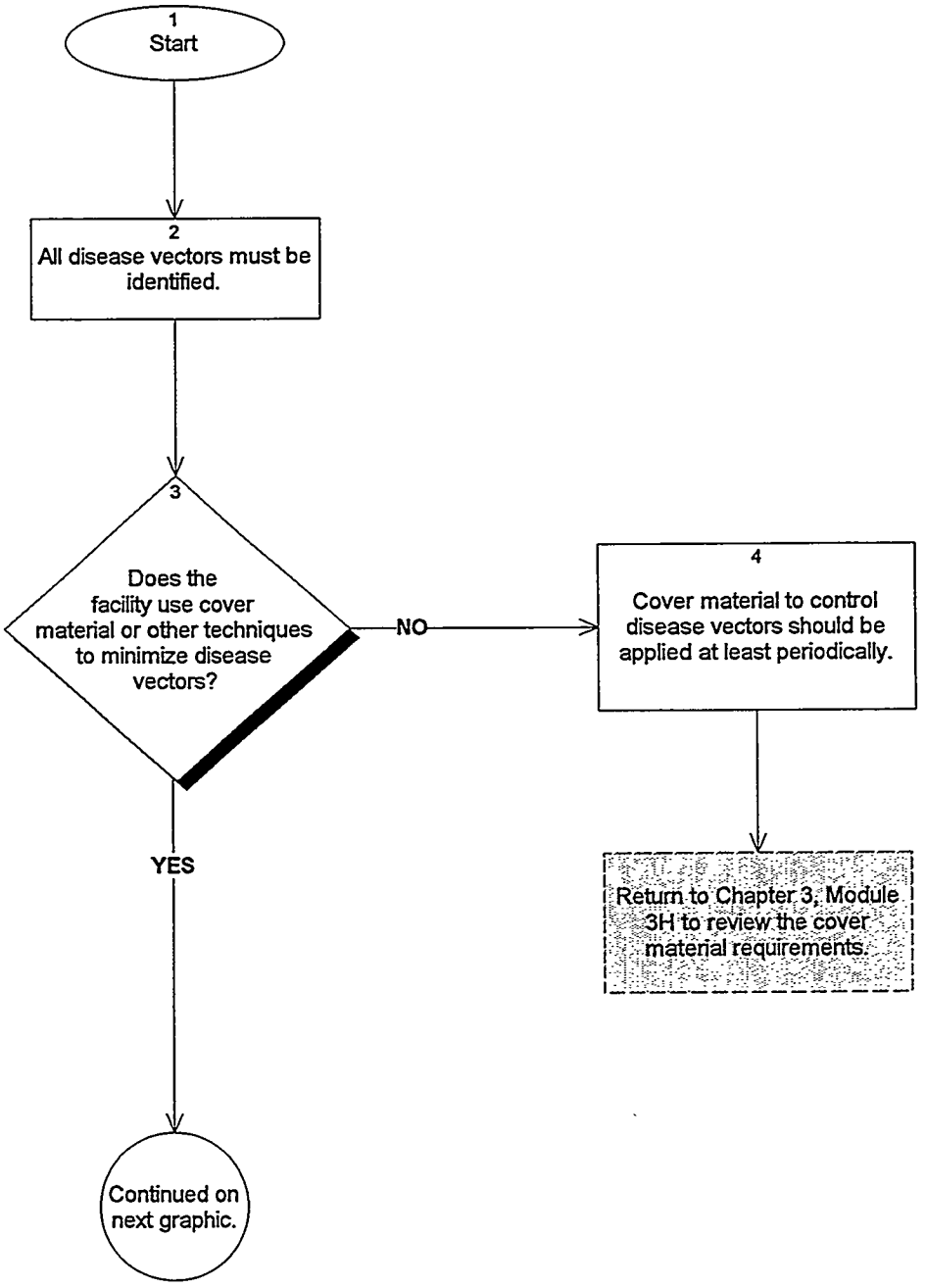
### 4.6.2 Milestones

***Has a program been instituted to control the proliferation of disease vectors?***

Steps that can be taken to control disease vectors include:

- Instituting a litter control program;
- Providing daily cover; and
- Utilizing PSRP and PFRP techniques on sewage sludge and septic tank pumpings, as appropriate.

# Figure 4E: Disease Vector Control

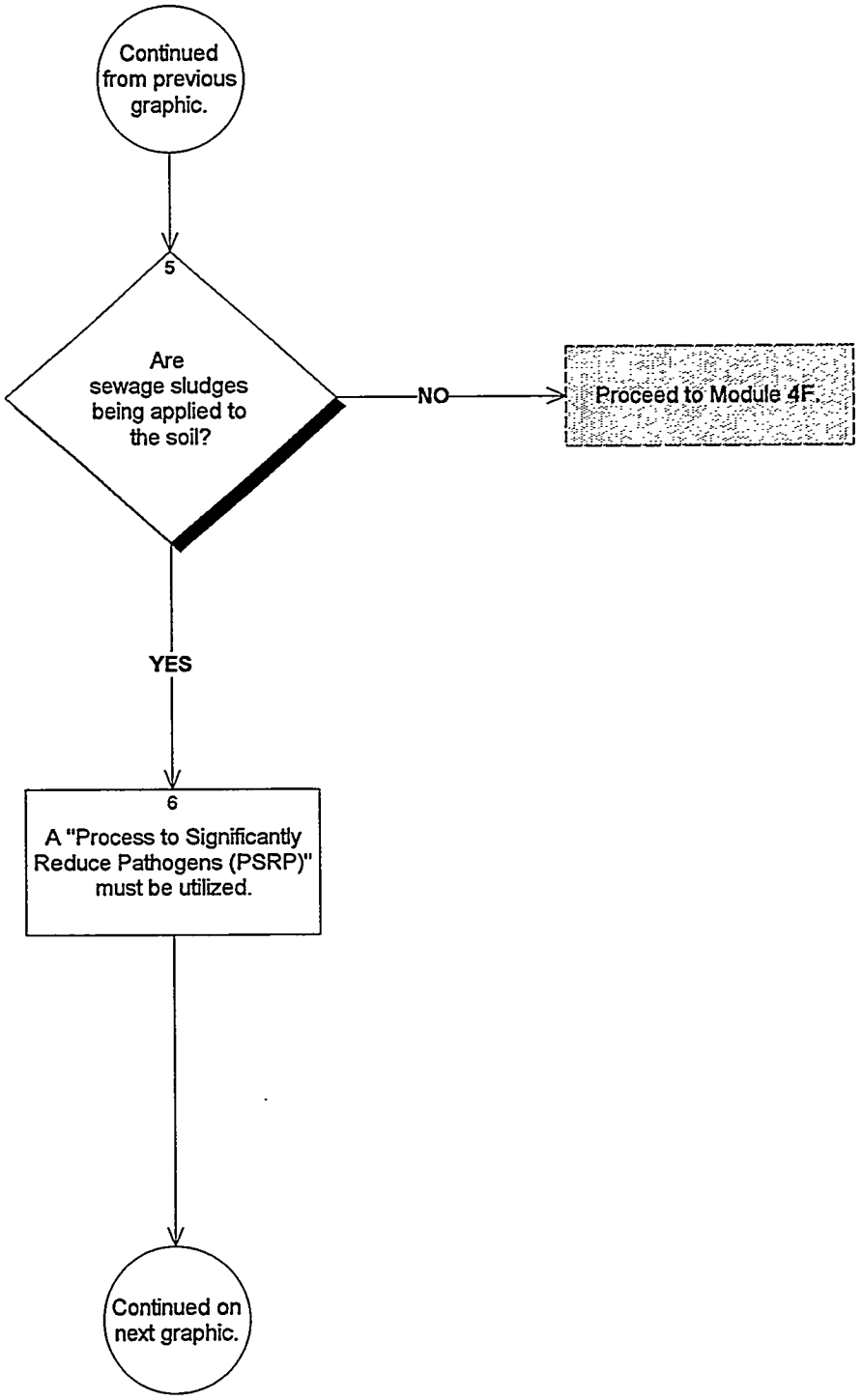


**Step 1** Start.

**Step 2** In the preamble discussion (44 *FR* 53455, 9/13/79) of the issue, EPA defines those organisms that it considers to be disease vectors. This list includes rodents, flies, and mosquitoes, but makes no mention of birds and other mammals that often frequent these types of facilities.

**Step 3** According to the disease vector criterion, solid wastes disposed of on the surface of the land must be covered periodically (similar cover requirements are found in 40 CFR Part 241 and discussed in Chapter 3) so as to control and/or discourage disease vector populations from becoming established on the site. Since putrescible wastes, the primary lure of vectors, make up a significant portion of the waste stream disposed of at land disposal facilities, daily cover was recommended as the leading method of preventing infestations of vector populations. The criterion also stipulates that "other techniques as appropriate" may be utilized to prevent the breeding of, or the provision of habitat or feeding areas for, vector populations that could pose a threat to human health.

**Step 4** The cover material requirements and recommendations in Chapter 3, Module 3H, discuss recommended procedures for the application of daily, intermediate, and final covers.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5
Are sewage sludges being applied to the soil?
NO
Proceed to Module 4F.
YES
6
A "Process to Significantly Reduce Pathogens (PSRP)" must be utilized.
Continued on next graphic.

**Step 5** A facility shall not dispose of sewage sludge or septic tank pumpings unless it does so in compliance with paragraphs (1), (2), or (3) of this section.

(1) Sewage sludge that is applied to the land surface or is incorporated into the soil must be treated by a process to significantly reduce pathogens (PSRP) prior to application or incorporation. Public access to the facility must be controlled for at least 12 months, and grazing by animals whose products are consumed by humans must be prevented for at least one month. PSRPs are listed in 40 CFR 257, Appendix II, Section A. (These provisions do not apply to sewage sludge disposed of by a trenching or burial operation.);

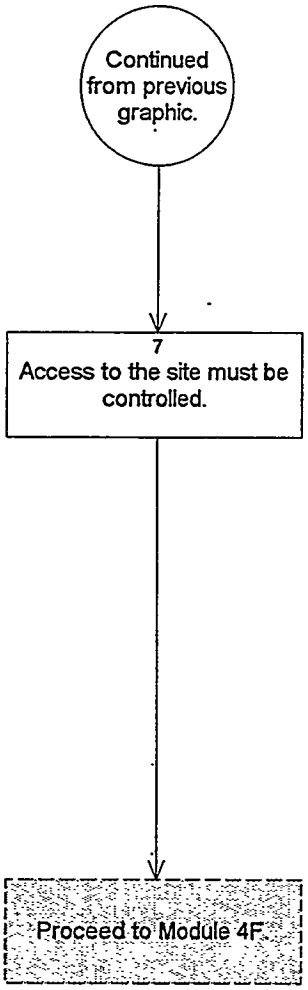
(2) Septic tank pumpings that are applied to the land surface or incorporated into the soil must be treated by a PSRP (as listed in 40 CFR Part 257, Appendix II, Section A) prior to application or incorporation, unless public access to the facility is controlled for at least 12 months and unless grazing by animals whose products are consumed by humans is prevented for at least one month. (These provisions do not apply to septic tank pumpings disposed of by a trenching or burial operation.); or

(3) Sewage sludge or septic tank pumpings that are applied to the land surface or incorporated into the soil must be treated by a PFRP, prior to application or incorporation, if crops for direct human consumption are grown within 18 months subsequent to application or incorporation. Such treatment is not required if there is no contact between the solid waste and the edible portion of the crop. However, in this case the solid waste must be treated by a PSRP prior to application; public access to the facility must be controlled for at least 12 months, and grazing by animals whose products are consumed by humans must be prevented for at least one month. If crops for direct human consumption are not grown within 18 months of application or incorporation, the requirements of paragraphs (1) and(2) of this section apply.

**Step 6** In its discussion of the issue of human exposure to parasites (44 *FR* 53456, 9/13/79), EPA determined that all **sewage sludges** applied on or incorporated into the surface of the soil should be treated by the PSRP prior to such an event. The techniques used to achieve the PSRP standard include: aerobic digestion, air drying, anaerobic digestion, composting (three techniques), lime stabilization, and other equivalent techniques.

The effectiveness of each of these techniques will vary depending on weather conditions, residence times, temperature, or other factors. The treatment provision does not apply, however, in cases where the sludge is disposed of by trenching or burial operations.

PSRP techniques are also to be employed in areas where septic tank pumpings are to be applied to or incorporated into the soil unless access controls are employed to prevent access by humans and animals.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7
Access to the site must be controlled.
Proceed to Module 4F.

**Step 7** In addition to using techniques to reduce pathogens, the criterion calls for "controlled" access to sites subject to waste application. Public access to such sites is to be controlled for a period of 12 months; grazing by animals whose products are to be consumed by humans is to be prevented for one month. Control of public access is not intended as an outright prevention of access to an application site. Indeed, with proper precautions there appears to be no health hazard posed by simply entering such a site. The potential threat exists in situations where the general public has frequent access to waste-amended soils. An example might be park lands where recreational activity by children and adults can significantly increase the possibility of contact with pathogens. In such a setting, fencing of the area might be appropriate to prevent contact. In other situations, where public access is unlikely to occur, the need for a physical barrier (such as a fence) would not be warranted. In general, the requirement for site control is primarily a function of the likelihood that the site will be used for various human activities after waste applications have occurred. In the case of DOE facilities that might apply sewage sludge to the soil, the need for significant controls is thought to be minimal.

Preventing livestock grazing on waste-amended sites is an additional measure designed to protect the general health of the public. Because the likelihood of parasites being transferred through the consumption of animal products (meat and milk) is significantly reduced a short time after wastes are applied, the one-month ban on grazing was determined by EPA to be protective of human health. Access control measures should be instituted in lieu of treatment techniques in those areas where public access might occur, although the need for such controls on DOE facilities is thought to be minimal.

The need to employ PSRP techniques and access controls to surface application sites depends on the source of the waste to be applied. In addition to access control, a reduction technique also must be utilized on septic sludge applied to the land in order to be protective. Either of the two measures, however, may be used on septic tank pumpings. This is due to the fact that containment in a septic tank will result in partial pathogen reduction in the waste. Once again, these septic tank pumping requirements do not apply if the material is to be disposed of by a trenching or burial operation.

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## 4.7 Module 4F: Air

### 4.7.1 Introduction

The requirements of this section are designed to protect the quality of the air at the solid waste disposal facility. Protection of the air is important to protect the health of both employees and patrons of the disposal facility.

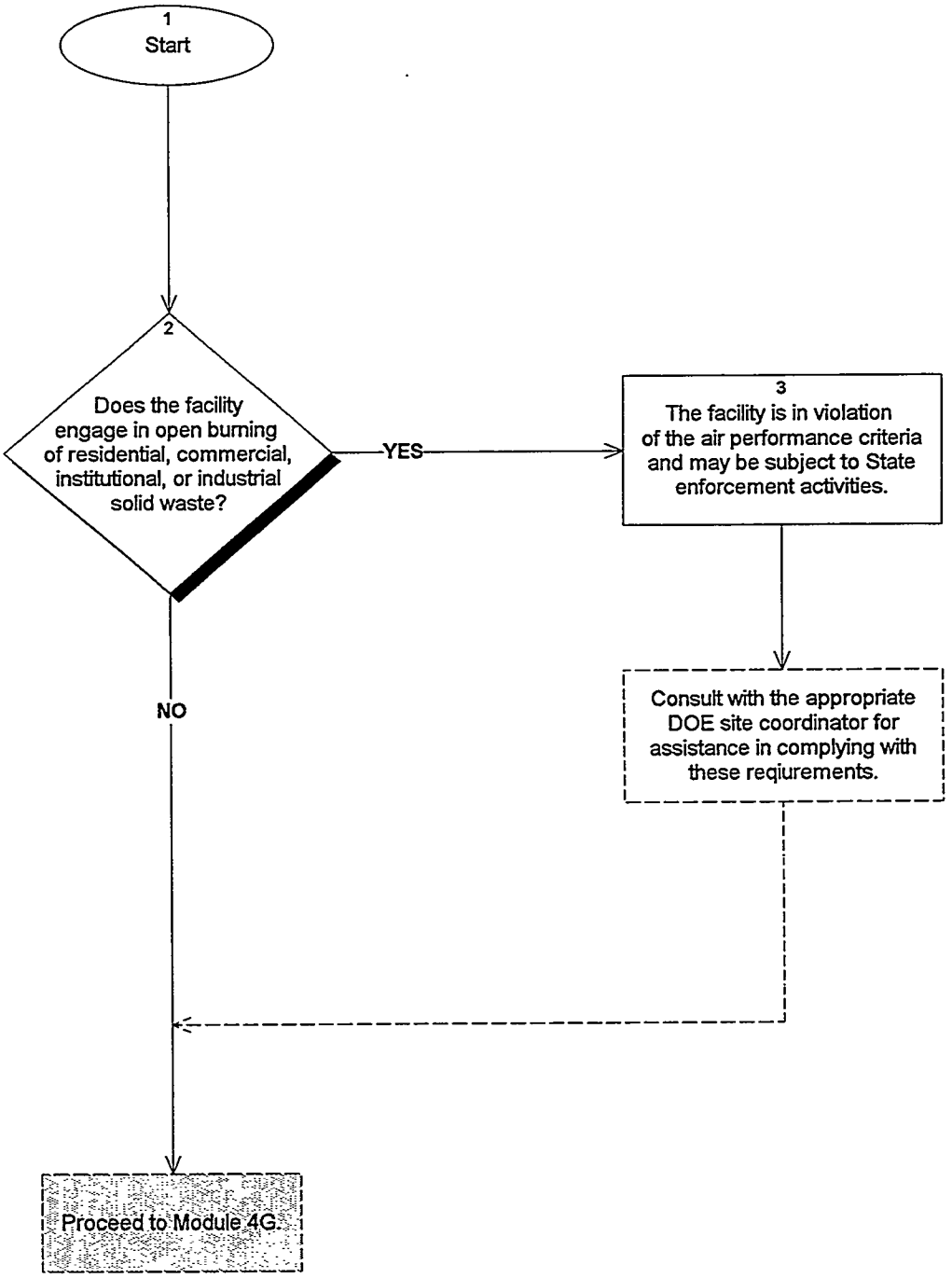
### 4.7.2 Milestones

***Have appropriate steps been taken to protect air quality at the solid waste disposal facility?***

Appropriate steps to protect air quality include:

- Prevention of open burning; and
- Operation of the site in compliance with the State's Implementation Plan (SIP).

# Figure 4F: Air



**Step 1** Start.

**Step 2** The first issue addressed under the air criterion concerns the prohibition against burning residential, commercial, institutional, or industrial solid wastes in an uncontrolled or unconfined setting. Open burning is a potential health hazard that can cause property damage and be a threat to public safety.

Section 257.3-7 of 40 CFR defines open burning to mean the combustion of solid waste **without**:

(1) Control of combustion air to maintain adequate temperature for efficient combustion;
(2) Containment of the combustion reaction in an enclosed device to provide sufficient residence time and mixing for complete combustion; and
(3) Control of the emission of the combustion products.

This ban on burning applies to wastes typically found in a landfill setting. Allowances are, however, made for infrequent burning of some types of wastes received at solid waste disposal facilities. These wastes include:

(1) Land-clearing debris;
(2) Diseased trees;
(3) Debris from emergency clean-up operations;
(4) Ordnance; and
(5) Agricultural wastes.

EPA decided to exempt these infrequently burned wastes because of the lack of significant environmental risk and the added environmental benefit of preventing additional outbreaks of disease and reducing the possibility of waste handling accidents. This limited burning activity, however, must be in compliance with applicable requirements developed under the State SIP.

The air performance criterion pertaining to SIPs is as follows: For purposes of Section 4004(a) of the CAA, a facility shall not violate applicable requirements developed under an SIP approved or promulgated by the Administrator pursuant to Section 110 of the CAA, as amended. Applicable provisions of a State's SIP may include: control strategies, emission limitations, and timetables for compliance with air quality goals under Section 110 of the CAA.

**Step 3** The open burning restriction of 40 CFR 257.3-7(a) applies to all facilities that manage solid wastes. With the exception of those wastes specifically identified in this section or by individual State regulations, intentional burning is not permitted and may result in enforcement actions being taken by the applicable State regulatory agency.

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## 4.8 Module 4G: Safety

### 4.8.1 Introduction

The potential safety hazards addressed in this chapter include explosive gases, fires, bird hazards to aircraft, and uncontrolled public access. Additional safety guidelines are addressed in Module 3I of Chapter 3.

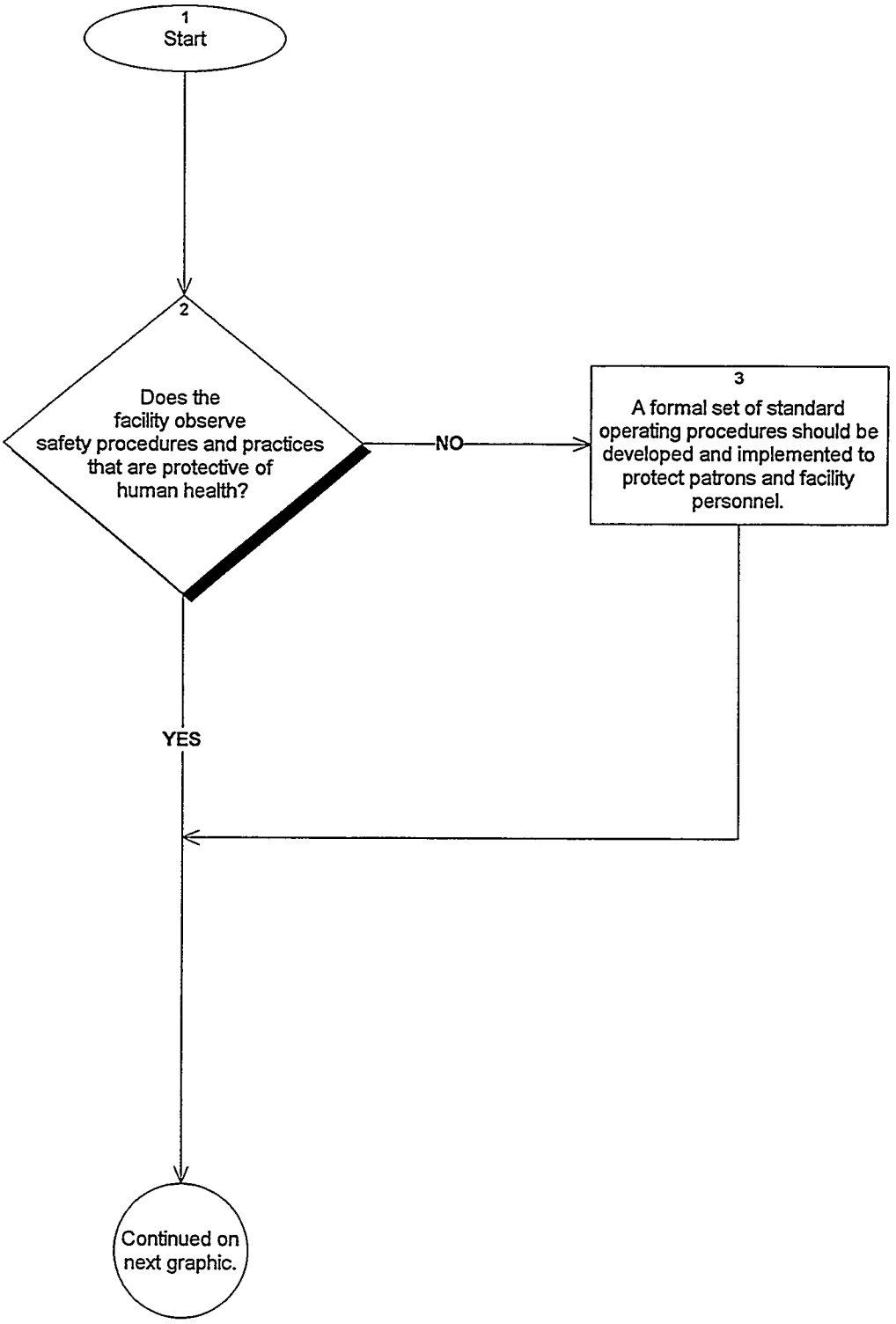
### 4.8.2 Milestones

***Is the site operated in a manner that protects the health and safety of all employees?***

To operate the site safely, the following factors must be addressed:

- Explosive gases;
- Fires;
- Bird hazards to aircraft; and
- Control of public access.

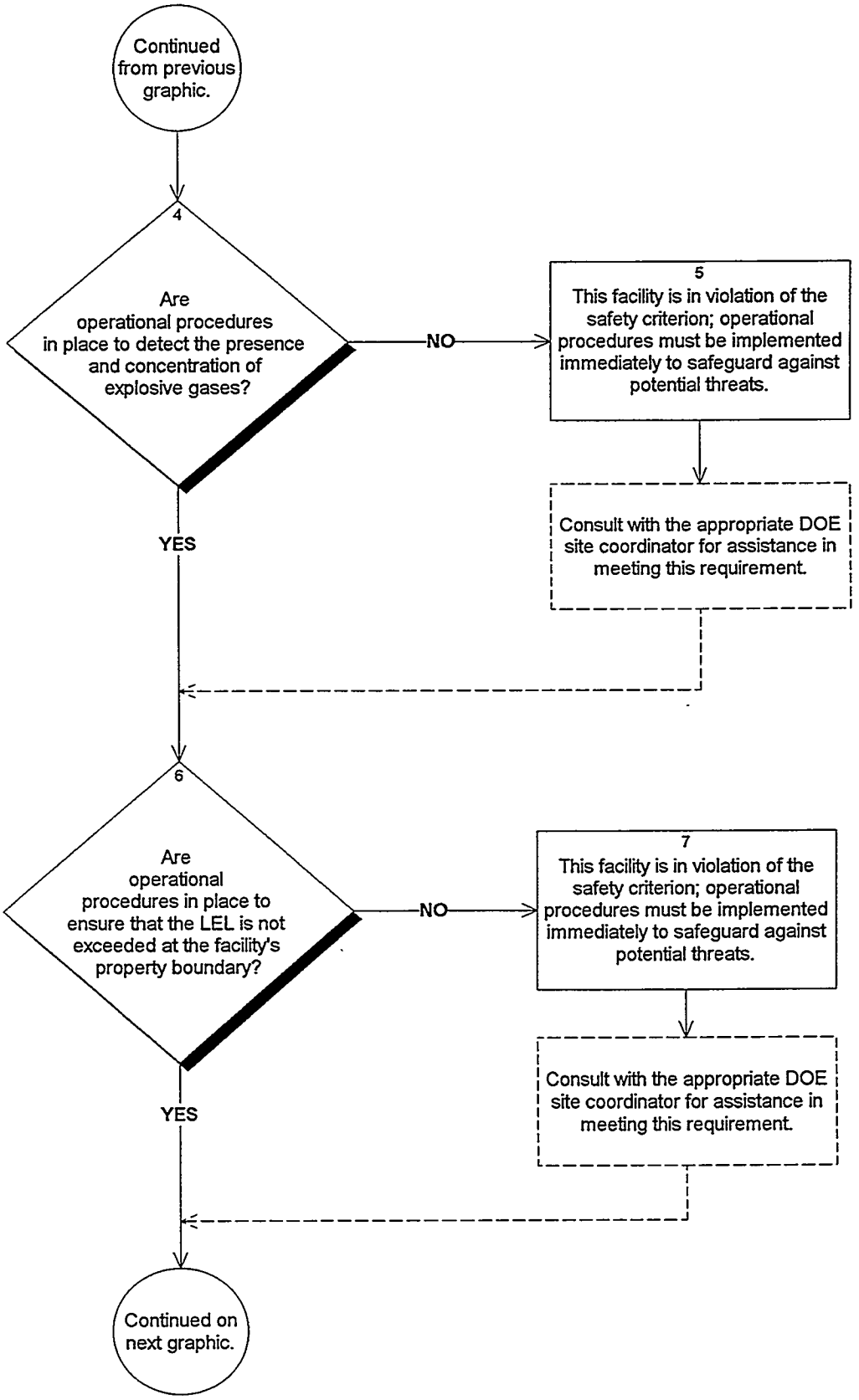
# Figure 4G: Safety



**Step 1** Start.

**Step 2** Land disposal operations may pose a significant threat to human safety and health. To safeguard patrons and facility employees, a system of safety procedures and practices must be instituted that effectively limits human exposure to the dangerous or life-threatening situations described above.

**Step 3** A formal set of standard operating procedures (SOPs) could be established at each land disposal facility, identifying in detail specific practices and procedures to be observed in the daily operation of the unit. In addition, facility patrons could be made familiar with safety requirements through the use of signs or safety fliers.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4
Are operational procedures in place to detect the presence and concentration of explosive gases?
NO
5
This facility is in violation of the safety criterion; operational procedures must be implemented immediately to safeguard against potential threats.
Consult with the appropriate DOE site coordinator for assistance in meeting this requirement.
YES
6
Are operational procedures in place to ensure that the LEL is not exceeded at the facility's property boundary?
NO
7
This facility is in violation of the safety criterion; operational procedures must be implemented immediately to safeguard against potential threats.
Consult with the appropriate DOE site coordinator for assistance in meeting this requirement.
YES
Continued on next graphic.

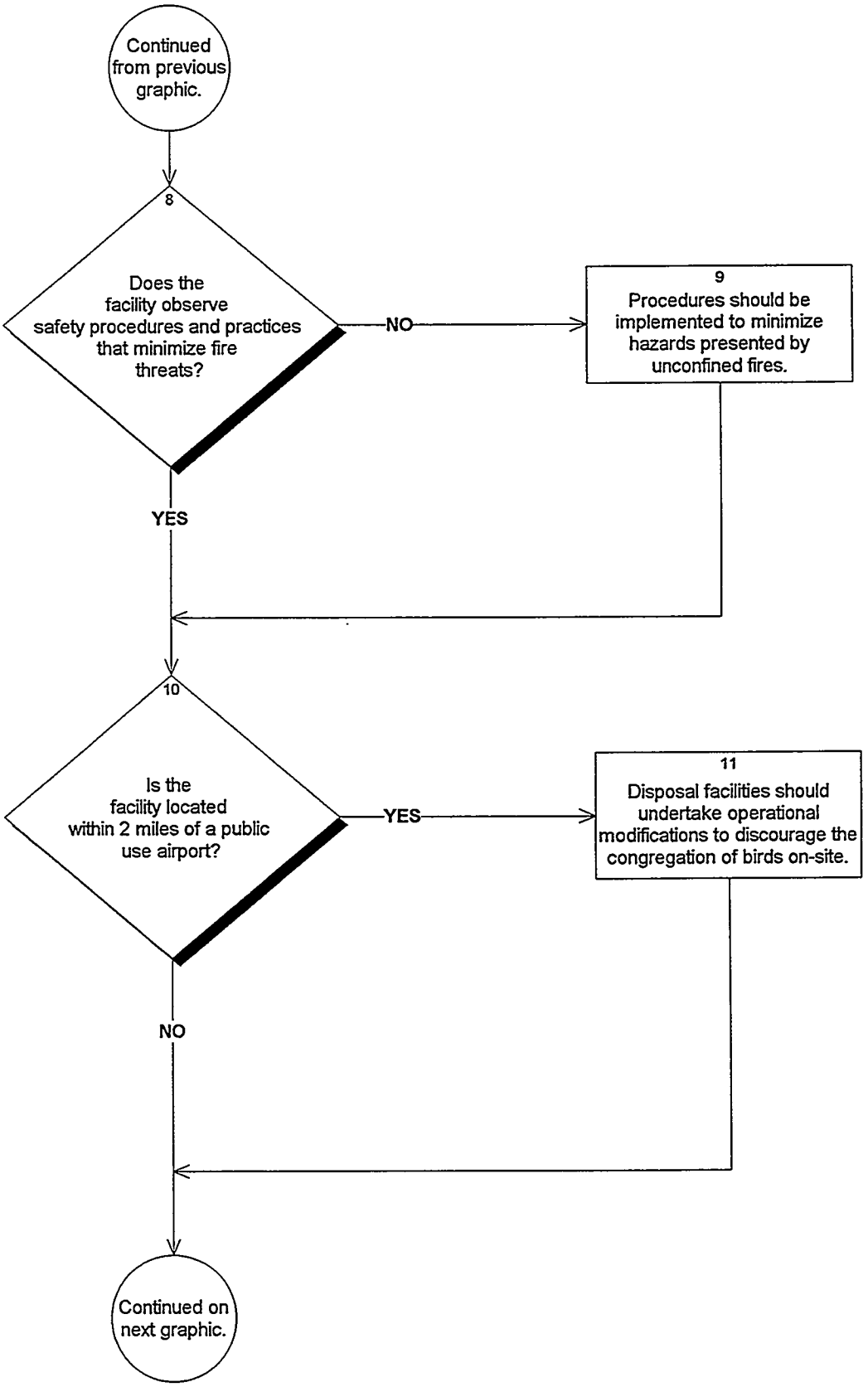
**Step 4** Of primary concern is methane gas, the principal source of explosions at solid waste disposal units. In the preamble discussion (44 *FR* 53458, 9/13/79) of the issue, EPA indicated that methane was the only gas of concern; other gases that may be identified in the future will be addressed under this criterion if warranted.

Methane gas forms and collects within land disposal units as a result of the decomposition of organic wastes. The gas has a tendency to migrate through soil from its generation source and collect near the surface. Frequently, methane will collect in nearby structures where it can quickly concentrate and become a serious threat. In recognition of this specific threat, EPA has specified that gas concentrations in facility structures in excess of 25% of the LEL will be considered a violation of the explosive gas criterion. Facility structures include any buildings, sheds, or utility or drainage lines located within the confines of the facility. It does not include, however, methane gas control or recovery system components. The LEL is defined as the lowest percent, by volume, of a mixture of explosive gases which will propagate a flame in air at 25°C and atmospheric pressure. [40 CFR 257.3-8]

**Step 5** Operational procedures should be established to correct and/or alleviate any potential threats to on-site receptors that may be endangered by explosive gases. These procedures might include added or improved structural ventilation or gas recovery systems designed to dissipate gases that might build up and create an explosion hazard.

**Step 6** The second component of the explosive gas restriction involves the migration and potential health threat posed by methane to off-site receptors. Because methane will become somewhat diffused as it travels farther from its source, EPA established a gas concentration limit equal to the LEL at the facility boundary. This limitation was deemed to protect against off-site explosions given the fact that potential explosive levels could not be exceeded within the facility itself.

**Step 7** Operational procedures should be in place to detect and limit concentrations of explosive gases at the property boundary. Efforts should be made to eliminate or keep such gases well below the LEL as an added safety precaution to off-site, as well as on-site, receptors.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8
Does the facility observe safety procedures and practices that minimize fire threats?
NO
9
Procedures should be implemented to minimize hazards presented by unconfined fires.
YES
10
Is the facility located within 2 miles of a public use airport?
YES
11
Disposal facilities should undertake operational modifications to discourage the congregation of birds on-site.
NO
Continued on next graphic.

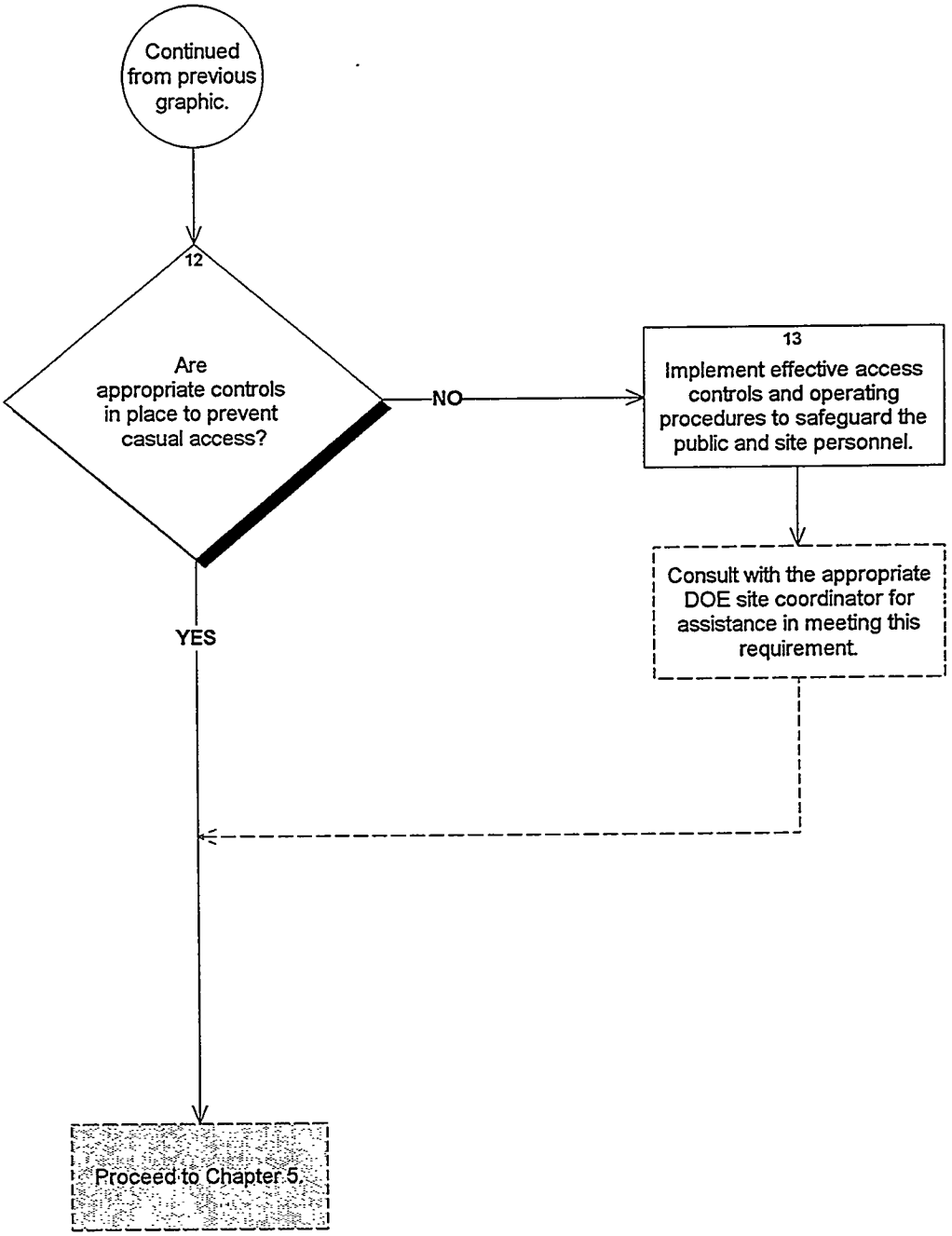
**Step 8** The safety criterion requires that facilities or practices conducted on-site shall not pose a fire threat to personal safety or property. Fires at solid waste facilities pose a potential health threat to facility employees, patrons, and nearby residences. Fires typically result from careless operational practices, spontaneous combustion, vandalism, disposal of hot ashes, and open burning. In the case of open burning, this activity is expressly prohibited by the criterion stipulated in 40 CFR 257.3-7 (Module 4F), with the exception of infrequent burning of particular wastes. As for the other potential fire sources, they can be eliminated by implementing better management practices, covering wastes periodically with appropriate materials, and improving load inspections and security measures. Any measure, as appropriate, can be utilized to meet the requirement of this criterion.

**Step 9** Procedures should be identified and implemented to minimize hazards presented by unconfined fires.

**Step 10** A facility or practice disposing of putrescible wastes that may attract birds and which occurs within 10,000 feet (3,048 meters) of any airport runway used by turbojet aircraft or within 5,000 feet (1,524 meters) of any airport runway used by only piston-type aircraft shall not pose a bird hazard to aircraft.

Collisions between aircraft and birds pose a significant threat to aviators and the general public because of the disabling effect such a strike can have on an aircraft. In developing this criterion, EPA consulted a Federal Aviation Administration (FAA) order (Order 5200.5) to provide guidance on establishing "danger zones" within which bird strikes were considered a likely hazard to aviation. The FAA order states that solid waste disposal facilities have been found by study and observation to be artificial attractants of birds, and therefore may be incompatible with safe flight operations when located in the vicinity of an airport. During its review of the issue, EPA determined that the distances identified by the FAA for determining the likelihood of a bird strike were reasonable and would be incorporated into the criterion. The recommended setback distance for solid waste facilities from airports varies depending on the type of propulsion system (turbojet or piston engine) used to power the aircraft. For turbojet aircraft, the FAA and 40 CFR 257.3-8 recommend a setback distance of 10,000 feet, while safe operational distances for piston engine aircraft are estimated at 5,000 feet. These setback distances are not intended to be hard and fast regulatory provisions. Indeed, solid waste disposal operations may be conducted within these zones; however, particular care should be taken within these "danger zones" to assure that no bird hazard arises.

**Step 11** Disposal facilities that operate within the setback distances of airports (defined by the FAA as public-use airports) should undertake modifications to operational procedures that minimize or eliminate the unit's attracting qualities. Frequent use of cover material, noise-making equipment, or other repelling or discouraging techniques should be employed as means of warding off birds. Proposed facilities may wish to take these distance criteria into consideration as part of the selection criteria or consider eliminating those sites that lie within these danger zones.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12
Are appropriate controls in place to prevent casual access?
NO
13
Implement effective access controls and operating procedures to safeguard the public and site personnel.
Consult with the appropriate DOE site coordinator for assistance in meeting this requirement.
YES
Proceed to Chapter 5.

**Step 12** Uncontrolled public access that would expose the public to potential health and safety hazards at the disposal site is to be prevented.

Because materials and activities associated with solid waste disposal units may pose a significant threat to human health and safety, precautions should be taken to restrict access to ensure that the safety of the general public and site personnel are safeguarded. In the preamble discussion (44 *FR* 53460, 9/13/79) of the issue, EPA decided that specific types of hazards (and ensuing preventative measures) should not be specified in the criterion, therefore allowing for flexibility in how the standard is applied. EPA did, however, discuss some basic safety recommendations that should be considered by nearly all land disposal units. The first recommendation presented suggests that during normal operating hours proper management controls can minimize safety hazards. For example, potential harm to facility operating personnel can be reduced through proper training, use of safety equipment, control of waste types, and other practices. Another recommendation involves minimizing the risk of injury to the public by completely prohibiting access to the site to all persons except site patrons. This could be accomplished through the use of suitable fencing, natural physiographic features, or other security measures. Patron safety could be ensured by implementing strict procedural controls on traffic, scavenging, and other activities that might pose a health and safety threat to the user. Implementing these and other access precautions can assure a high degree of safety and, at the same time, provide the facility with the flexibility to implement protective strategies on a case-by-case or as-needed basis.

**Step 13** A program to implement effective access control measures and safety procedures should be undertaken to ensure the health and safety of the public and site personnel. The scope of these measures is thought to be relatively limited in the case of DOE land disposal facilities because of the secure nature of DOE installations and the limited degree of patronage.

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# Chapter 5
# Introduction to Municipal Solid Waste Landfills

**Contents**

## 5.1 Introduction

### 5.1.1 Background

Any landfill unit that meets the definition of an MSWLF may be subject to 40 CFR 258 in whole or in part. (Chapter 2, Module A, can be used to determine which landfill units are MSWLFs.) A new Part 258 was published in the Federal Register [56 *FR* 50978, 10/9/91]. This new Part 258 sets forth revised minimum criteria for the siting, design, operation, monitoring, closure, and post-closure care of MSWLFs.

Part 258 provides that approved States will have flexibility in implementing specific design and operational criteria. For example, approved States, unlike unapproved States, may establish alternative methods/procedures of compliance or compliance schedules for selected requirements.

## 5.2 Module 5A: Applicability of 40 CFR Part 258 to Municipal Solid Waste Landfills

### 5.2.1 Introduction

An MSWLF may be subject to 40 CFR Part 258 in whole or in part. In addition different types of MSWLFs have been allowed varying compliance dates. Application of the criteria illustrated in this module will allow DOE personnel to identify the applicable subparts and compliance dates for each MSWLF. Also, the regulation of MSWLFs may not be uniform from State to State. If a State has an approved program, the administrator of the State program may allow the owner/operator greater flexibility in the implementation of some program elements, such as compliance schedules, and the selection of groundwater constituents which must be included as part of a detection monitoring program. The EPA approves a State program by determining that the State has developed an MSW permit program (or other system of prior approval) adequate to ensure that each MSWLF that may receive household hazardous waste (HHW) or small quantity generator (SQG) waste will comply with 40 CFR Part 258. (EPA plans to propose that Indian Tribes also be eligible for permit program approval.)

### 5.2.2 Milestones

***Is 40 CFR 258 applicable (in whole or in part) to the identified MSWLF?***

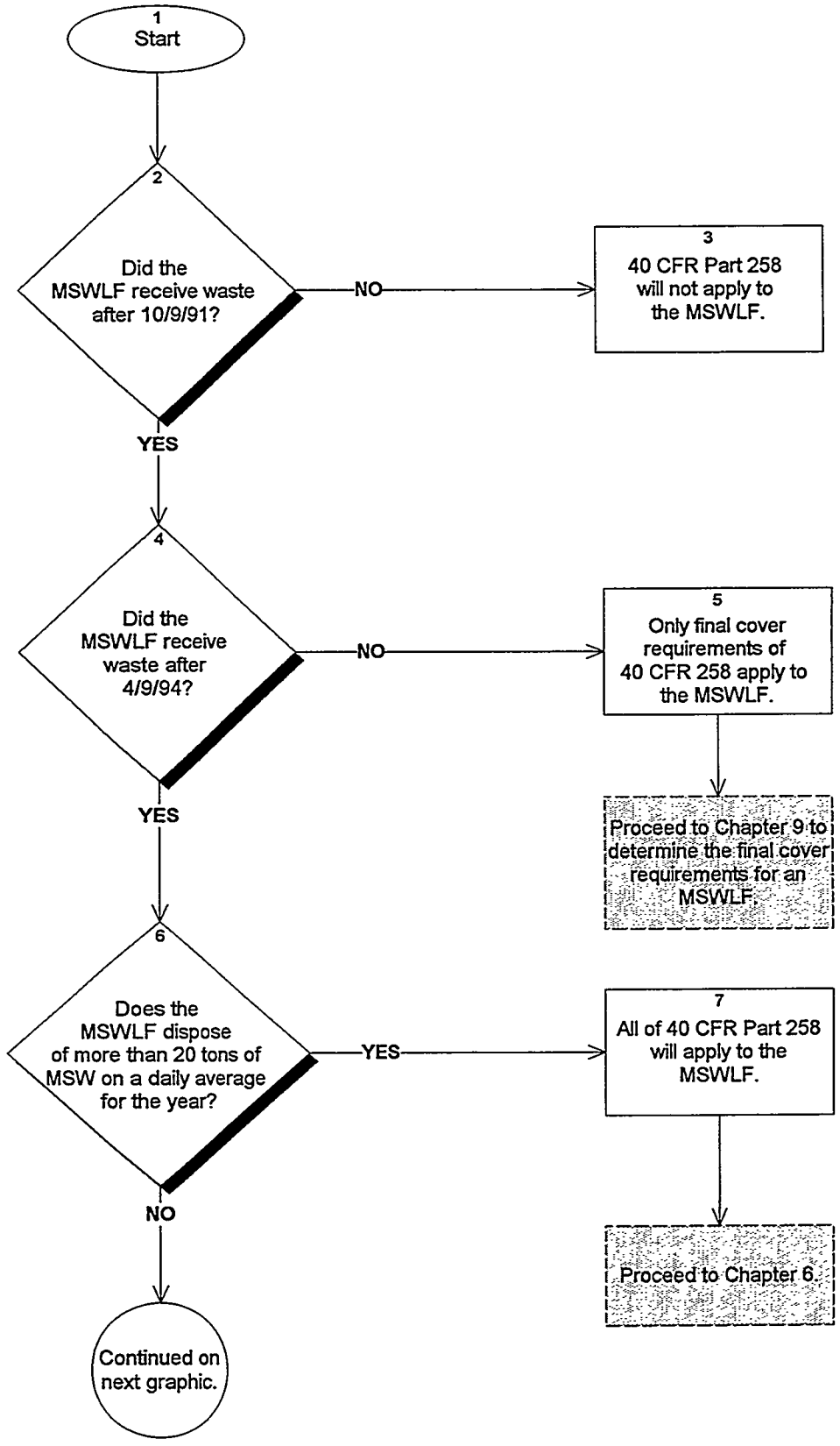
The following elements must be identified to determine what subparts of 40 CFR 258 must be applied to the MSWLF.

- The last date (by month and year) on which the MSWLF will accept waste; and
- The amount of municipal solid waste received at the MSWLF on a daily average for the year.

The owner/operator also must consider the applicability of two geographically-based exemptions. To do this, the owner or operator needs to know the following:

- Whether there is a 3-month or greater interruption in surface transportation of waste in the region;
- Whether the MSWLF serves a community with no practicable waste management alternative;
- Whether there is evidence of existing groundwater contamination from the MSWLF; and
- The annual precipitation in the area of the MSWLF.

# Figure 5A: Applicability of 40 CFR 258 to Municipal Solid Waste Landfills



**Step 1** Start.

**Step 2** October 9, 1991, was the last day an MSWLF was allowed to receive waste without having to comply with 40 CFR 258. After that date, 40 CFR 258 applies to an MSWLF either in its entirety or in part.

**Step 3** The requirements of 40 CFR 258 **do not** apply to MSWLFs that **do not** receive waste after October 9, 1991.

**Step 4** Before April 9, 1994, an MSWLF was allowed to terminate receipt of waste and abide by only the final cover requirements specified in 40 CFR 258.60(a). However, all MSWLFs that receive waste on or after April 9, 1994, must comply with **all** requirements of 40 CFR 258 unless otherwise specified.

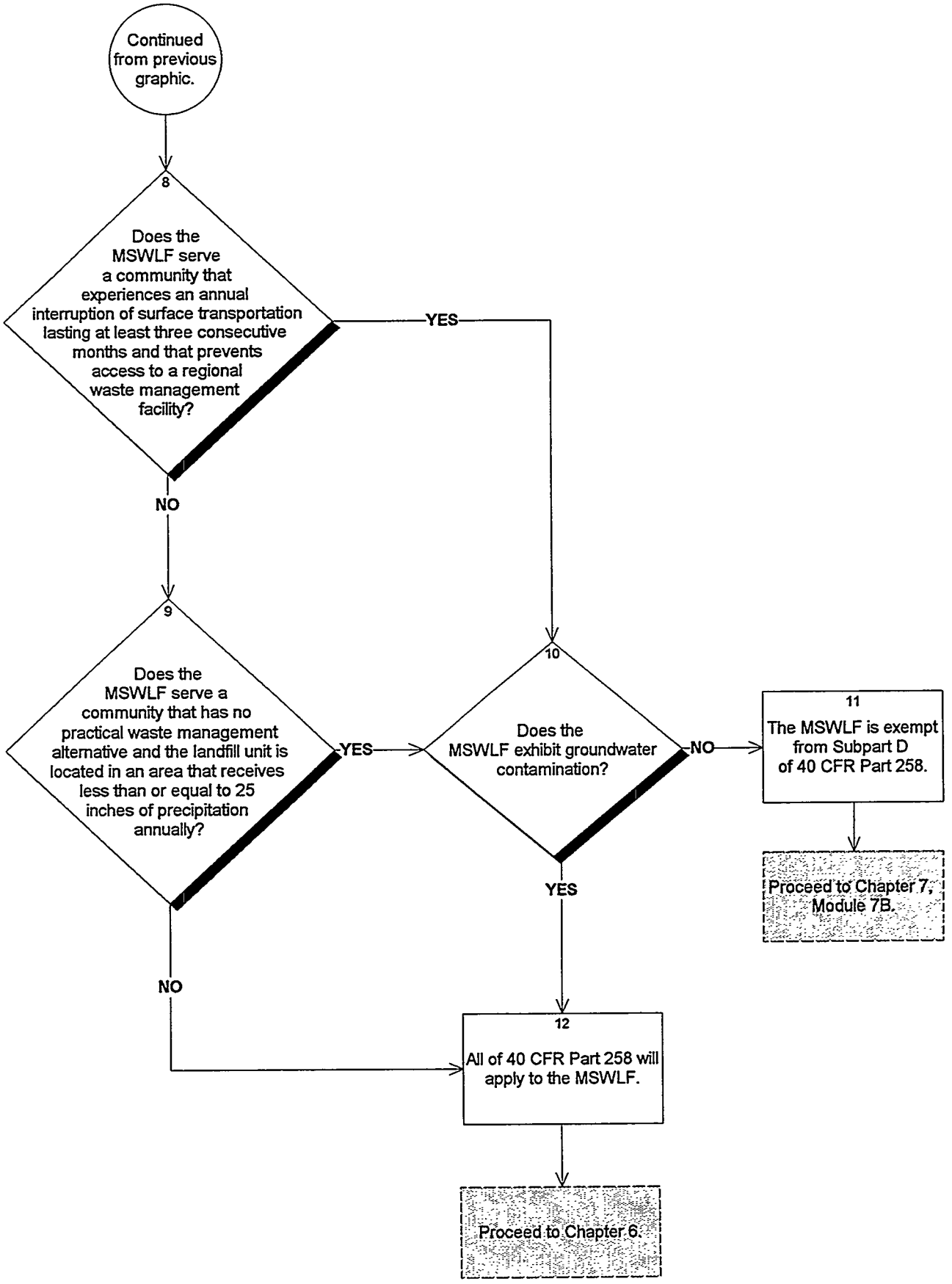
**Step 5** MSWLFs that received waste after October 9, 1991, but stopped receiving waste before April 9, 1994, are **exempt** from all the requirements of 40 CFR Part 258, except the final cover requirements (See Chapter 9).

The final cover must be installed within one year of last receipt of wastes. Owners/operators of MSWLFs described in this paragraph that fail to complete cover installation within this six-month period will be subject to all the requirements of 40 CFR 258 unless otherwise specified.

**Step 6** For those MSWLFs that dispose of more than 20 tons of municipal solid waste (MSW) on a daily average annually, **all** of 40 CFR 258 will apply.

If the MSWLF unit is an existing or laterally expanding unit that disposed of 100 tons per day or less of solid waste during a representative period prior to 1993, and the unit did not dispose of more than 100 tons per day of solid waste each month between October 9, 1993 and April 9, 1994, and the unit is located in a State that has submitted an application for permit program approval to EPA by October 9, 1993, is located in the State of Iowa, or is located on Indian Lands or Indian Country, and the MSWLF unit is not on the National Priorities List, then the compliance date for this unit is April 9, 1994. The unit must, however, comply with all of the requirements of 40 CFR Part 258.

**Step 7** The specific requirements applicable to an MSWLF depend on whether it is an existing unit, a lateral expansion of an existing unit, or a new MSWLF unit. Proceed to Module 2B to determine relevant chapters of this report.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8
Does the MSWLF serve a community that experiences an annual interruption of surface transportation lasting at least three consecutive months and that prevents access to a regional waste management facility?
YES
NO
9
Does the MSWLF serve a community that has no practical waste management alternative and the landfill unit is located in an area that receives less than or equal to 25 inches of precipitation annually?
YES
NO
10
Does the MSWLF exhibit groundwater contamination?
NO
YES
11
The MSWLF is exempt from Subpart D of 40 CFR Part 258.
Proceed to Chapter 7, Module 7B.
12
All of 40 CFR Part 258 will apply to the MSWLF.
Proceed to Chapter 6.

**Step 8** An MSWLF is exempt from Subpart D (Design Criteria) of 40 CFR 258 when it meets the following three criteria:

(1) It disposes of less than 20 tons of MSW daily, based on an annual average; **and**
(2) It serves a community that experiences an annual interruption of surface transportation lasting at least 3 consecutive months and that prevents access to a regional waste management facility; **and**
(3) There is no evidence of existing groundwater contamination from the MSWLF, **or** (See Step 9).

**Step 9** An MSWLF is exempt from Subpart D of 40 CFR 258 when it meets the following four criteria:

(1) It disposes of less than 20 tons of MSW daily, based on an annual average; **and**
(2) It serves a community that has no practicable waste management alternative; **and**
(3) The landfill unit is located in an area that receives less than or equal to 25 inches of precipitation annually; **and**
(4) There is no evidence of existing groundwater contamination from the MSWLF.

[NOTE: Those owners and operators of new, existing, or laterally expanding MSWLFs that meet all of the criteria listed in either Step 8 or Step 9 must place information demonstrating this in the operating record of the MSWLF.]

Please note that the compliance date for such units is October 9, 1995.

**Step 10** For those MSWLFs that exhibit evidence of groundwater contamination, the owner/operator must notify the State Director of such contamination and thereafter comply with Subpart D (Design Criteria) of 40 CFR Part 258.

**Step 11** The MSWLF is exempt from Subpart D (Design Criteria) although all other Subparts apply. The specific requirements applicable to MSWLFs depend on whether the MSWLF is an existing, laterally expanding existing, or new MSWLF unit.

**Step 12** Those MSWLFs that do not fall under either exemption in Step 8 or Step 9 must have complied with **all** of 40 CFR 258 by 10/9/93, with two exceptions:

(1) Groundwater monitoring provisions of Subpart E will be phased in over a five-year period beginning on 10/9/91; and
(2) The specific requirements applicable to an MSWLF depend on whether the MSWLF is an existing unit, lateral expansion, or a new MSWLF unit.

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# Chapter 6
# Location Restrictions for Municipal Solid Waste Landfills

**Contents**

## 6.1 Introduction

### 6.1.1 Background

EPA, in developing these regulations, sought to minimize the development of MSWLFs in areas that are environmentally sensitive. Areas considered to be environmentally sensitive are floodplains, wetlands, fault areas, unstable areas, and geologically-sensitive areas. Development adjacent to airport runways was also seen as an undesirable action.

In addition to the requirements presented in this chapter, owners/operators of MSWLFs should be aware that a State in which their landfill is located or is to be located may have adopted a State wellhead protection program in accordance with Section 1428 of the Safe Drinking Water Act. Such State programs may impose further requirements on owners/operators of MSWLFs in addition to those set forth in this chapter.

## 6.2 Module 6A: Floodplains

### 6.2.1 Introduction

The floodplain location restriction is applicable to existing, new, and laterally expanding MSWLFs. Owners/operators of MSWLF units located in 100-year floodplains must demonstrate that the unit will not restrict the flow of the 100-year flood, reduce the temporary water storage capacity of the floodplain, or result in washout of solid waste so as to pose a hazard to human health and the environment. Washout means the carrying away of solid waste by waters of the base flood. The owner/operator must place the demonstration in the operating record and notify the State Director that it has been placed in the operating record.

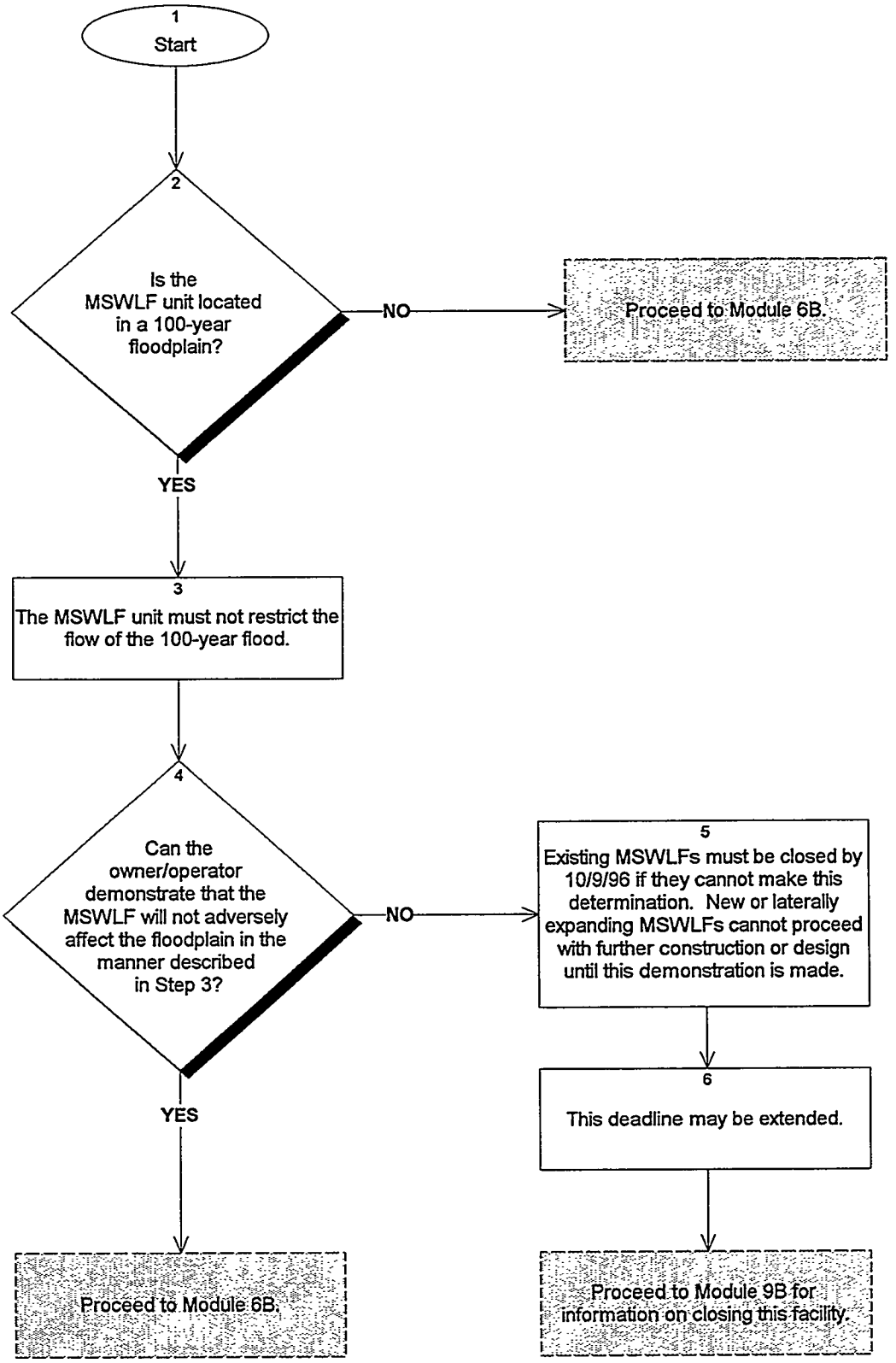
### 6.2.2 Milestones

***Has the owner or operator of the MSWLF been able to demonstrate that the construction of the MSWLF unit will not adversely affect the floodplain?***

Facilities in floodplains must be able to demonstrate that they will not:

- Restrict the flow of the base flood; or
- Negatively impact the temporary storage capacity of the floodplain.

# Figure 6A: Floodplains



**Step 1** Start.

**Step 2** Floodplain means the lowland and relatively flat areas adjoining inland and coastal waters, including flood-prone areas of offshore islands, that are inundated by the 100-year flood.

**Step 3** 100-year flood means a flood that has a one percent or greater chance of recurring in any given year or a flood of a magnitude equalled or exceeded once in 100 years on the average over a significantly long period.

**Step 4** This demonstration must be placed in the operating record. In addition, the owner/operator must notify the State Director.

**Step 5** Existing MSWLF units that cannot make the demonstration pertaining to floodplains must close by October 9, 1996, in accordance with 40 CFR 258.60 and conduct post-closure activities in accordance with 40 CFR 258.61.

**Step 6** The deadline for closure may be extended up to two years if the owner/operator demonstrates to the Director of an approved State that:

(1) There is no available alternative disposal capacity; and
(2) There is no immediate threat to human health and the environment.

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## 6.3 Module 6B: Wetlands

### 6.3.1 Introduction

A wetland is an area of land where the soils are saturated for varying periods of time during the growing season. Wetland soils contain little or no oxygen, and as a result only support plants adapted to such conditions. Wetlands can be found in both tidal and non-tidal areas.

The protection of wetlands has received increasing attention in recent years from Federal and State officials due to increasing recognition of the many valuable functions that wetlands serve. For example, wetlands can enhance water quality by absorbing and filtering harmful sediments, nutrients, and pollutants that can contaminate surface and groundwater. Wetlands can also help prevent floods due to their ability to hold large volumes of water.

MSWLFs may not be constructed in wetlands if the construction will cause or contribute to significant degradation of the wetlands. The wetlands location restriction described in this chapter is applicable to both new and laterally expanding MSWLFs. It is not applicable to existing facilities.

Wetland environments are of particular note to owner/operators of MSWLFs, especially for existing facilities that have been operational for a number of years, because of the common historical practice of locating such facilities in or adjacent to wetland environments.

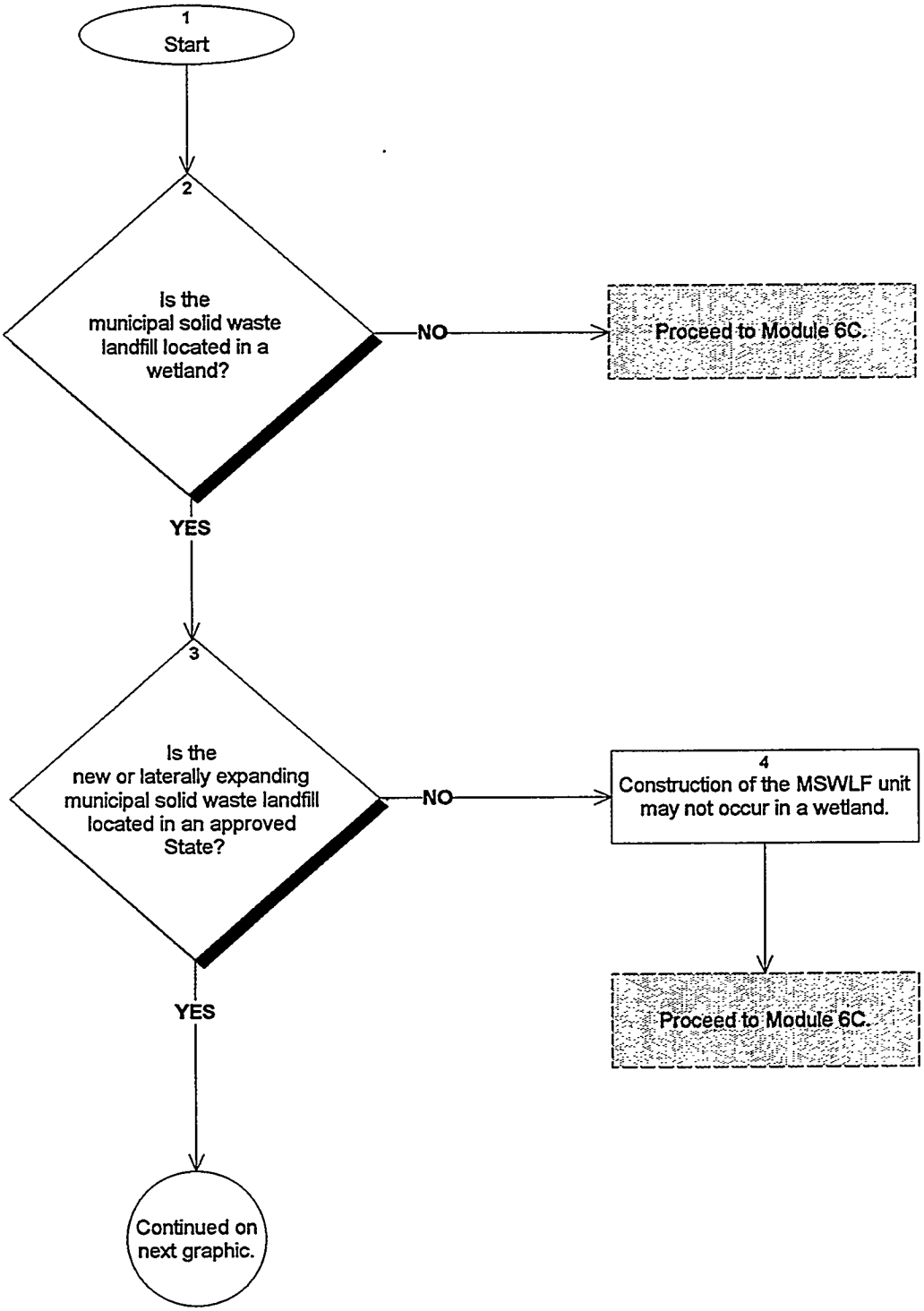
### 6.3.2 Milestones

***Has the owner or operator demonstrated that the MSWLF will not adversely affect wetlands?***

As part of this demonstration, the owner or operator must be able to prove that the construction of the new, or laterally expanding, MSWLF will not:

- Cause or contribute to degradation of the wetlands; or
- Violate applicable provisions of the CWA; the Marine Protection, Research, and Sanctuaries Act; or the Endangered Species Act.

# Figure 6B: Wetlands

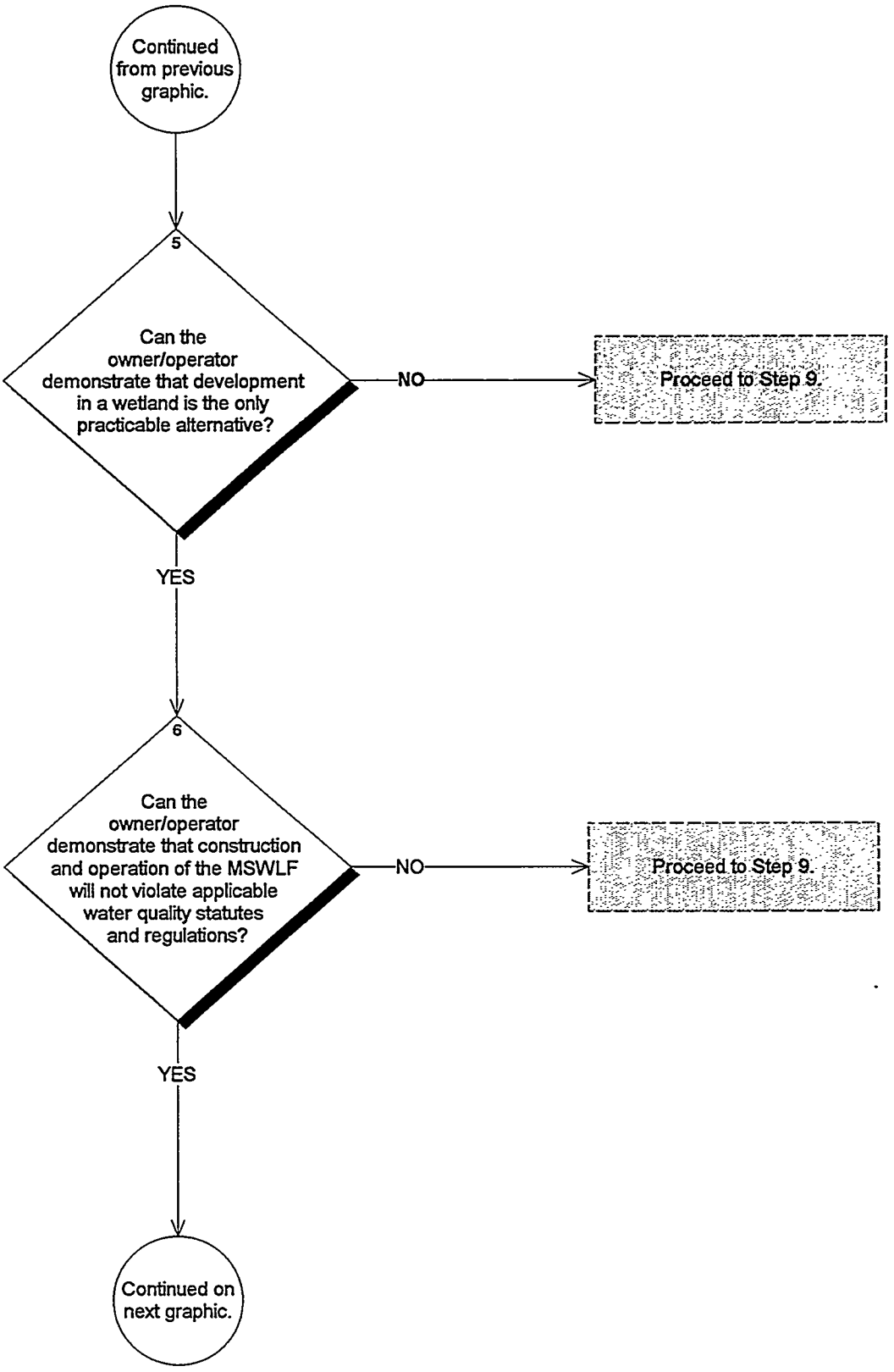


**Step 1** Start.

**Step 2** Wetlands are defined in 40 CFR 232.2(r) as "those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions." Wetlands generally include swamps, marshes, bogs, and similar areas.

**Step 3** An approved State is one that has received the approval of the EPA to regulate its own State program. This approval is based on the EPA's determination that the State has developed a program that is at least as stringent as the Federal program as detailed in 40 CFR Part 258. State programs are sometimes more stringent than the Federal program.

**Step 4** New MSWLF units and lateral expansions shall not be located in wetlands, unless the owner/operator can effectively demonstrate that no practicable alternative to the proposed landfill is available. This demonstration must be made to the State Director of an approved program. Because these demonstrations must be approved by the Director of an approved State, the siting of new MSWLFs and lateral expansions in States that do not have an approved program is effectively banned.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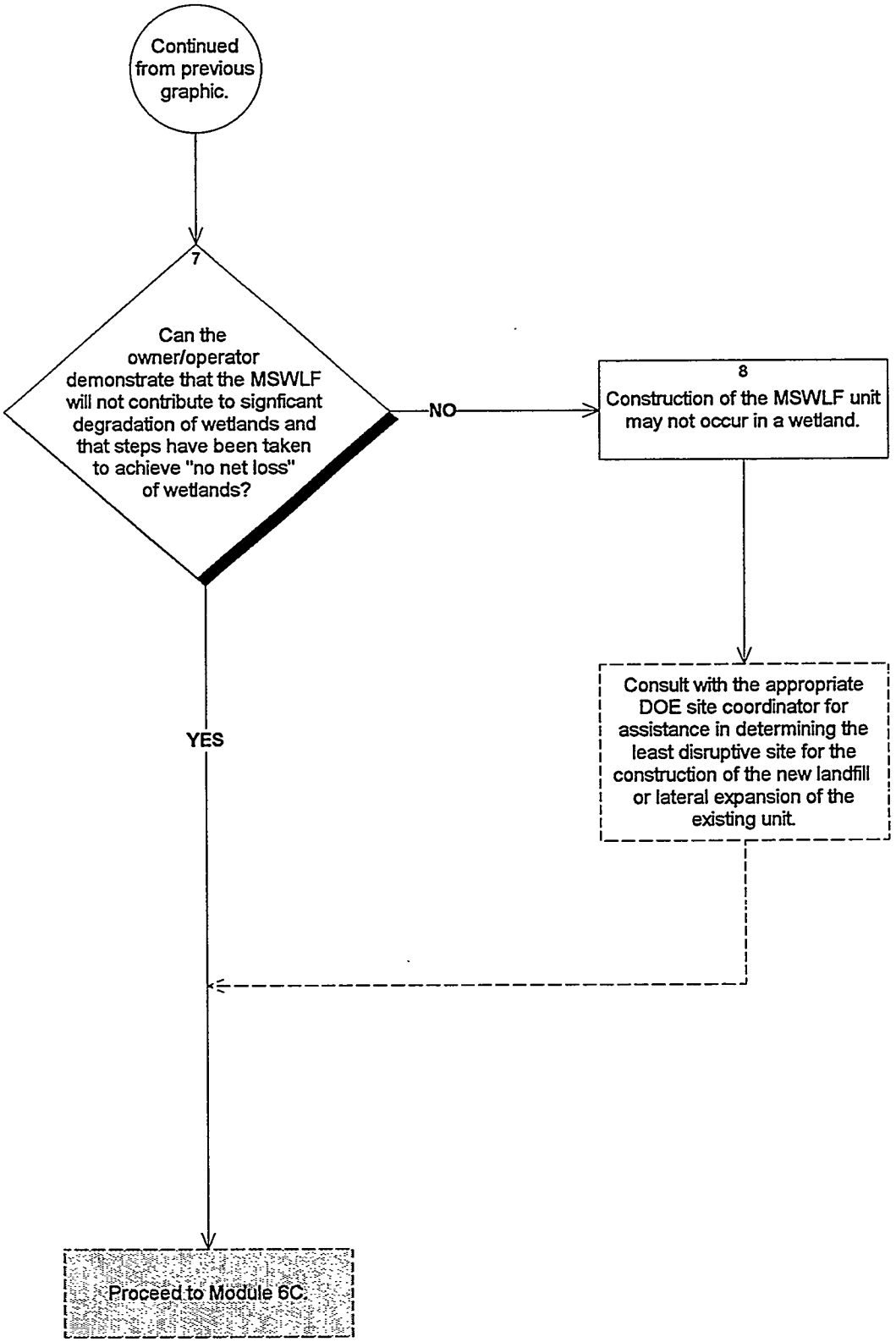
5
Can the owner/operator demonstrate that development in a wetland is the only practicable alternative?
NO
Proceed to Step 9.
YES
6
Can the owner/operator demonstrate that construction and operation of the MSWLF will not violate applicable water quality statutes and regulations?
NO
Proceed to Step 9.
YES
Continued on next graphic.

**Step 5** The presumption that a practicable alternative to the proposed landfill is available which does not involve wetlands must be clearly rebutted.

**Step 6** The construction and operation of the MSWLF unit must not:

(1) Cause or contribute to violations of any applicable State water quality standard;
(2) Violate any applicable toxic effluent standard or prohibition under Section 307 of the CWA;
(3) Jeopardize the continued existence of endangered or threatened species or result in the destruction or adverse modification of a critical habitat protected under the Endangered Species Act of 1973; or
(4) Violate any requirement under the Marine Protection, Research, and Sanctuaries Act of 1972 for the protection of a marine sanctuary.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7
Can the owner/operator demonstrate that the MSWLF will not contribute to signficant degradation of wetlands and that steps have been taken to achieve "no net loss" of wetlands?
NO
8
Construction of the MSWLF unit may not occur in a wetland.
Consult with the appropriate DOE site coordinator for assistance in determining the least disruptive site for the construction of the new landfill or lateral expansion of the existing unit.
YES
Proceed to Module 6C.

**Step 7** The owner/operator must demonstrate the integrity of the MSWLF unit and its ability to protect ecological resources by addressing the following factors:

(1) Erosion, stability, and migration potential of native wetland soils, muds, and deposits used to support the MSWLF unit;
(2) Erosion, stability, and migration potential of dredged and fill materials used to support the MSWLF unit;
(3) The volume and chemical nature of the waste managed in the MSWLF unit;
(4) Impacts on fish, wildlife, and other aquatic resources and their habitat from release of the solid waste;
(5) The potential effects of catastrophic release of waste to the wetland and the resulting impacts on the environment; and
(6) Any additional factors, as necessary, to demonstrate that ecological resources in the wetland are sufficiently protected.

Construction in a wetland cannot occur until these potential negative impacts have been addressed. Furthermore, the owner/operator must demonstrate that to the extent required under Section 404 of the CWA or applicable State wetlands laws, steps have been taken to achieve no net loss of wetlands (as defined by acreage and function) by first avoiding impacts to wetlands to the maximum extent practicable, then minimizing unavoidable impacts to the maximum extent practicable, and finally offsetting remaining unavoidable wetland impacts through all appropriate and practicable compensatory mitigation actions (e.g., restoration of existing degraded wetlands or creation of man-made wetlands). Sufficient information must be available to make a reasonable determination with respect to these demonstrations.

**Step 8** Construction in a wetland cannot occur until the "no net loss" requirements have been addressed.

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## 6.4 Module 6C: Geologically-sensitive Areas

### 6.4.1 Introduction

40 CFR 258 describes three types of unique geologic areas (or formations) that, when present at a site, may:

(1) Preclude its use as a location of a new or laterally expanding MSWLF;
(2) Require the incorporation of special design features; or
(3) Require the owner/operator to make a demonstration that their presence will not infringe upon the structural integrity of the unit.

These three types of geologically-sensitive areas (or formations) are: unstable areas, fault areas, and seismic impact zones.

Unstable areas include: areas susceptible to mass movement, karst terranes, or areas with poor foundations such as weak or unstable soils. Existing MSWLF units that cannot make the demonstration pertaining to unstable areas must close by October 9, 1996, in accordance with 40 CFR 258.60 and must conduct post-closure activities in accordance with 40 CFR 258.61 (closure requirements are discussed in Chapter 9). The deadline for closure may be extended up to two years if the owner/operator demonstrates to the Director of an approved State that:

(1) There is no available alternative disposal capacity; and
(2) There is no immediate threat to human health and the environment.

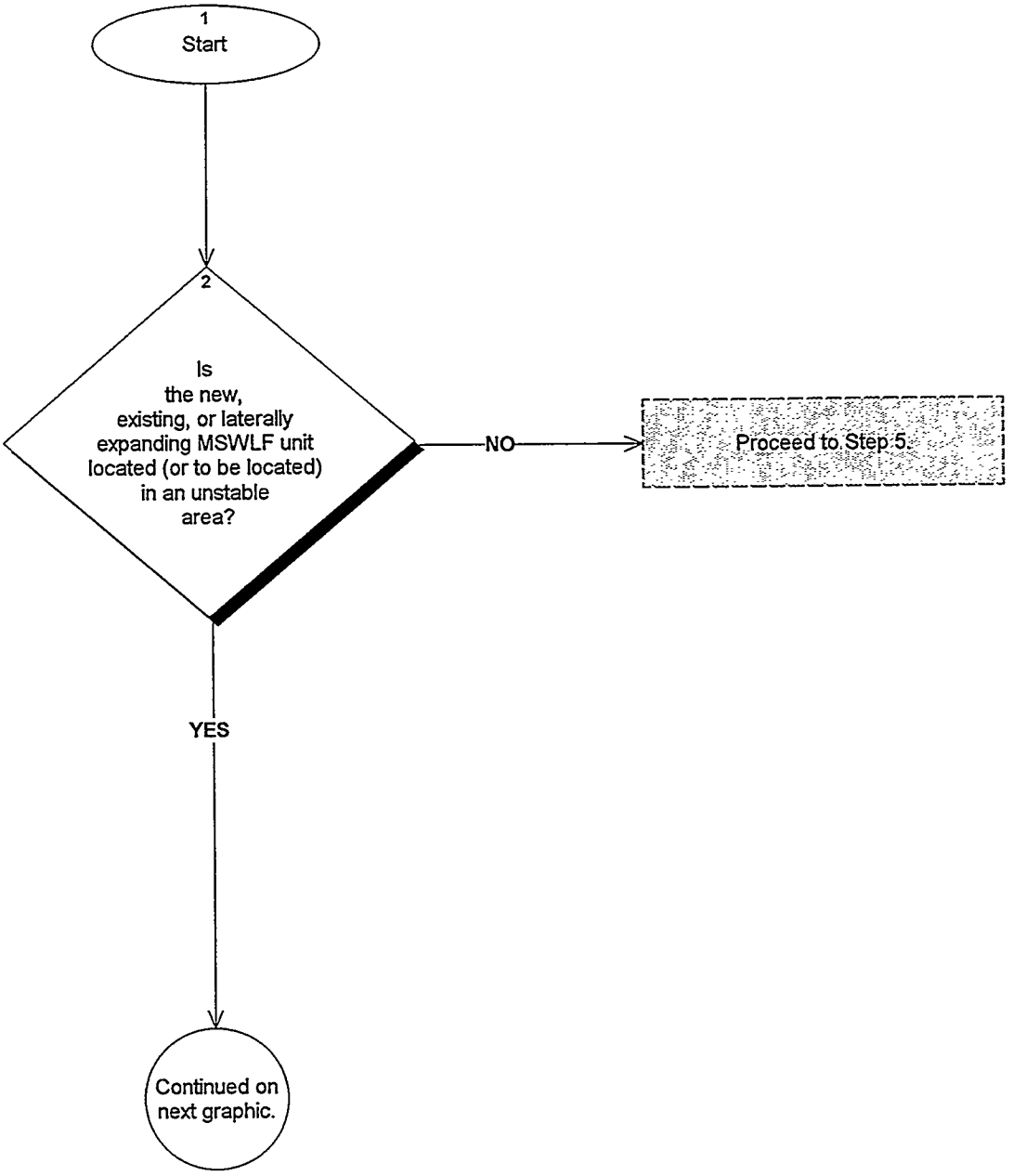
### 6.4.2 Milestones

***Is the MSWLF located, or proposed for location, in a geologically-sensitive area?***

The geologic areas that are considered unique for the purposes of locating an MSWLF are:

- Unstable areas;
- Fault areas; or
- Seismic impact zones.

# Figure 6C: Geologically-sensitive Areas



**Step 1** Start.

**Step 2** An unstable area is one that is susceptible to natural or human-induced events or forces capable of impairing the integrity of some or all of the landfill structural components responsible for preventing releases from a landfill. Structural components are liners, leachate collection systems, final covers, run-on/run-off systems, and any other component used in the construction and operation of the MSWLF that is necessary for protection of human health and the environment. Unstable areas can include poor foundation conditions, areas susceptible to mass movements, and karst terranes.

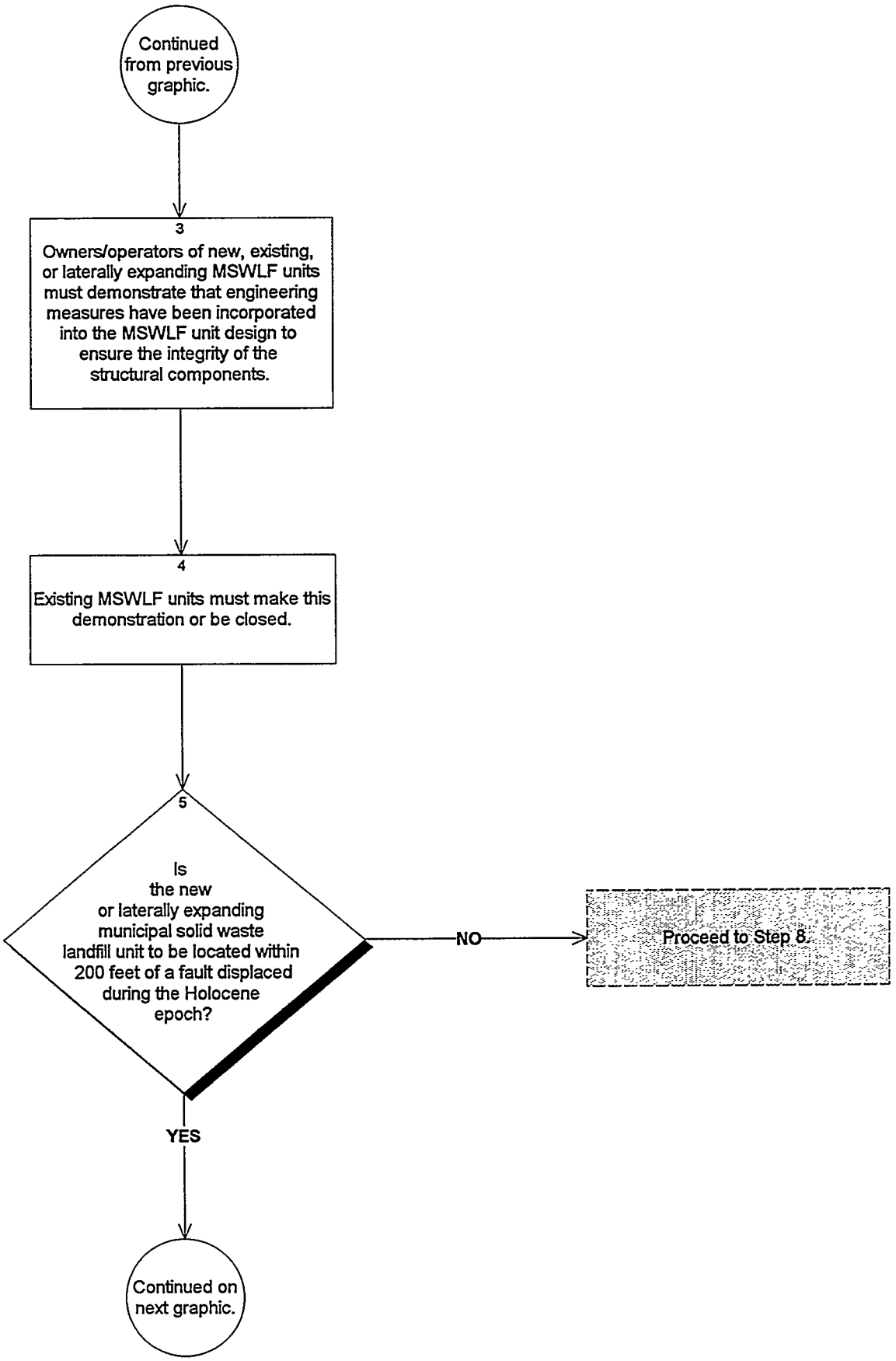
Poor foundation conditions are defined as those areas where features exist which indicate that a natural or man-induced event may result in inadequate foundation support for the structural components of an MSWLF unit. Areas susceptible to mass movement are those areas of influence (i.e., areas characterized as having an active or substantial possibility of mass movement) where the movement of earth material at, beneath, or adjacent to the MSWLF unit, because of natural or man-induced events, results in the downslope transport of soil and rock material by means of gravitational influence.

Areas of mass movement include, but are not limited to, landslides, avalanches, debris slides and flows, block sliding, and rock fall.

Karst terranes are areas where karst topography, with its characteristic surface and subterranean features, is developed as the result of dissolution of limestone, dolomite, or other soluble rock. Characteristic physiographic features present in karst terranes include, but are not limited to, sinkholes, sinking streams, caves, large springs, and blind valleys.

The owner/operator must consider the following factors, at a minimum, when determining whether an area is unstable:

(1) On-site or local soil conditions that may result in significant differential settling;
(2) On-site or local geologic or geomorphologic features; and
(3) On-site or local human-made features or events (both surface and subsurface.)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3
Owners/operators of new, existing, or laterally expanding MSWLF units must demonstrate that engineering measures have been incorporated into the MSWLF unit design to ensure the integrity of the structural components.
4
Existing MSWLF units must make this demonstration or be closed.
5
Is the new or laterally expanding municipal solid waste landfill unit to be located within 200 feet of a fault displaced during the Holocene epoch?
NO
Proceed to Step 8.
YES
Continued on next graphic.

**Step 3** Owners/operators of new MSWLF units, existing MSWLF units, and lateral expansions located in an unstable area must demonstrate that engineering measures have been incorporated into the MSWLF unit's design to ensure that the integrity of the structural components of the MSWLF unit will not be disrupted. The owner/operator must place the demonstration in the operating record and notify the State Director that it has been placed in the operating record.

**Step 4** Existing units that cannot make this demonstration must close by October 9, 1996, in accordance with the closure and post-closure requirements described in Chapter 9.

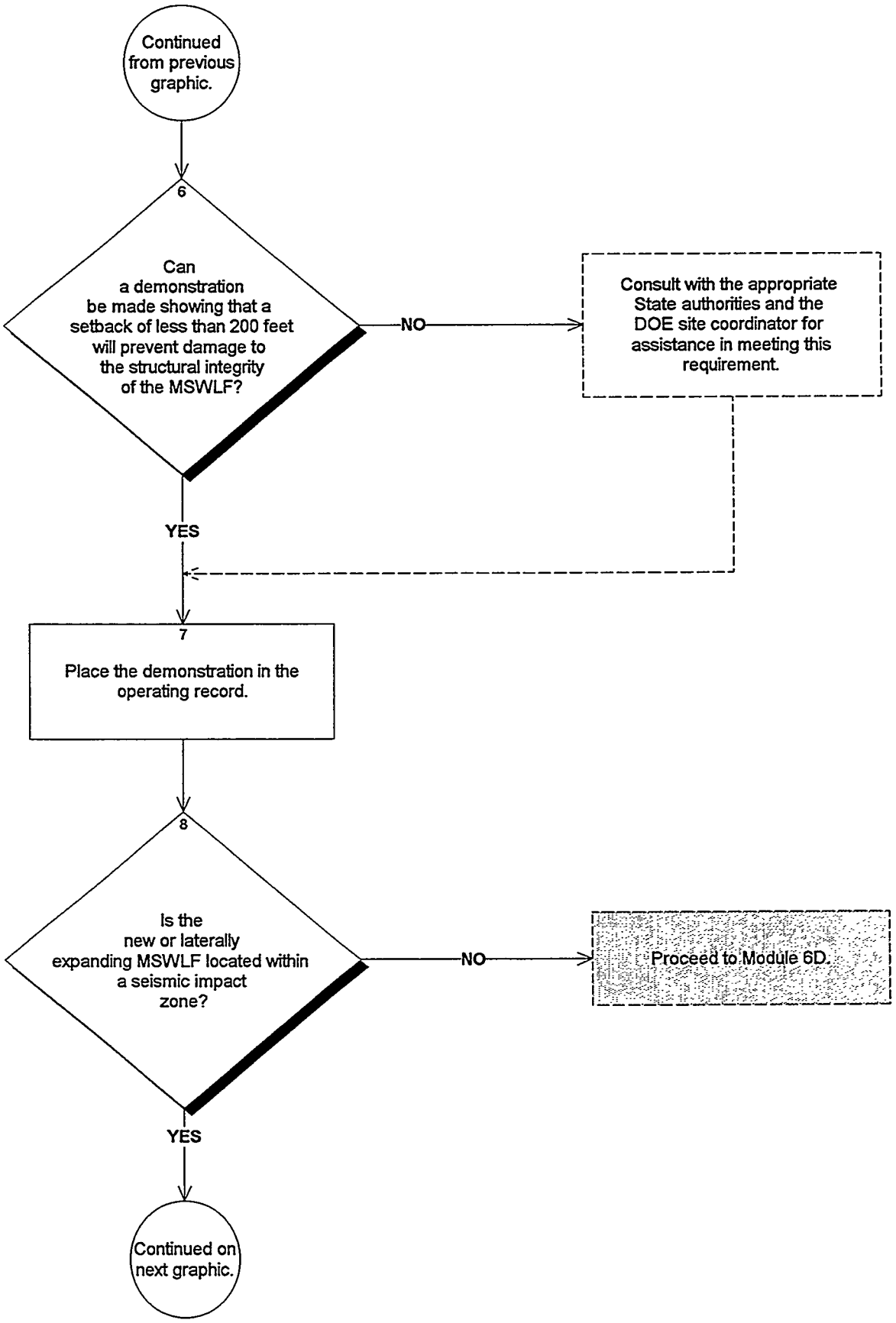
This deadline may be extended for up to two years if the owner/operator demonstrates to the Director of an approved State that there is no available alternative disposal capacity, and if there is no immediate threat to human health or the environment.

**Step 5** Fault means a fracture or a zone of fractures in any material along which strata on one side have been displaced with respect to those on the other side.

Displacement means the relative movement of any two sides of a fault measured in any direction.

Holocene means the most recent epoch of the Quaternary period, extending from the end of the Pleistocene Epoch to the present.

Consult the U.S. Geological Survey map on Holocene fault locations in the United States.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6
Can a demonstration be made showing that a setback of less than 200 feet will prevent damage to the structural integrity of the MSWLF?
NO
Consult with the appropriate State authorities and the DOE site coordinator for assistance in meeting this requirement.
YES
7
Place the demonstration in the operating record.
8
Is the new or laterally expanding MSWLF located within a seismic impact zone?
NO
Proceed to Module 6D.
YES
Continued on next graphic.

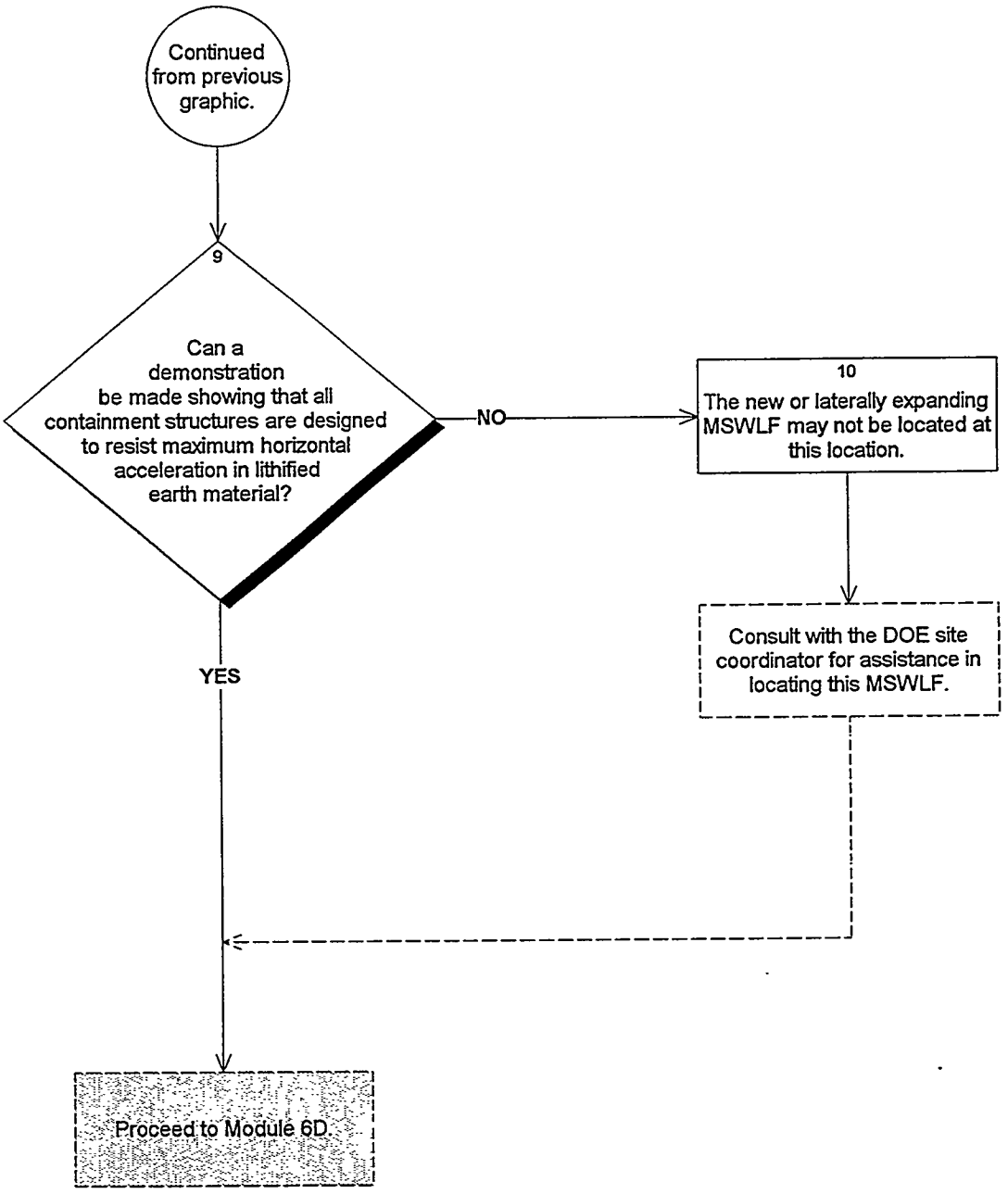
**Step 6** New MSWLF units and lateral expansions shall not be located within 200 feet (60 meters) of a fault that has had displacement in Holocene time unless the owner/ operator demonstrates to the Director of an approved State that an alternative setback distance of less than 200 feet (60 meters) will prevent damage to the structural integrity of the MSWLFs and will be protective of human health and the environment.

Existing MSWLFs (those in existence prior to 10/9/91) and new or laterally expanding MSWLFs outside of the fault areas (as defined) are not obligated to comply with this requirement.

**Step 7** Module 7F in Chapter 7 provides further details on the development and maintenance of the facility's operating record.

**Step 8** Seismic impact zone means an area with a ten percent or greater probability that the maximum horizontal acceleration in lithified earth material, expressed as a percentage of the earth's gravitational pull, will exceed 0.10g in 250 years.

Consult U.S. Geologic Survey open-file report 82-1033.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9
Can a demonstration be made showing that all containment structures are designed to resist maximum horizontal acceleration in lithified earth material?
NO
10
The new or laterally expanding MSWLF may not be located at this location.
Consult with the DOE site coordinator for assistance in locating this MSWLF.
YES
Proceed to Module 6D.

**Step 9** New MSWLF units and lateral expansions shall not be located in seismic impact zones, unless the owner/operator demonstrates to the Director of an approved State/Tribe that all containment structures, including liners, leachate collection systems, and surface water control systems, are designed to resist the maximum horizontal acceleration in lithified earth material for the site. The owner/operator must place the demonstration in the operating record and notify the State Director that it has been placed in the operating record.

Maximum horizontal acceleration in lithified earth material means the maximum expected horizontal acceleration depicted on a seismic hazard map, with a 90 percent or greater probability that the acceleration will not be exceeded in 250 years, or the maximum expected horizontal acceleration based on a site-specific seismic risk assessment.

Lithified earth material means all rock, including all naturally occurring and naturally formed aggregates or masses of minerals or small particles of older rock that formed by crystallization of magma or by cementation of loose sediments. This term does not include man-made materials, such as fill, concrete, and asphalt, or unconsolidated earth materials, soil, or regolith lying at or near the earth surface.

Existing MSWLF units and units that are not located in seismic impact zones are not subject to the requirements of this module.

**Step 10** It is also important to remember that MSWLF units located in unapproved States cannot be located in seismic impact zones, because the demonstration can only be made to Directors of approved States.

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## 6.5 Module 6D: Airport Safety

### 6.5.1 Introduction

Because MSWLFs attract scavenging animals, including seagulls and other birds, the owners/operators of MSWLFs must be aware that the presence of a large number of birds at the MSWLF could pose a threat to the safe operation of airports in the vicinity. Because of this potential threat, 40 CFR 258.10 requires that owners/operators demonstrate that the MSWLF will not pose a threat to airplanes entering and leaving local airports.

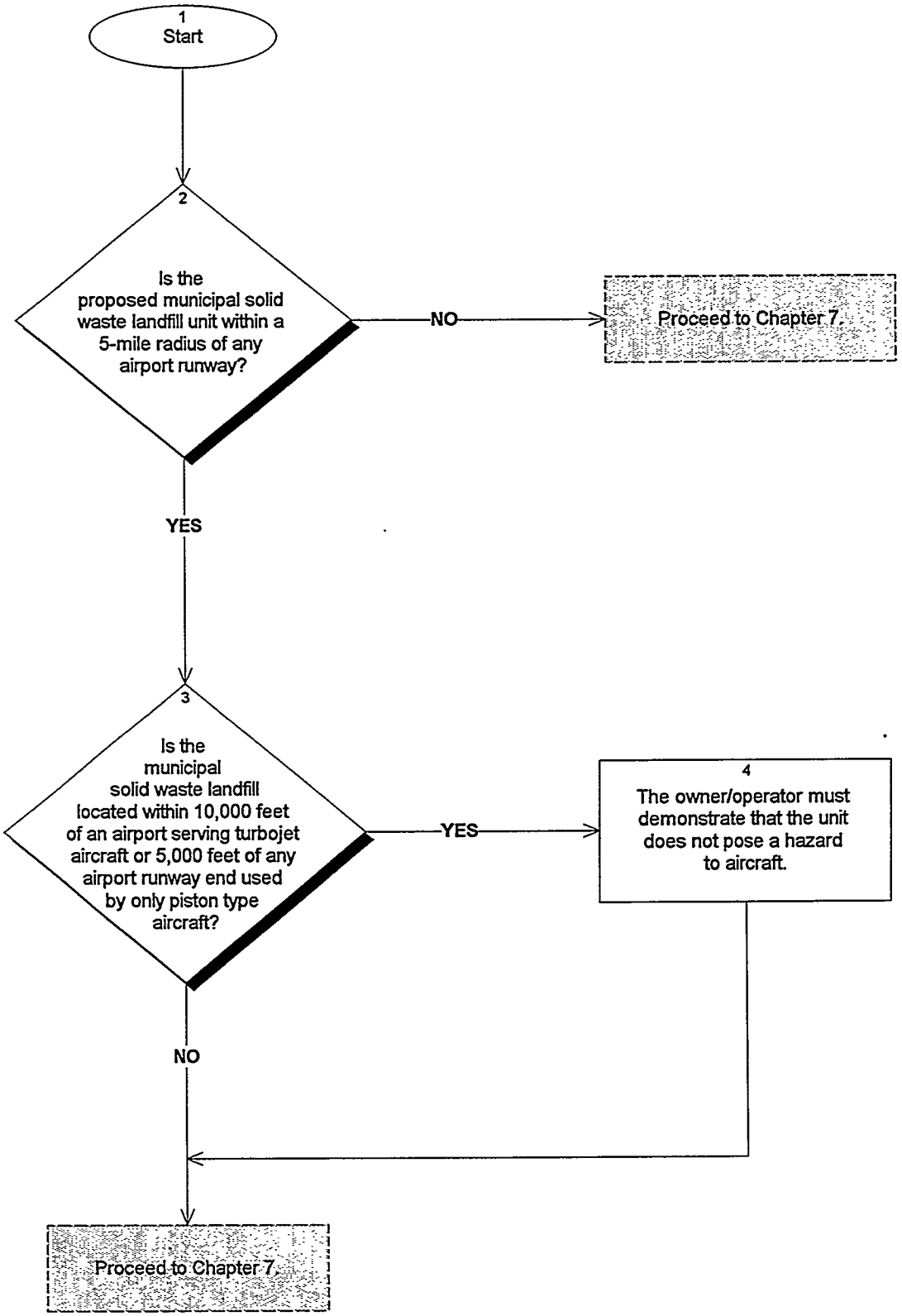
### 6.5.2 Milestones

***Have the owners or operators made the demonstration pertaining to airport safety?***

This demonstration pertains to:

- Existing;
- Laterally expanding; and
- New MSWLFs.

# Figure 6D: Airport Safety



**Step 1** Start.

**Step 2** Owners/operators proposing to site new MSWLF units and lateral expansions within a five-mile radius of any airport runway end used by turbojet or piston-type aircraft must notify the affected airport and the FAA.

Consult FAA Order 5200.5A (January 1990) for FAA's position on MSWLFs on or near airports.

**Step 3** Owners/operators of new MSWLF units, existing MSWLF units, and lateral expansions that are located within 10,000 feet (3,048 meters) of any airport runway end used by turbojet aircraft or within 5,000 feet (1,524 meters) of any airport runway end used by only piston-type aircraft must demonstrate that the units are designed and operated so that the MSWLF unit does not pose a bird hazard to aircraft. Airport means public-use airport open to the public without prior permission and without restrictions within the physical capacities of available facilities. Bird hazard means an increase in the likelihood of bird/aircraft collisions that may cause damage to the aircraft or injury to its occupants.

**Step 4** The owner/operator must place the demonstration in the operating record and notify the State Director that it has been placed in the operating record.

Existing MSWLF units that cannot make the demonstration specified in 40 CFR 258.10(a) (pertaining to Step 3) must close by October 9, 1996, in accordance with the closure and post-closure activities described in Chapter 9. The deadline for closure may be extended up to two years if the owner/operator demonstrates to the Director of an approved state that:

(1) There is no available alternative disposal capacity; and
(2) There is no immediate threat to human health and the environment.

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# Chapter 7
# Design and Operating Criteria for Municipal Solid Waste Landfills

**Contents**

## 7.1 Introduction

### 7.1.1 Background

MSWLFs must comply with the design and operational requirements of two parts of 40 CFR: Part 258 and Part 241. Part 241 covers all solid waste facilities, while Part 258 addresses only MSWLFs. Chapter 3 addressed the requirements mandated by 40 CFR Part 241. This chapter provides the information from Part 258 needed to safely operate an MSWLF in compliance with these requirements.

Part 258 establishes minimum national operational and design criteria for MSWLFs, including those used for sludge disposal and disposal of nonhazardous municipal waste combustion (MWC) ash. The operational requirements address the following:

(1) (Non) Receipt of hazardous waste;
(2) Daily cover;
(3) Control of on-site disease vectors;
(4) Routine methane gas monitoring;
(5) Elimination of most open burning;
(6) Control of public access;
(7) Construction of run-on and run-off control systems;
(8) Elimination of disposal of most liquid wastes; and
(9) Recordkeeping to demonstrate compliance with these requirements.

All of the operational requirements apply to new units, existing units, and lateral expansions. However, the design criteria (site design and composite liner design) requirements only apply to new units and lateral expansions. Existing MSWLFs are exempt from Subpart D (Design Criteria) of 40 CFR Part 258.

MSWLFs subject to the design and/or operational criteria of 40 CFR Part 258 were required to achieve compliance by October 9, 1993.

## 7.2 Module 7A: Liner Design

### 7.2.1 Introduction

New MSWLF units and lateral expansions must be constructed with either: (1) a uniform design consisting of a composite liner and leachate collection system meeting specific requirements, or (2) a site-specific design that is approved by the Director of an approved State and that meets a performance standard (i.e., these designs must meet EPA-approved concentration limits for constituents in groundwater).

This approach provides flexibility by allowing landfill designs to be based on consideration of site-specific factors in approved States. It also provides States and local governments with limited technical expertise and resources with an EPA-approved uniform design. In selecting this uniform design, EPA's goal was to identify a design for MSWLFs that would provide adequate protection in all locations.

It is important to note that under certain conditions owners and operators of MSWLFs located in **unapproved** States that normally must comply with the uniform design requirements may petition the EPA for permission to use a site-specific design.

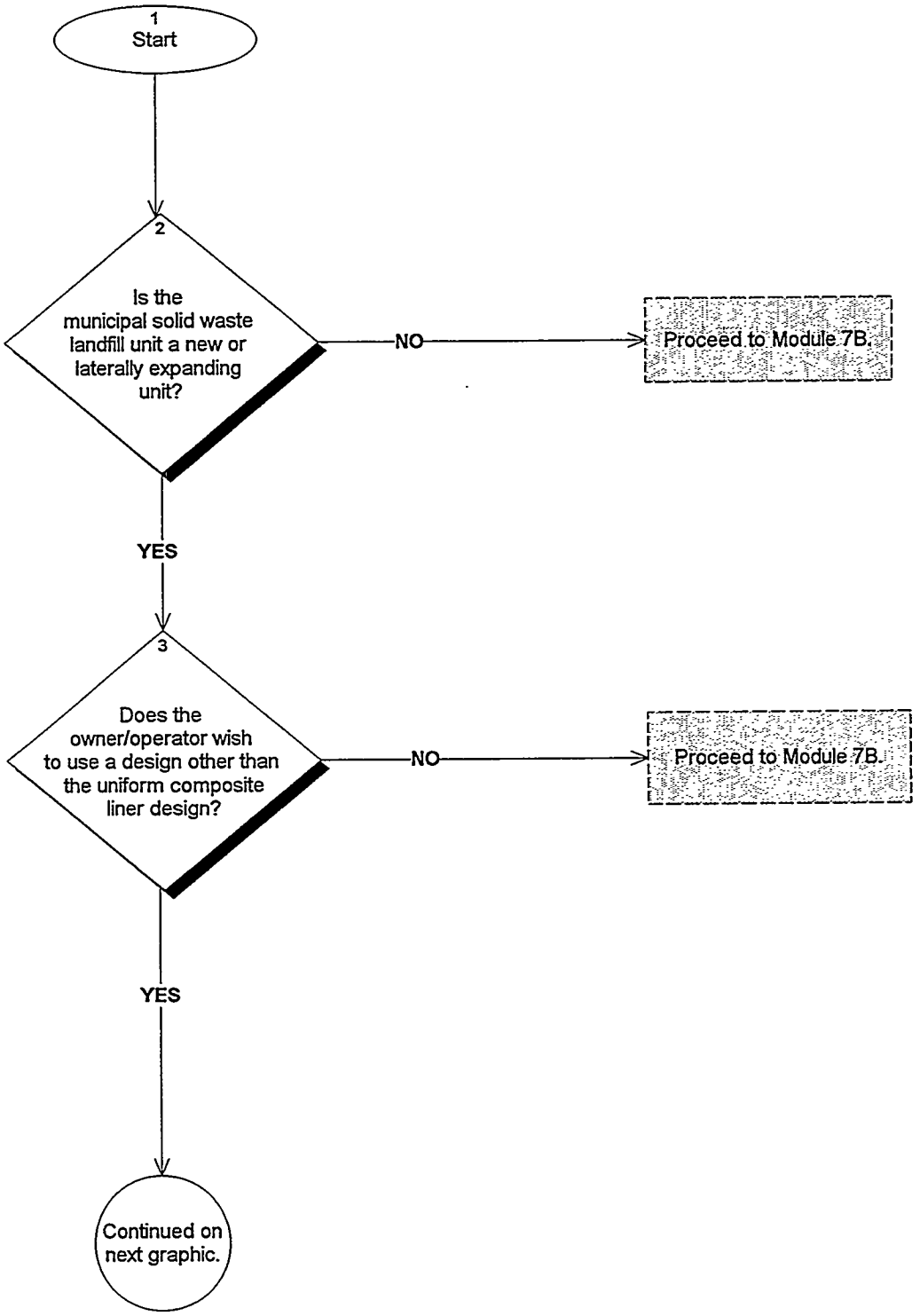
### 7.2.2 Milestones

***Does the landfill's liner meet the required design criteria?***

The new or laterally expanding landfill must meet either:

- The uniform design standard; or
- The design standard approved by the Director of an approved State.

# Figure 7A: Liner Design



**Step 1** Start

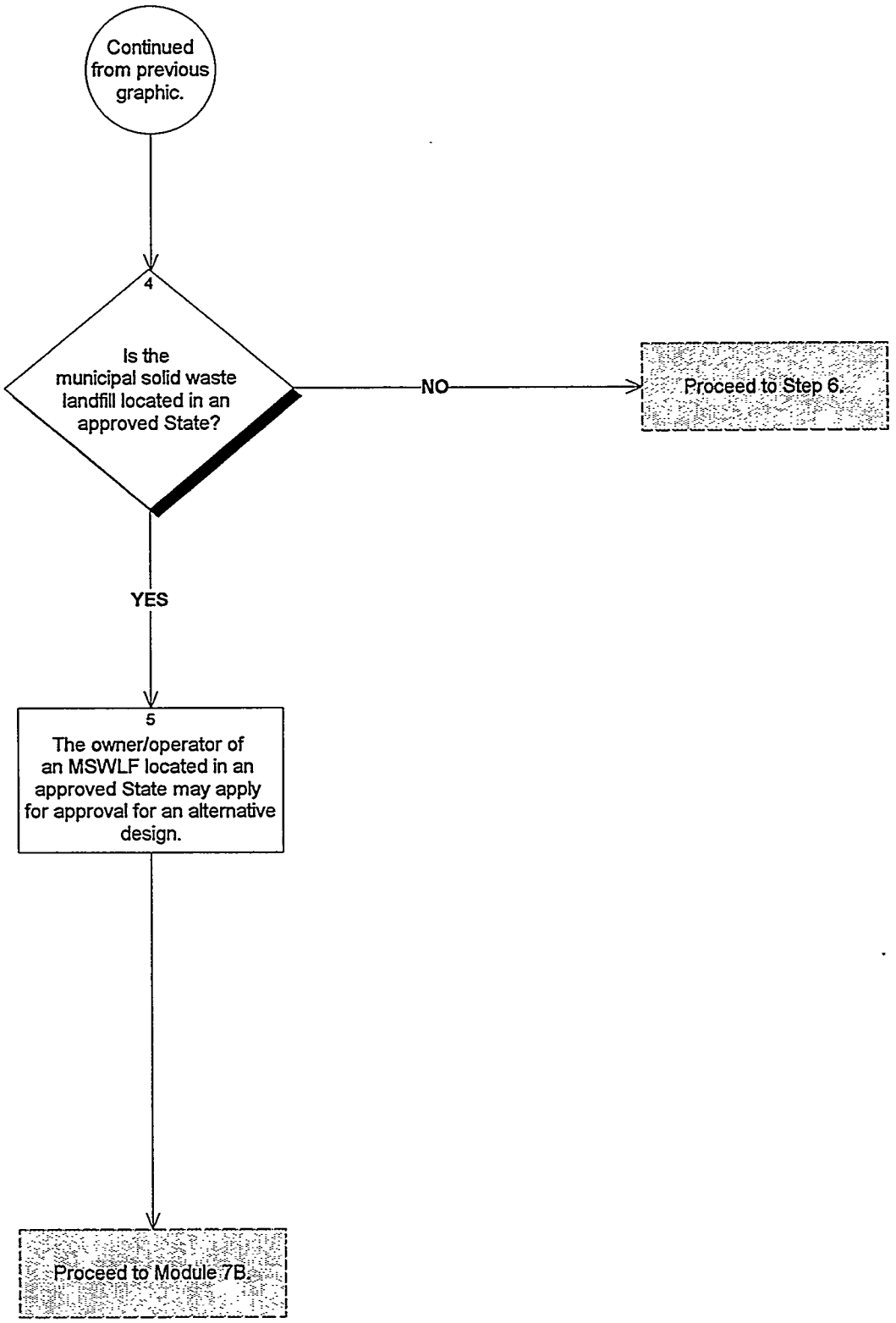
**Step 2** The design criteria of 40 CFR 258 are applicable only to new MSWLF units and lateral expansions that are not exempt from Subpart D of 40 CFR 258 (See Module A of Chapter 5 to determine if the MSWLF is exempt from this subpart.)

**Step 3** The uniform composite liner design standard consists of a composite liner and a leachate collection system that maintains less than a 30-cm depth of leachate over the liner. In selecting a uniform design, EPA's goal was to identify one that would provide adequate protection in all locations, including poor locations.

The composite liner is made up of both an upper and lower component. The upper component must consist of a minimum 30-mil (1 mil = 0.001 inch) flexible membrane liner (FML). FML components consisting of high density polyethylene (HDPE), however, should be at least 60-mil thick. Based on EPA's experience with these liner materials, these are the minimum thicknesses necessary to ensure adequate liner performance (see "Lining of Waste Containment and Other Impoundment Facilities," U.S. EPA/RREL, EPA/600/2-88/052, September 1988).

The FML component must be installed in direct and uniform contact with the lower component, which must consist of a two-foot or greater layer of compacted soil with a hydraulic conductivity of no more than $1x10^{-7}$ cm/sec. The upper FML component provides a highly impermeable layer to maximize leachate collection and removal, while the lower soil component serves as a back up in the event of FML liner failure.

The uniform composite liner design standard is open to MSWLFs in States with or without approved programs.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4
Is the municipal solid waste landfill located in an approved State?
NO
Proceed to Step 6.
YES
5
The owner/operator of an MSWLF located in an approved State may apply for approval for an alternative design.
Proceed to Module 7B.

**Step 4** The EPA approves a State program by determining that the State has developed an MSW permit program (or other system of prior approval) adequate to ensure that each MSWLF that may receive household hazardous waste (HHW) or SQG waste will comply with 40 CFR Part 258. (EPA plans to propose that Indian Tribes also be eligible for permit program approval.)

**Step 5** Directors of approved States may approve a site-specific liner design instead of the uniform composite liner design. However, all site-specific liner designs must meet the performance standard of 40 CFR Part 258. This standard requires that State-approved designs ensure that the concentration values listed in Table 7-1 (see page 192) will not be exceeded in the uppermost aquifer at the relevant point of compliance (POC), as determined by the State. (EPA plans to update this list as new MCLs are promulgated.)

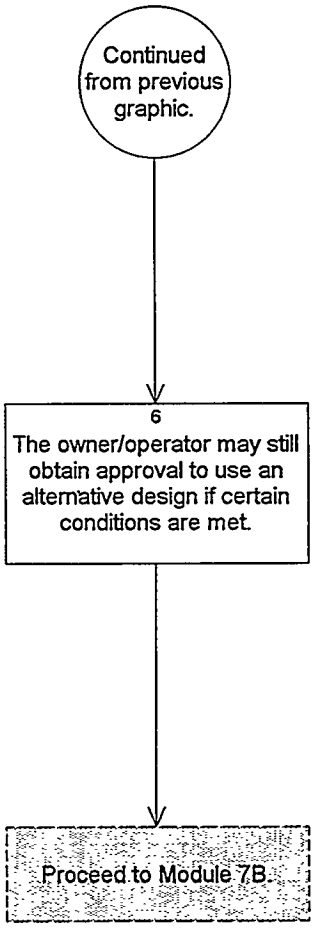
The relevant POC specified by the Director of an approved State must be no more than 150 meters from the waste management unit boundary on land owned by the owner of the MSWLF. In determining the relevant POC, the State must consider, at a minimum, the following set of factors:

(1) The hydrogeologic characteristics of the facility and surrounding land;
(2) The volume and physical and chemical characteristics of the leachate;
(3) The quantity, quality, and direction of flow of groundwater;
(4) The proximity and withdrawal rate of the groundwater users;
(5) The availability of alternative drinking water supplies;
(6) The existing quality of the groundwater, including other sources of contamination and their cumulative impacts on the groundwater, and whether the groundwater is currently used or reasonably expected to be used for drinking water;
(7) Public health, safety, and welfare effects; and
(8) Practicable capability of the owner/operator.

When approving a site-specific landfill design that complies with the performance standard, the Director of an approved State should also consider, at a minimum:

(1) The hydrogeologic characteristics of the facility and surrounding land;
(2) The climate of the area; and
(3) The volume and physical and chemical characteristics of the leachate.

EPA believes that these factors are relevant and important for evaluating landfill designs because they all influence the nature and extent of releases to groundwater. (Guidance on consideration of these factors in landfill design will be included in an upcoming EPA technical guidance document.)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6
The owner/operator may still obtain approval to use an alternative design if certain conditions are met.
Proceed to Module 7B.

**Step 6** Under certain circumstances, unapproved States may also approve a site-specific landfill design. EPA is concerned that certain owners/operators of new or laterally expanding MSWLFs in unapproved States may be forced to use the more stringent uniform design standard in situations where it is not necessary to protect human health and the environment only because their State does not have program approval.

EPA established a petition process that would allow the owners/operators of MSWLFs in unapproved States to utilize a site-specific landfill design meeting the performance standard when the following criteria are met:

(1) EPA does not promulgate a rule establishing the procedures and requirements for State compliance with RCRA Section 4005(c)(1)(B) by October 9, 1993;
(2) The State determines that the design meets the performance standard;
(3) The State considers the following factors when approving an alternative landfill design that complies with the performance standard:
    (i) The hydrogeologic characteristics of the facility and surrounding land;
    (ii) The climate of the area; and
    (iii) The volume and physical and chemical characteristics of the leachate;
(4) The State petitions EPA to review its determination; and
(5) EPA approves the State determination (or does not disapprove the determination within 30 days).

Only when an unapproved State petitions EPA to review its determination that a site-specific landfill design meets the "performance standard" of 40 CFR 258.40, **and** the other conditions for an exclusion from the uniform design standard are met, may the State approve a site-specific liner design.

## Table 7-1
## Concentration Values*

| Chemical | MCL (mg/l) |
|---|---|
| Arsenic | 0.05 |
| Barium | 1.0 |
| Benzene | 0.005 |
| Cadmium | 0.01 |
| Carbon tetrachloride | 0.005 |
| Chromium (hexavalent) | 0.05 |
| 2,4-Dichlorophenoxy acetic acid | 0.1 |
| 1,4-Dichlorobenzene | 0.075 |
| 1,2-Dichloroethane | 0.005 |
| 1,1-Dichloroethylene | 0.007 |
| Endrin | 0.0002 |
| Fluoride | 4 |
| Lindane | 0.004 |
| Lead | 0.05 |
| Mercury | 0.002 |
| Methoxychlor | 0.1 |
| Nitrate | 10 |
| Selenium | 0.01 |
| Silver | 0.05 |
| Toxaphene | 0.005 |
| 1,1,1-Trichloromethane | 0.2 |
| Trichloroethylene | 0.005 |
| 2,4,5-Trichlorophenoxy acetic acid | 0.01 |
| Vinyl Chloride | 0.002 |

* Concentration Values which must not be exceeded in the uppermost aquifer at the relevant point of compliance. [40 CFR 258.40]

## 7.3 Module 7B: Access Control

### 7.3.1 Introduction

Access control at MSWLFs is necessary because people have suffered injury and even death at uncontrolled waste disposal sites. In addition to minimizing risk to the public, access restrictions minimize illegal dumping of wastes at the site.

Part 258 mandates that owners/operators of MSWLFs control public access and restrict access of unauthorized vehicles. In doing so, they may use either artificial barriers, natural barriers, or both, as appropriate to protect human health and the environment. The most effective way to minimize risk to the public is to completely prohibit access to the site by unauthorized users (e.g., by using suitable fencing).

Part 258 also requires owners/operators of MSWLFs to establish a program at the facility for detecting and preventing disposal of "regulated hazardous wastes" and PCB waste. Such a program would minimize inadvertent contact with hazardous materials by employees at the facility and would discourage attempts to dump unauthorized substances at the facility.

Because the disposal of liquids into landfills can be a significant source of leachate generation, 40 CFR Part 258 also requires owners/operators of MSWLFs to restrict disposal of almost all types of liquids. Such a restriction would reduce the risk of liner failure and subsequent contamination of groundwater.

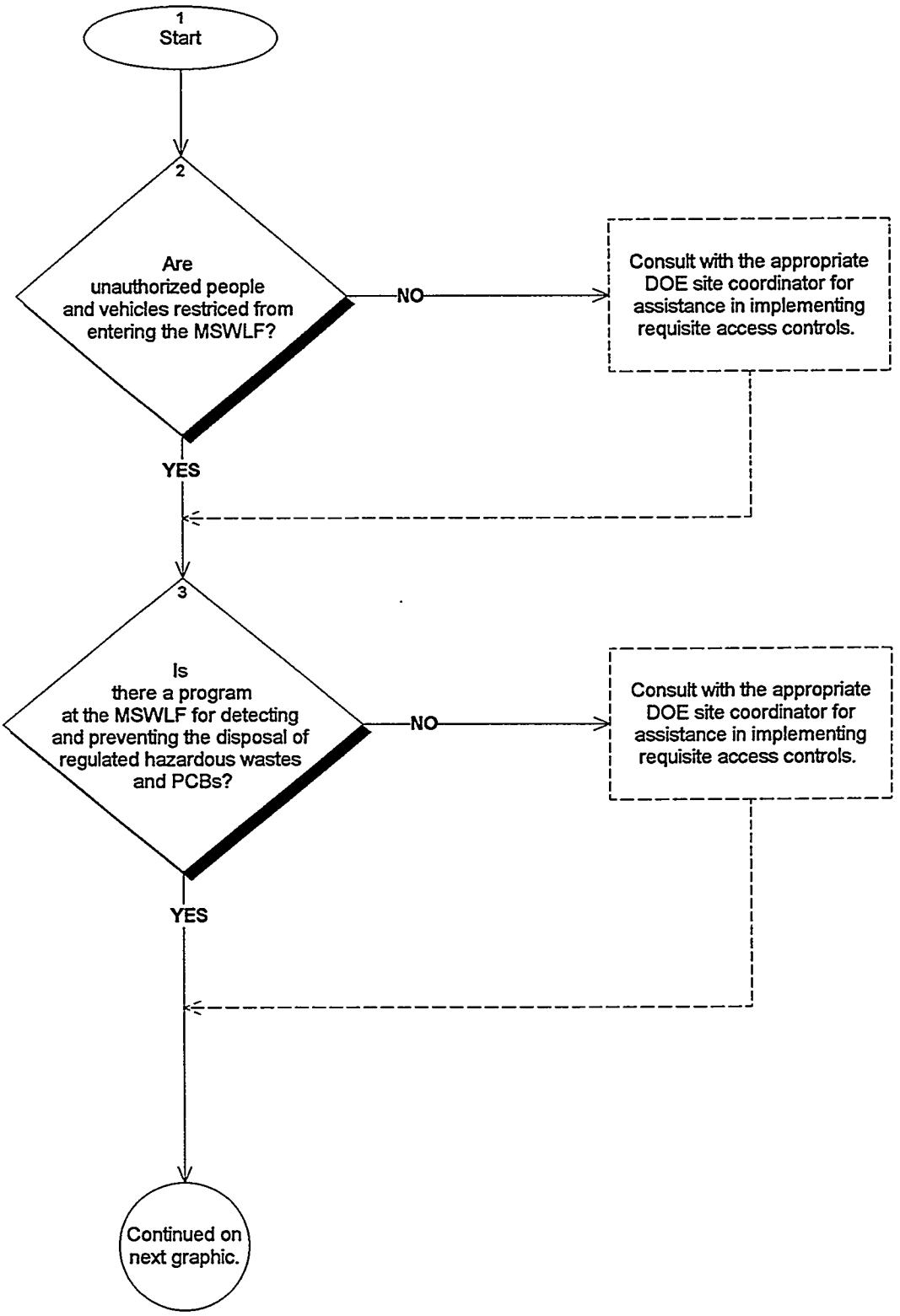
### 7.3.2 Milestones

***Have all of the access control requirements been met?***

The access control requirements apply to:

- Regulated hazardous wastes;
- Polychlorinated biphenyls (PCBs); and
- Landfill patrons and their vehicles.

# Figure 7B: Access Control

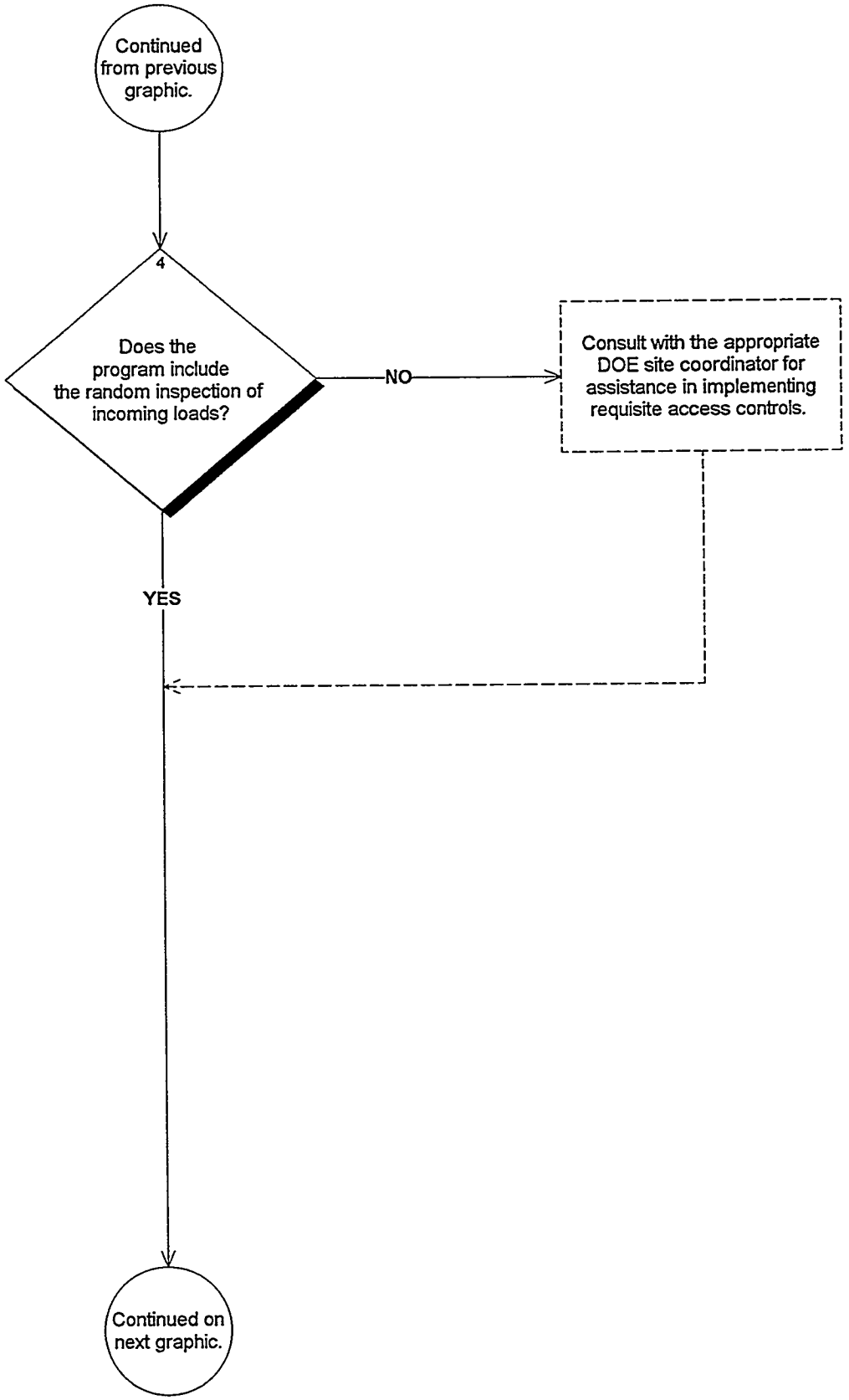


**Step 1** Start.

**Step 2** Access of unauthorized vehicles and people to an MSWLF may be controlled by using artificial barriers, natural barriers, or both as necessary. The type of barrier chosen must be appropriate to protect human health and the environment. Control of access to the site will prevent illegal dumping of wastes and public exposure to hazards at MSWLFs. When necessary, a waste receptacle may be placed just outside the MSWLF for disposal of waste when the facility is closed. To determine other access restrictions for MSWLFs, proceed to Step 3.

**Step 3** "Regulated hazardous wastes" are wastes regulated under Subtitle C of RCRA. They are defined as solid waste that is a hazardous waste, as defined in 40 CFR 261.3, that is not excluded from regulation as a hazardous waste under 40 CFR 261.4(b), or was not generated by a conditionally exempt SQG. PCBs are polychlorinated biphenyl wastes regulated under the Toxic Substances Control Act (TSCA).

For assistance in identifying and defining hazardous wastes, please consult "Definition of Solid and Hazardous Waste" (DOE/EH-273, August 1992). For assistance in identifying and managing PCB waste, consult "Guidance on the Management of PCBs" (DOE/EH-0350, November 1993). Both of these documents were published by the DOE Office of Environmental Policy and Assistance.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4
Does the program include the random inspection of incoming loads?
NO
Consult with the appropriate DOE site coordinator for assistance in implementing requisite access controls.
YES
Continued on next graphic.

**Step 4** As the first of four elements of its on-site program to prevent disposal of "regulated hazardous waste" and PCB waste at MSWLFs, owners/operators of the facilities must inspect incoming loads at random. The appropriate frequency for inspections will vary significantly based on site-specific factors, including the owner/operator's knowledge of the waste generator and hauler and the source of waste received. (EPA plans to provide additional guidance on this issue.)

An adequate inspection would involve discharging a waste load and viewing the contents before disposal. At this time, the inspector should determine the nature of all materials in the load and whether or not they are "regulated hazardous wastes" or PCB waste. For wastes of unknown nature received from sources other than households (e.g., industrial or commercial establishments), the inspector should question the transporter about the composition of materials.

Inspections could be performed at the following locations:

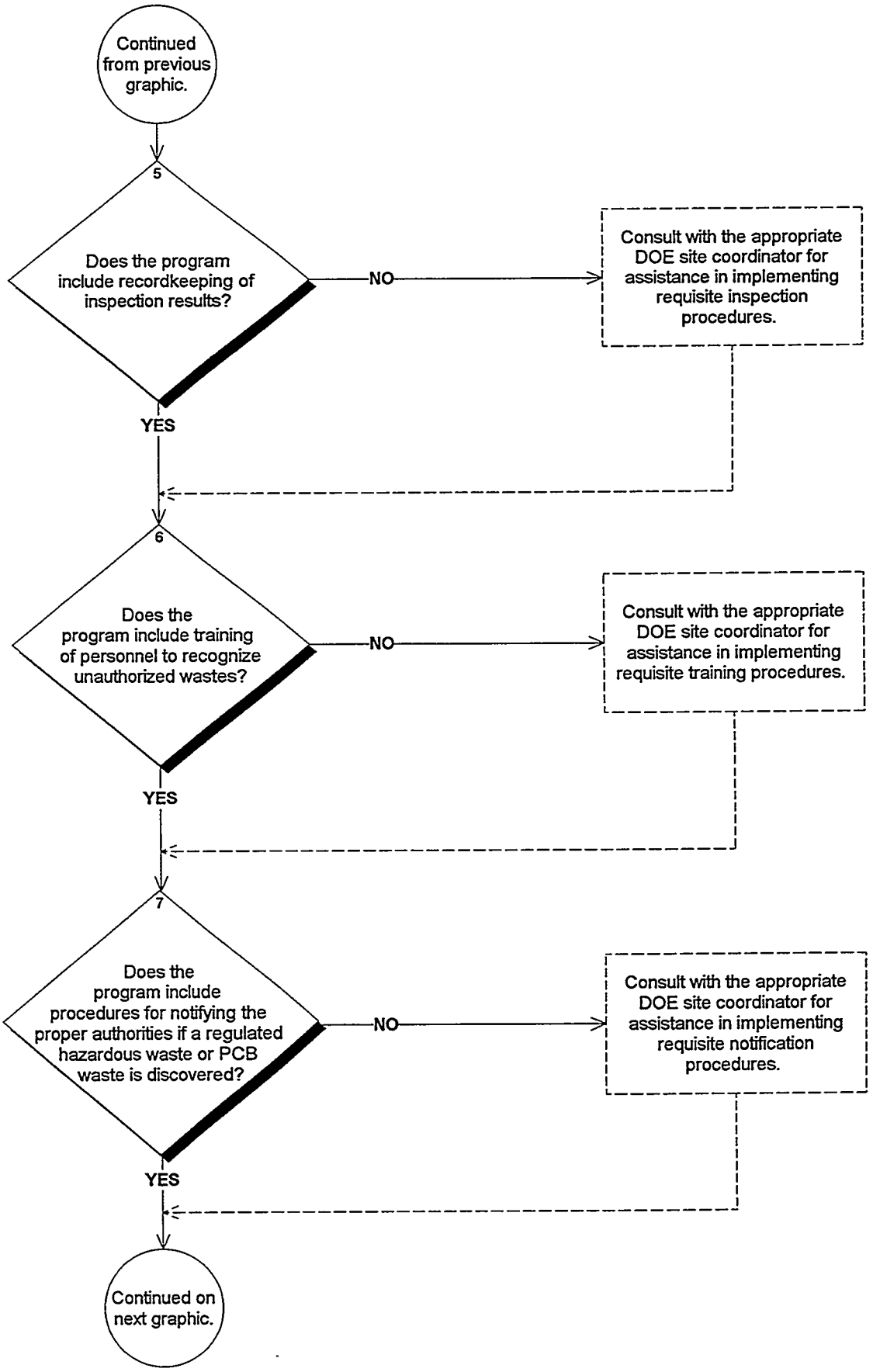
(1) Near or adjacent to the working face of the landfill;
(2) On a tipping floor located near the facility scale house or inside the site entrance; or
(3) At the tipping floor of transfer stations, prior to the transfer of waste to the facility. [56 *FR* 51049, 10/9/91]

Inspection at a transfer station could take the place of a random inspection of incoming loads at the MSWLF.

Characteristics of wastes that may warrant inspections include:

(1) Wastes brought to the facility in containers used for hazardous materials;
(2) Wastes brought to the facility in containers not ordinarily used for the disposal of household wastes (e.g., in 55-gallon drums);
(3) Wastes in unmarked containers;
(4) Loads brought to the facility in vehicles not typically used for disposal of MSW; and
(5) Loads transported by haulers who usually transport hazardous waste. [56 *FR* 51050, 10/9/91]

[NOTE: DOE sites often have internal requirements addressing site generator certification of waste before the waste is accepted at a site's landfill.]


Continued from previous graphic.
5
Does the program include recordkeeping of inspection results?
NO
Consult with the appropriate DOE site coordinator for assistance in implementing requisite inspection procedures.
YES
6
Does the program include training of personnel to recognize unauthorized wastes?
NO
Consult with the appropriate DOE site coordinator for assistance in implementing requisite training procedures.
YES
7
Does the program include procedures for notifying the proper authorities if a regulated hazardous waste or PCB waste is discovered?
NO
Consult with the appropriate DOE site coordinator for assistance in implementing requisite notification procedures.
YES
Continued on next graphic.

**Step 5** As the second of four elements of its on-site program to prevent disposal of "regulated hazardous waste" and PCB waste at MSWLFs, owners/operators of the facilities must place the results from all inspections of incoming loads in the operating record. (See Module 7F.)

Inspection records should include the date and time wastes were received during inspection, names of the hauling firm and driver, source of the wastes, vehicle identification numbers, and all observations made by the inspector.

The operating record should be located near the facility. However, Part 258 provides flexibility to "approved States " by allowing them to establish alternative recordkeeping locations (and alternative schedules) for recordkeeping.

**Step 6** As the third of four elements of its on-site program to prevent disposal of "regulated hazardous waste" and PCB waste at MSWLFs, owners/operators of the facilities must train relevant personnel to recognize unauthorized wastes. "Relevant personnel" may include supervisors, spotters, designated inspectors, equipment operators, and weigh station attendants.

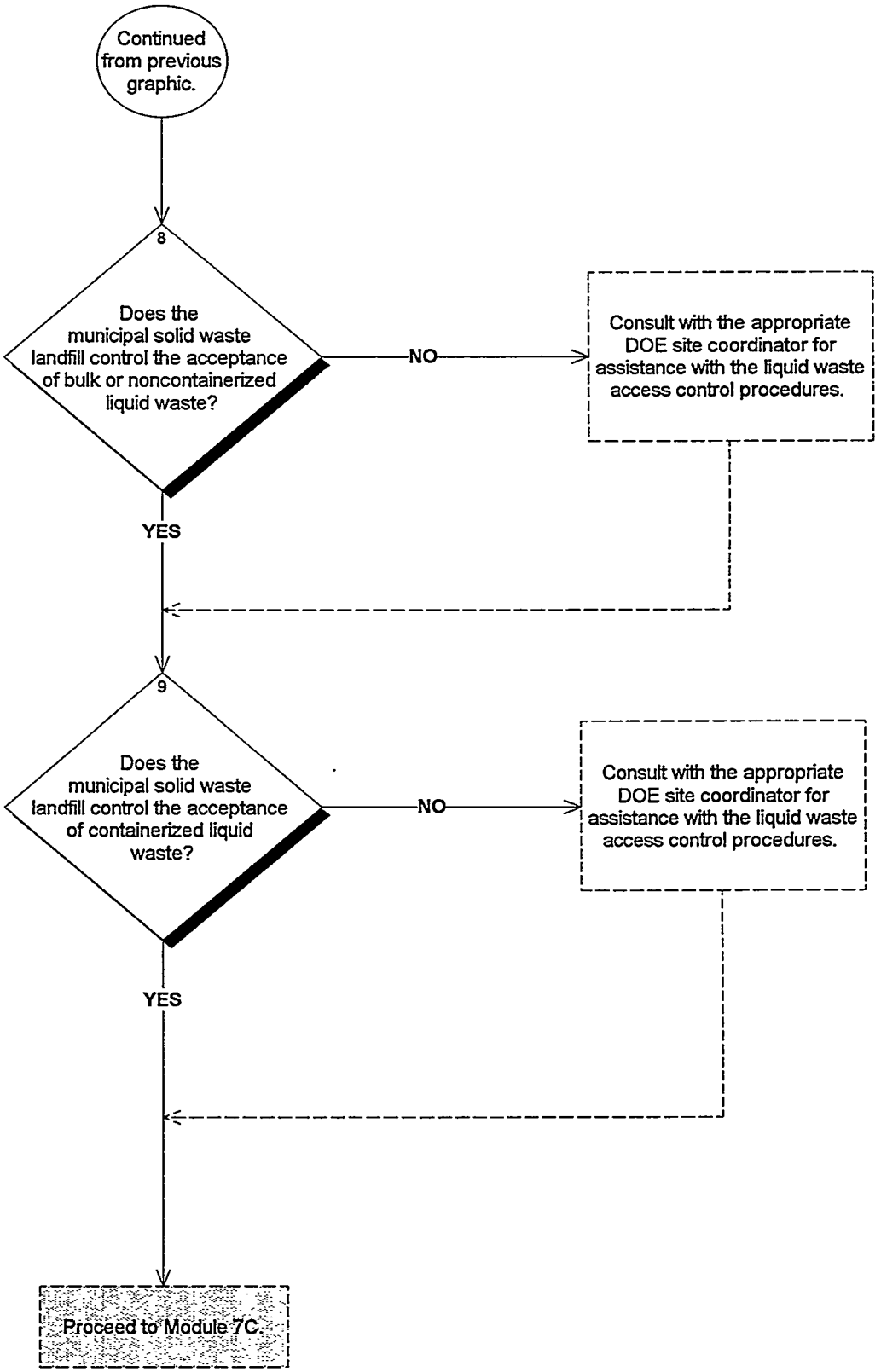
Training should emphasize methods to identify containers and labels typical of "regulated hazardous wastes" and PCB waste, and should address the proper handling of hazardous waste.

**Step 7** As the last of four elements of its on-site program to prevent disposal of "regulated hazardous waste" and PCB waste at MSWLFs, owners/operators of the facilities must develop procedures for notifying the proper authorities when a "regulated hazardous waste" or PCB waste is discovered at the facility.

The "proper authorities" include the State Directors in States authorized to run a hazardous waste program under Subtitle C of RCRA or the EPA Regional Administrator in all other States.

Generally, if the owner/operator is able to identify the waste as a regulated hazardous waste while the material is still in possession of the transporter, and refuses to accept the waste, it remains the responsibility of the transporter.

If the owner/operator discovers regulated hazardous waste at the MSWLF, he or she must ensure that the waste is treated, stored, or disposed of in compliance with RCRA and applicable State requirements.


Continued from previous graphic.
8
Does the municipal solid waste landfill control the acceptance of bulk or noncontainerized liquid waste?
NO
Consult with the appropriate DOE site coordinator for assistance with the liquid waste access control procedures.
YES
9
Does the municipal solid waste landfill control the acceptance of containerized liquid waste?
NO
Consult with the appropriate DOE site coordinator for assistance with the liquid waste access control procedures.
YES
Proceed to Module 7C.

**Step 8** Because the introduction of liquids into landfills can be a significant source of leachate generation, owners/operators of MSWLFs must control disposal of liquids, allowing disposal of only certain categories of "liquid wastes." Disposal of bulk or non-containerized liquid waste is prohibited at an MSWLF. However, household waste, except septic waste, is excluded from the bulk or non-containerized liquids prohibition, and therefore, may be disposed at MSWLFs.

"Liquid wastes" means any waste material that is determined to contain "free liquids" as defined by EPA Method 9095 (Paint Filter Liquids Test) as described in "Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods" (EPA Publication No. SW-846).

Liquid materials, such as septic tank, grease trap, oily water, and sand trap wastes, that fail the Paint Filter Liquid Test are prohibited at MSWLFs, but they can be solidified (e.g., by addition of soil or other absorbent materials) prior to their disposal at these facilities. If possible, liquids should be treated at an NPDES treatment facility. The solidified waste must pass the Paint Filter Liquids Test.

Leachate and gas condensate (liquid generated as a result of gas recovery process(es) at the MSWLF) derived from the MSWLF are also exempt from the bulk or non-containerized liquids prohibition when the unit is equipped with a composite liner and leachate collection system that meet the design specifications. The owner/operator must place a demonstration of this in the operating record and notify the State Director that it has been placed there.

**Step 9** Disposal of containers holding liquid waste in MSWLFs is allowed when the containers are small and similar in size to that normally found in household waste (e.g., beverage containers), or if the waste in fact is household waste.

Part 258 also exempts liquid waste held within containers designed to hold liquids for use other than storage from the containerized liquids restriction. Therefore, these liquid wastes may be disposed at MSWLFs.

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## 7.4 Module 7C: Disease Vector Control and Daily Cover Material

### 7.4.1 Introduction

40 CFR 258 requires owners/operators of MSWLFs to apply suitable cover material at MSWLFs at the end of each operating day (or at more frequent intervals, if necessary) to control disease vectors, fires, odors, blowing litter, and scavenging. Additional benefits of daily cover at landfills include the following:

(1) Containment of air emissions that may threaten human health and the environment; and
(2) Improvement in the site appearance and its utilization after closure.

Cover material applied less frequently than once a day will not be as effective in meeting these purposes. EPA considers daily cover to be a necessary good housekeeping practice at all MSWLFs; it should be required regardless of waste types, location of facility, or design and operation of the facility. Extreme climatic conditions make placement of daily cover very difficult; EPA allows an exemption from the daily cover requirements under such conditions when certain criteria are met.

Part 258 requires owners/operators to operate MSWLFs in such a way as to prevent or control on-site disease vector populations using techniques appropriate for the protection of human health and the environment. Specifically, owners/operators of all MSWLFs must prevent the facilities from becoming breeding grounds, habitats, or feeding areas for disease vector populations. If cover material requirements prove insufficient to ensure vector control, other steps (e.g., shredding waste) must be taken at the facility to control disease vectors. Methods for controlling disease vectors are discussed in the EPA guidance document "Solid Waste Disposal Facility Criteria: Technical Manual" (November 1993, EPA 530-R-93-017).

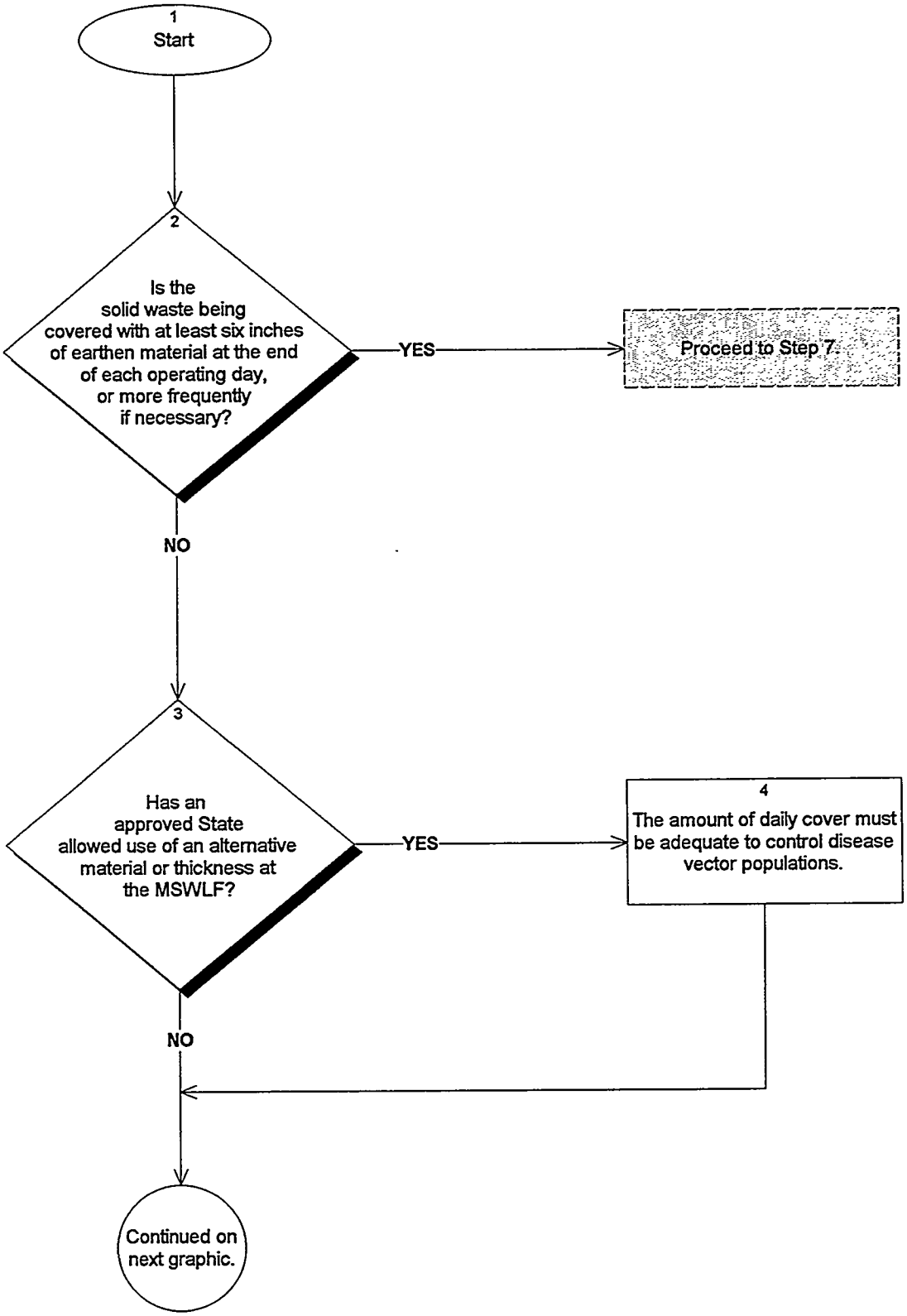
### 7.4.2 Milestones

***Have the appropriate steps been taken to control the proliferation of disease vectors?***

Appropriate steps include:

- The application of a daily cover;
- Segregation of wastes; and
- Installation of perimeter fencing.

# Figure 7C: Disease Vector Control and Daily Cover Material

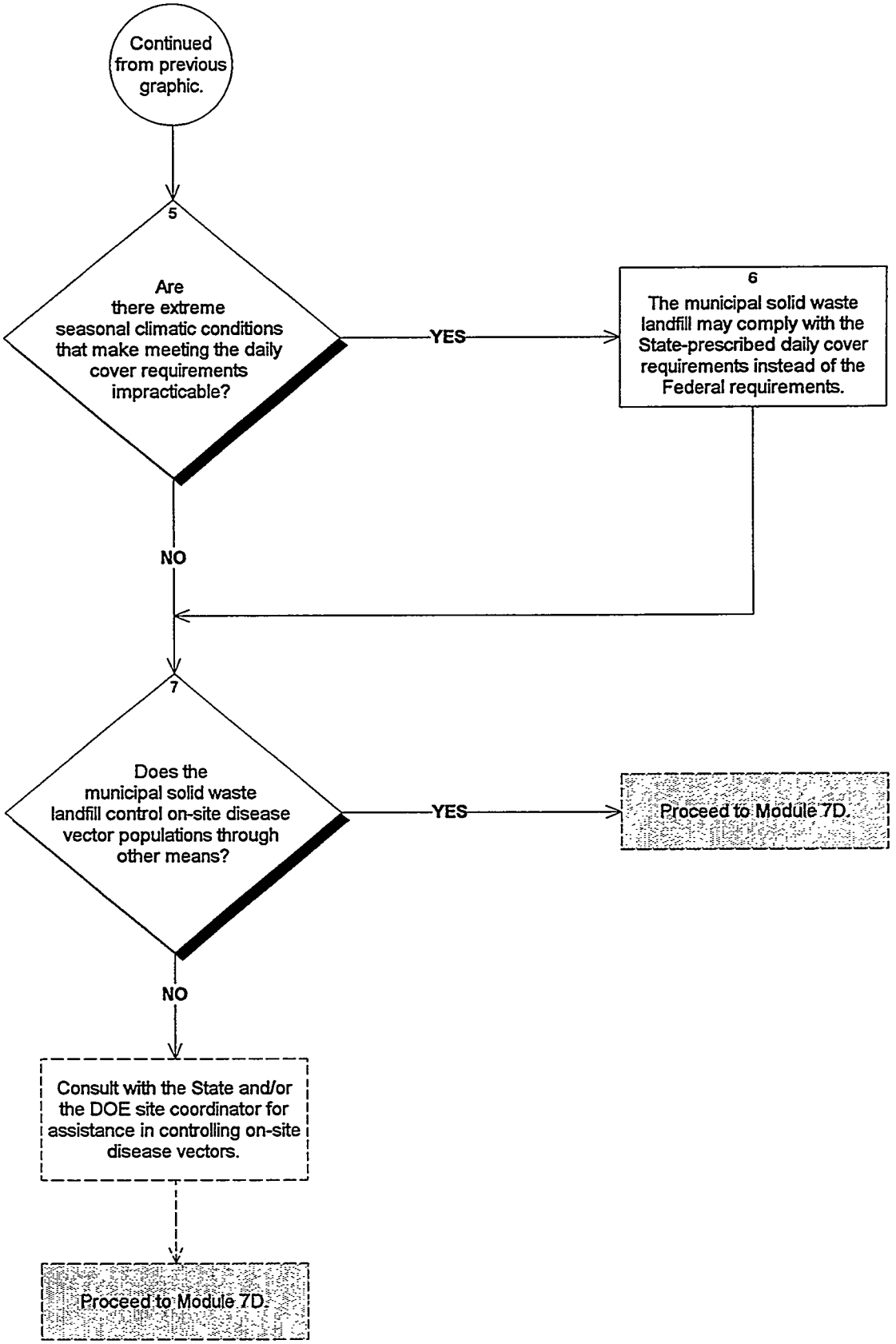


**Step 1** Start.

**Step 2** Except as provided in Step 7, the owner/operator of an MSWLF must cover solid waste with at least six inches of earthen material (i.e., soils) at the end of each operating day, or at more frequent intervals if necessary to control disease vectors, fires, odors, blowing litter, and scavenging.

**Step 3** Only an approved State may allow alternative materials or an alternative thickness (other than at least six inches of earthen material) to be used as daily cover material. The owner/operator of the MSWLF must demonstrate to the State that the alternative material and/or thickness will control disease vectors, fires, odors, blowing litter, and scavenging without presenting a threat to human health and the environment.

**Step 4** The EPA has provided guidance on this issue in "Solid Waste Disposal Facility Criteria: Technical Manual" (November 1993, EPA 530-R-93-017), which covers methods for evaluating alternative materials. This document also includes EPA's concerns regarding the use of certain materials as cover material. Consult with the State as necessary for assistance with this issue.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5
Are there extreme seasonal climatic conditions that make meeting the daily cover requirements impracticable?
YES
6
The municipal solid waste landfill may comply with the State-prescribed daily cover requirements instead of the Federal requirements.
NO
7
Does the municipal solid waste landfill control on-site disease vector populations through other means?
YES
Proceed to Module 7D.
NO
Consult with the State and/or the DOE site coordinator for assistance in controlling on-site disease vectors.
Proceed to Module 7D.

**Step 5** Daily cover is a necessary good housekeeping practice at all MSWLFs and should be required regardless of waste types, location of facility, or design and operation of facility. Only extreme climatic conditions (e.g. heavy snow or severe freezing) make placement of daily cover very difficult.

**Step 6** An approved State can temporarily waive the daily cover requirements on a case-by-case basis. To be eligible for this exemption, the owner/operator of the MSWLF must demonstrate that there are extreme seasonal climatic conditions (such as heavy snow or severe freezing) that make the placement of daily cover impracticable.

**Step 7** Owners/operators of all MSWLFs must prevent or control on-site populations of disease vectors using techniques appropriate for protection of human health and the environment. This action must be taken to prevent the facility from becoming a breeding ground, habitat, or feeding area for disease vector populations. One of these techniques is providing daily cover at the landfill facility.

"Disease vectors" are any rodents, flies, mosquitoes, or other animals, including insects, that are capable of transmitting disease to humans.

Methods for controlling disease vectors are discussed in "Solid Waste Disposal Facility Criteria: Technical Manual" (November 1993, EPA 530-R-93-017).

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## 7.5 Module 7D: Explosive Gas Control and Air Criteria

### 7.5.1 Introduction

Accumulation of methane (an explosive gas produced by the decomposition of solid waste, particularly household waste) can cause fires or explosions that can injure or kill not only employees and users of the site, but also occupants of nearby structures. Such fires and explosions may also damage containment structures, causing the emission of toxic fumes. To prevent such accidents, the owner/operator of each MSWLF is required to implement a program at the facility to routinely (at least quarterly) monitor the concentration of methane in facility structures and at the property boundary. When the methane levels are exceeded, the owner/operator must undertake all necessary steps to ensure protection of human health and the environment.

Part 258 prohibits open burning of most materials at MSWLFs because the hazards posed to human health by allowing the practice (e.g., decreased aircraft and automobile visibility, and uncontrolled emissions of hazardous constituents that pose a threat to human health and the environment) outweigh any benefits derived from the practice. In the few cases when infrequent open burning is allowed, specific requirements must be met, as detailed below.

Part 258 also requires owners/operators of all MSWLFs to ensure that the facilities do not violate any applicable requirements developed under the SIPs approved or promulgated under Section 110 of the CAA, as amended.

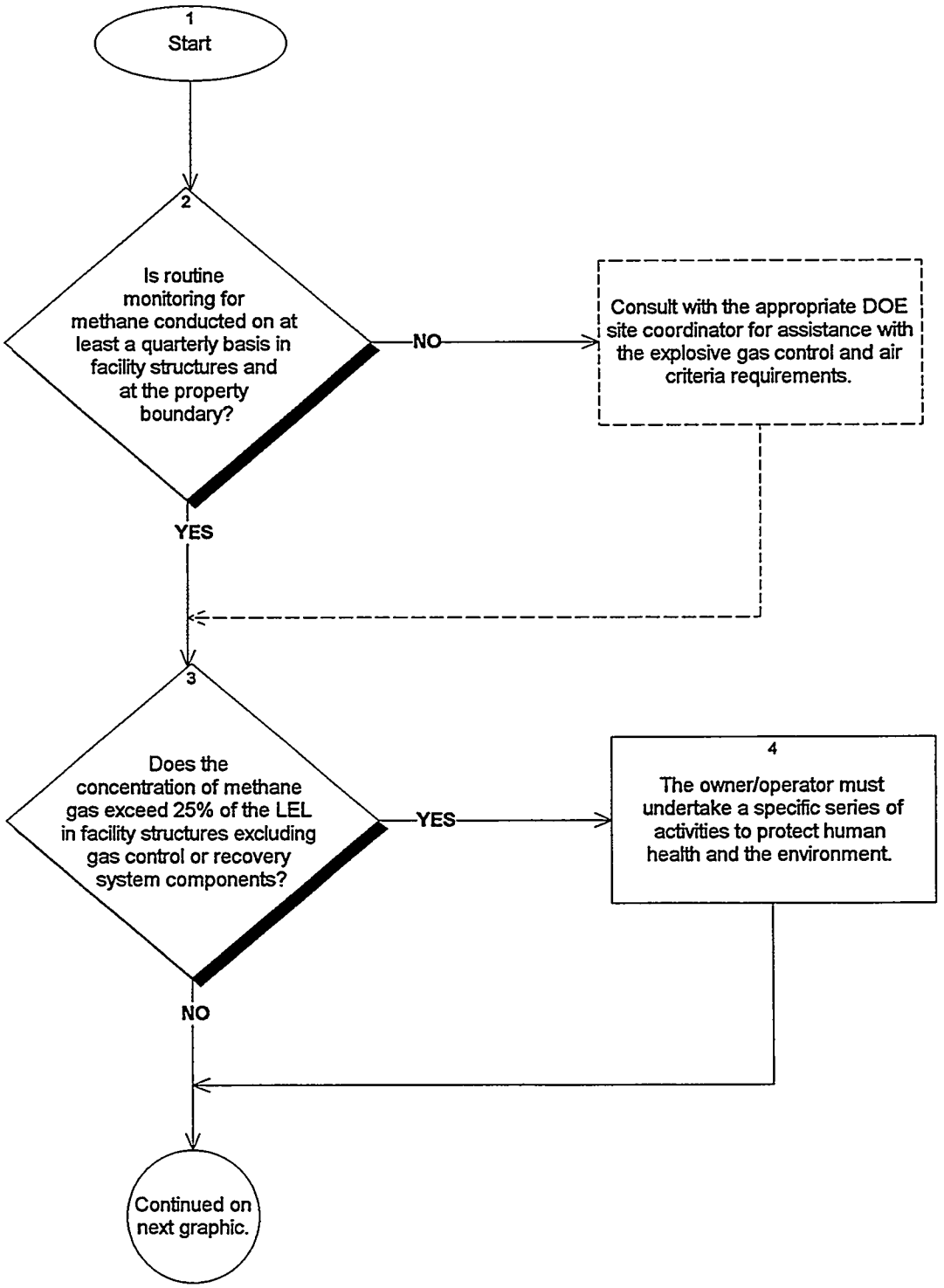
### 7.5.2 Milestones

***Have the EPA's requirements for the control of explosive gases and other air pollutants been met?***

EPA's requirements include:

- Methane monitoring on a routine basis;
- The institution of a prohibition on open burning; and
- Full compliance with the requirements of a State's Implementation Plan.

# Figure 7D: Explosive Gas Control and Air Criteria



**Step 1** Start.

**Step 2** Owners/operators of all MSWLF units must implement a program to routinely monitor the concentration of methane in facility structures and at the property boundary. Methane monitoring provides an early warning of potential methane build-up that may lead to explosions. While monitoring should occur at least quarterly, the following site-specific factors, which control the rate and extent of gas migration, should be considered when determining the frequency (and type) of monitoring:

(1) Soil conditions;
(2) Hydrogeologic conditions surrounding the facility;
(3) Hydraulic conditions surrounding the facility; and
(4) Location of facility structures relative to property boundaries.

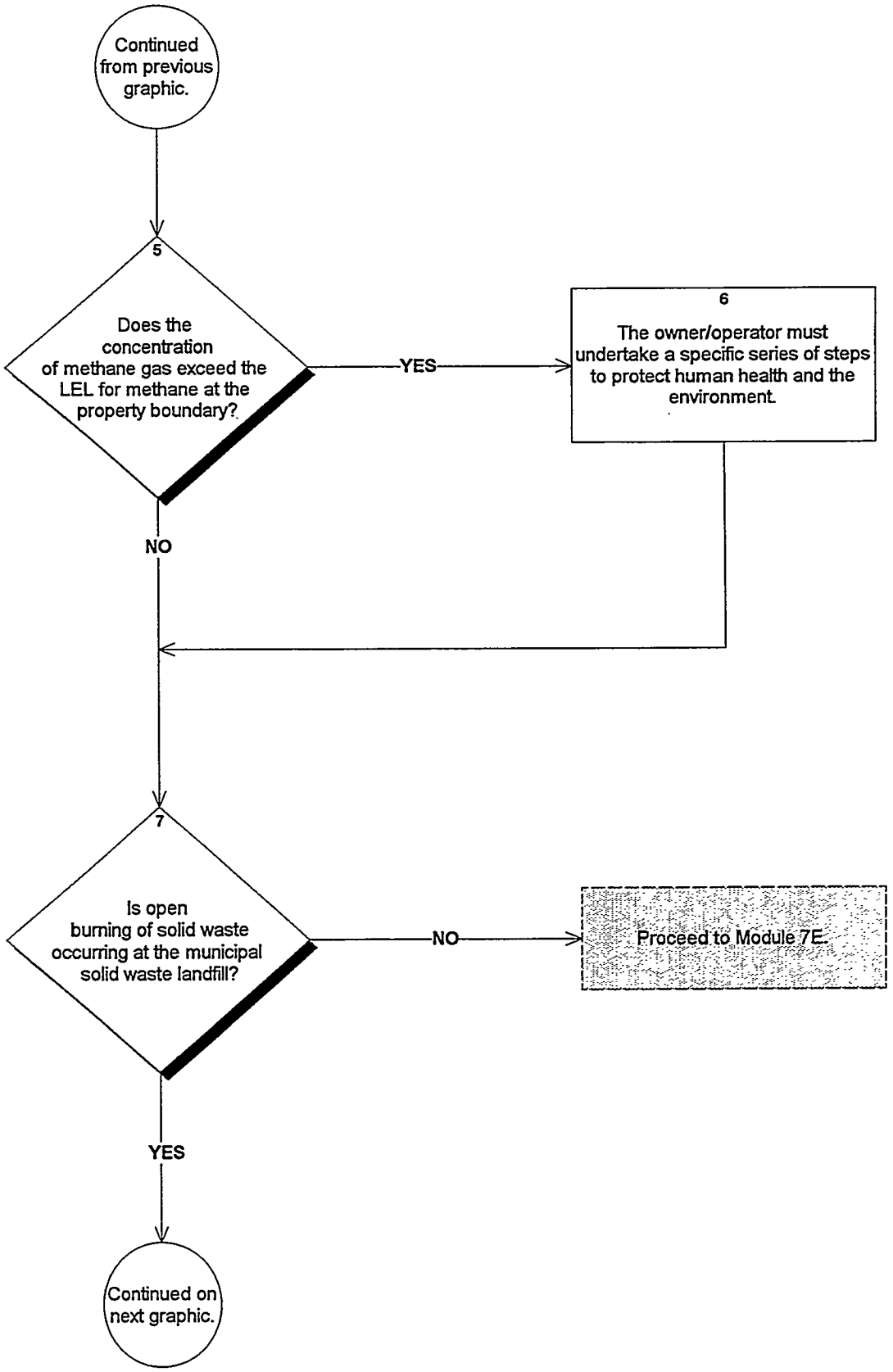
EPA imposed a minimum quarterly frequency for methane monitoring to account for the seasonal variations in subsurface gas migration patterns.

**Step 3** The owner/operator must ensure that the concentration of methane gas generated by the facility does not exceed 25 percent of the lower explosive level (LEL) for methane in facility structures (excluding gas control or recovery system components). (The LEL means the lowest percent by volume of a mixture of explosive gases in air that will propagate a flame at 25° C and atmospheric pressure.)

**Step 4** If methane gas levels exceed 25 percent of the LEL in facility structures (excluding gas control or recovery system components) all of the following steps must be taken:

(1) Immediately take all necessary steps to ensure protection of human health;
(2) Immediately notify the State Director of the methane levels detected and actions taken;
(3) Within **7** days of detection, place in the operating record (See Module 7F) documentation of the methane gas levels detected and a description of the interim steps taken to protect human health; and
(4) Within **60** days of detection, develop and implement a remediation plan for the methane gas releases that describes the nature of the problem and the proposed remedy (e.g., evacuation and ventilation of affected buildings). The plan should include an identification of the exact location and extent of the methane gas problem, a determination of the need for and location of interceptor gas collection trenches, and a decision as to whether venting of structures and subsurface gas withdrawal is necessary. The 60-day time period should be adequate for the owner/operator to contact, if necessary, knowledgeable outside parties to assist in the development of the remediation plan. [56 *FR* 51052, 10/9/91]

(The Director of an approved State may establish alternative locations and schedules for the seven-day and sixty-day requirements above.) Also, within this time, the owner/operator must place a copy of the remediation plan in the operating record, and notify the State Director that the plan has been placed in the operating record.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5
Does the concentration of methane gas exceed the LEL for methane at the property boundary?
YES
6
The owner/operator must undertake a specific series of steps to protect human health and the environment.
NO
7
Is open burning of solid waste occurring at the municipal solid waste landfill?
NO
Proceed to Module 7E.
YES
Continued on next graphic.

**Step 5** Owners/operators of all MSWLF units must also ensure that the concentration of methane gas generated by the facility does not exceed the LEL for methane at the facility property boundary.

**Step 6** If methane gas levels exceed the LEL for methane at the property boundary, the owner/operator of the MSWLF must do all of the following:

(1) Immediately take all necessary steps to ensure protection of human health;
(2) Immediately notify the State Director of the methane levels detected and actions taken;
(3) Within **7** days of detection, place in the operating record (See Module 7F) documentation of the methane gas levels detected and a description of the interim steps taken to protect human health; and
(4) Within **60** days of detection, develop and implement a remediation plan for the methane gas release that describes the nature of the problem and the proposed remedy. The plan should include an identification of the exact location and extent of the methane gas problem, a determination of the need for and location of interceptor gas collection trenches, and a decision as to whether venting of structures and subsurface gas withdrawal is necessary. The 60-day time period should be adequate for the owner/operator to contact, if necessary, knowledgeable outside parties to assist in the development of the remediation plan. [56 *FR* 51052, 10/9/91]

(The Director of an approved State may establish alternative schedules for the seven-day and sixty-day requirements above.)

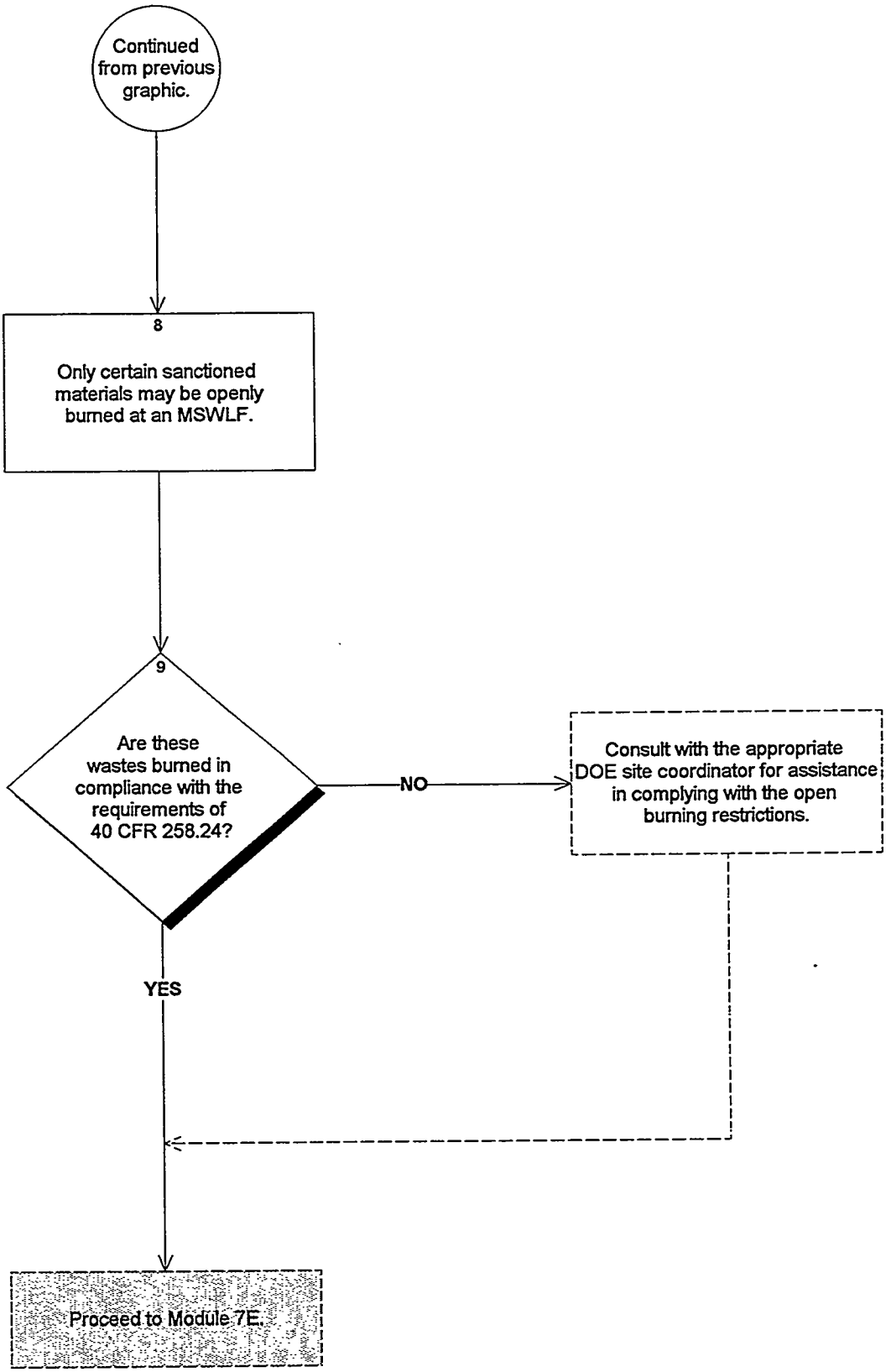
Also, within this time, the owner/operator must place a copy of the remediation plan in the operating record, and notify the State Director that the plan has been implemented.

**Step 7** "Open burning" is defined as uncontrolled or unconfined combustion, or, more specifically, as the combustion of solid waste:

(1) Without control of combustion air to maintain adequate temperature for efficient combustion;
(2) Without containment of the combustion reaction in an enclosed device to provide sufficient residence time and mixing for complete combustion; and
(3) Without the control of the emission of the combustion products.

Because trench incinerators, pit burners, and air curtain destructors do not control the emission of combustion products, they are considered "open burning."

Open burning of most wastes is prohibited at MSWLFs. For example, ordnance (e.g., ammunition and bombs) may not be open-burned at an MSWLF. Also, open burning of yard wastes, pesticide containers, and wooden pallets is not an allowed practice.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8
Only certain sanctioned materials may be openly burned at an MSWLF.
9
Are these wastes burned in compliance with the requirements of 40 CFR 258.24?
NO
Consult with the appropriate DOE site coordinator for assistance in complying with the open burning restrictions.
YES
Proceed to Module 7E.

**Step 8** Only the following materials may be open burned at an MSWLF and only under certain conditions (See Step 9):

(1) Land-clearing debris;
(2) Diseased trees;
(3) Agricultural wastes; and
(4) Debris from emergency cleanup operations.

The open burning of these materials is not typically an ongoing practice and, therefore, does not present a significant environmental risk. In addition, the destruction of disease-carrying trees or debris from emergency operations may decrease the chances of disease or accident.

Open burning of ordnance wastes has been deleted from this list which originally appeared in 40 CFR Part 241. Ordnance therefore, cannot be burned at an MSWLF under any circumstances (56 *FR* 51053, 10/9/91).

**Step 9** The wastes listed in Step 8 may be open burned only under the following conditions:

(1) The acts of burning are infrequent;
(2) The burning is in compliance with applicable requirements under the SIPs; and
(3) The burning is conducted in areas dedicated to that purpose and at a distance from the landfill unit in order to prevent the accidental burning of other solid wastes.

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## 7.6 Module 7E: Surface Water Requirements and Run-on/Run-off Control Systems

### 7.6.1 Introduction

To minimize the potential adverse impact of MSWLF activities on the quality of surface water, 40 CFR Part 258 requires that **all** MSWLFs be operated in compliance with the requirements of the CWA, including, but not limited to, the NPDES requirements.

Specifically, 40 CFR Part 258 prohibits any MSWLF unit from doing either of the following:

(1) Causing a discharge of pollutants into waters of the United States, including wetlands, that violates any requirements of the CWA, including, but not limited to, NPDES requirements; or
(2) Causing the discharge of a non-point source of pollution into the waters of the U.S., including wetlands, that violates any requirement of any established State-wide or area-wide water quality management plan developed under the CWA.

To further prevent surface water contamination, owners/operators of MSWLFs must design, construct, and maintain both a run-on control system to prevent flow onto the active portion of the landfill, and a run-off control system to collect and control run-off from this portion of the landfill. The collected run-off should be handled in accordance with the surface water requirements discussed above.

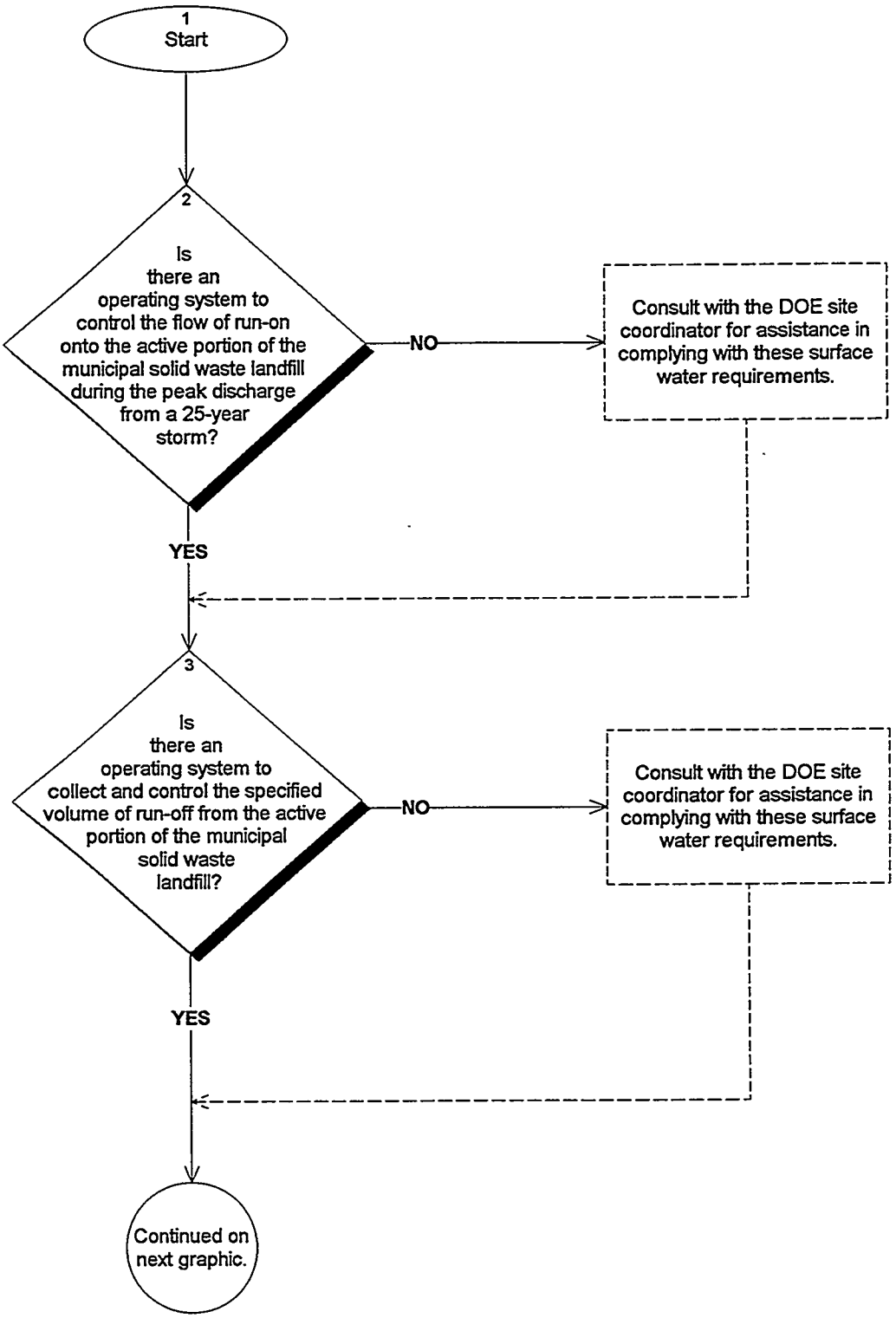
### 7.6.2 Milestones

***Have all of the surface water (and run-on/run-off) requirements been met for the MSWLF?***

The surface water (and run-on/run-off) requirements may include:

- The submission of an application for an NPDES permit; and
- The collection and control of run-on and run-off through sedimentation control ponds and other structures.

# Figure 7E: Surface Water Requirements and Run-on/Run-off Control Systems



**Step 1** Start.

**Step 2** This run-on control system should prevent flow onto the active portion of the landfill during peak discharge of a 24-hour, 25-year storm.

By minimizing the amount of surface water entering the landfill facility, the run-on control system prevents the following:

(1) Erosion and resulting damage to the physical structure of the landfill;
(2) Surface discharge of wastes in solution or suspension; and
(3) Downward percolation of run-on through wastes, thereby creating less leachate.

**Step 3** This run-off control system should collect and control, at a minimum, the water volume (run-off from the active portion of the landfill) resulting from a 24-hour, 25-year storm.

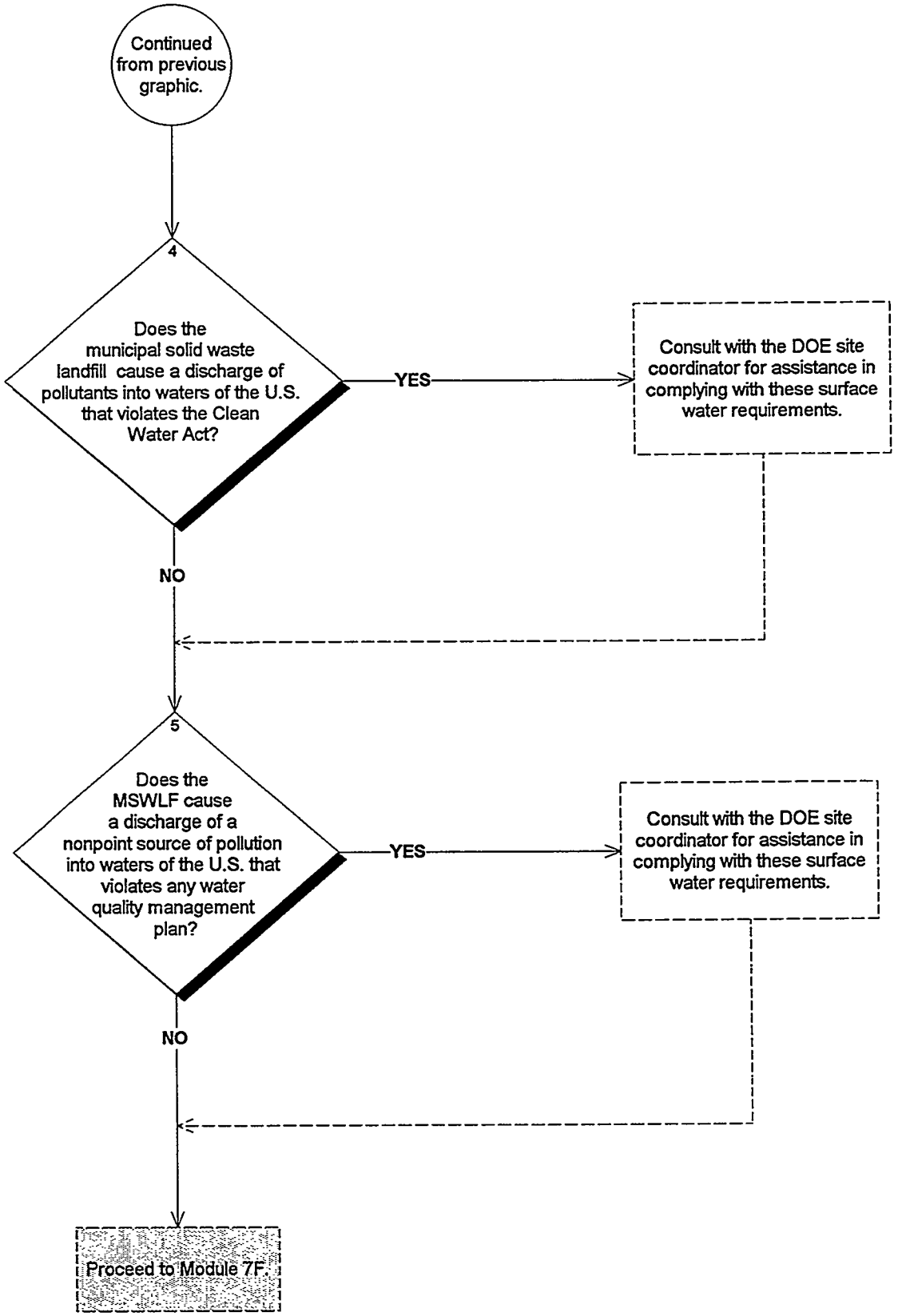
While 40 CFR Part 258 does not require that the collected run-off from the landfill be sampled prior to surface water release, the owner/operator may be subject to this requirement under the facility's NPDES permit.

To ensure that the CWA requirements are not violated, 40 CFR Part 258 does require that the collected run-off from the active portion of the landfill be handled in accordance with the surface water requirements detailed below.

Discharges of pollutants from MSWLF units into waters of the U.S., including wetlands, must be in conformance with any requirements of the CWA, including, but not limited to, NPDES requirements.

Any discharge of a **non-point source** of pollution from an MSWLF into the waters described above must be in conformance with the requirements of any established water quality management plan. These State-wide or area-wide plans are developed under Sections 208 or 319 of the CWA, as amended.

(Regulations that specifically address compliance of MSWLF units with the CWA will be developed under the CWA as needed. The Environmental Protection Agency may issue national limits for discharge to surface water from MSWLFs at a later date; until then, discharge limits will continue to be set on a case-by-case basis.) NPDES requirements for landfills will be implemented under the NPDES permitting program.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4
Does the municipal solid waste landfill cause a discharge of pollutants into waters of the U.S. that violates the Clean Water Act?
YES
Consult with the DOE site coordinator for assistance in complying with these surface water requirements.
NO
5
Does the MSWLF cause a discharge of a nonpoint source of pollution into waters of the U.S. that violates any water quality management plan?
YES
Consult with the DOE site coordinator for assistance in complying with these surface water requirements.
NO
Proceed to Module 7F.

**Step 4** **All** MSWLFs are required by 20 CFR Part 258 to be operated in compliance with the requirements of the CWA, including, but not limited to, NPDES requirements. In part, 40 CFR 258 prohibits MSWLFs from causing a discharge of pollutants into waters of the U.S., including wetlands, that violates any requirement of the CWA.

**Step 5** In part, 40 CFR 258 also prohibits MSWLFs from causing the discharge of a non-point source of pollution into the waters of the U.S., including wetlands, that violates any requirement of any established State-wide or area-wide water quality management plan developed under the CWA.

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## 7.7 Module 7F: Recordkeeping Requirements

### 7.7.1 Introduction

MSWLFs are subject to the recordkeeping requirements of 40 CFR Parts 241 and 258. Unlike the former part, which is applicable to all solid waste facilities, 40 CFR Part 258 only applies to MSWLFs.

This module presents the 40 CFR Part 258 recordkeeping requirements, including those that require that certain documents be recorded and retained by the owner/operator of each MSWLF. (For a discussion of the requirements of 40 CFR Part 241, see Chapter 3, Module 3J.)

40 CFR Part 258 also requires owners/operators to notify the State when the required documents have been placed in the operating record. Only approved States can set alternative schedules for recordkeeping and notification requirements.

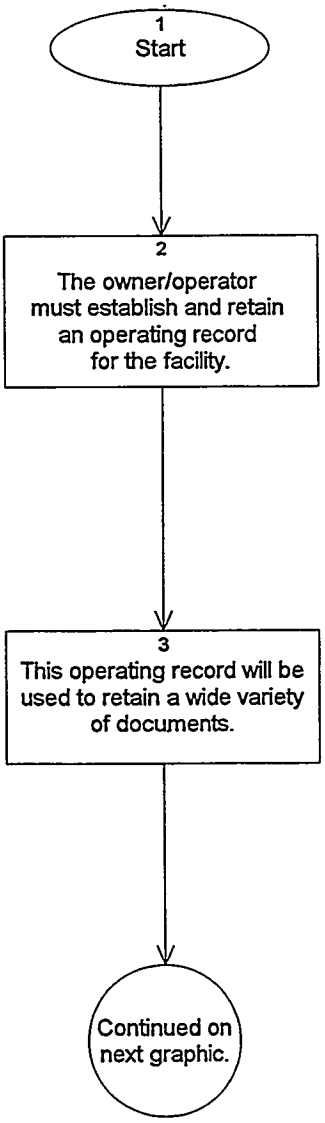
### 7.7.2 Milestones

***Have all of the recordkeeping requirements been met for activities conducted at the MSWLF?***

Records must be kept for all:

- Location restriction demonstrations;
- Inspection results;
- Methane gas monitoring results;
- Groundwater monitoring results; and
- Closure and post-closure plans.

# Figure 7F: Recordkeeping Requirements



**Step 1** Start.

**Step 2** The owner/operator of an MSWLF must establish and retain an operating record for the facility.

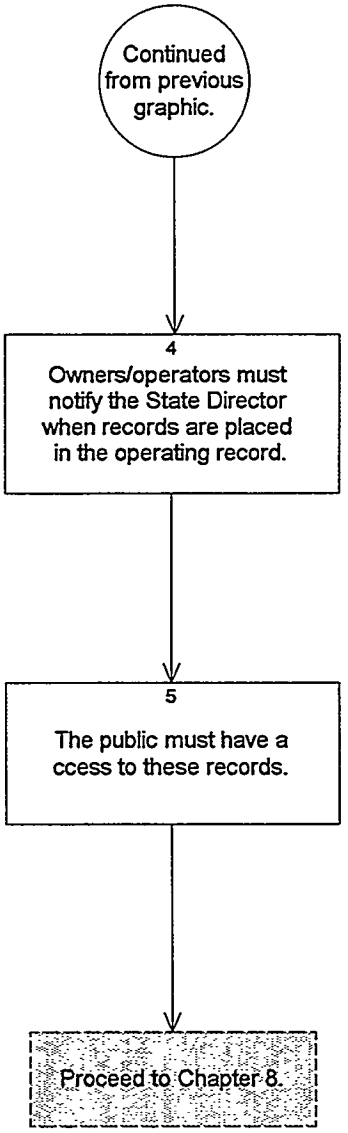
Documents in the operating record should be retained throughout the life of the facility, including the post-closure care period. [56 *FR* 51057, 10/9/91]

The operating record for the MSWLF must be maintained near the facility or in an alternative location approved by the Director of an "approved State." The appropriate location (e.g., at the facility itself, in the corporate headquarters, or in city hall) depends on the size of the landfill and/or the ownership of the landfill.

**Step 3** The following documents must be placed in a single location, in the operating record as they become available:

(1) Any location restriction demonstration required under Subpart B (i.e., demonstration that the MSWLF meets all the requirements for locating an MSWLF near or in the following areas: an airport, 100-year floodplains, wetlands, fault areas, seismic impact zones, or unstable areas);
(2) Records of any inspections, training, or notification procedures required as part of the program at the facility for detecting and preventing the disposal of "regulated hazardous wastes" and PCB wastes;
(3) Gas monitoring results and any remediation plans for gas releases;
(4) Documentation that the MSWLF is designed with a composite liner and leachate collection system if leachate or gas condensate derived from the unit is disposed at the facility;
(5) Any demonstration, certification, finding, monitoring, testing, or analytical data required by the groundwater monitoring requirements under Subpart E (Groundwater Monitoring and Corrective Action) of 40 CFR Part 258;
(6) Closure and post-closure care plans and any monitoring, testing, or analytical data required by the closure and post-closure care requirements of Subpart F (Closure and Post-Closure Care) of 40 CFR Part 258; and
(7) Any information demonstrating that the MSWLF qualifies for an exclusion from Subpart D (Design Criteria).

These records should be retained throughout the life of the facility, including the post-closure care period. Documents should be organized, legible, dated, and signed by the appropriate personnel. [56 *FR* 51057, 10/9/91]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4
Owners/operators must notify the State Director when records are placed in the operating record.
5
The public must have access to these records.
Proceed to Chapter 8.

**Step 4** Upon completion of each document required in the operating record, the owner/operator in both approved and unapproved States must notify the State Director of the document's existence and its addition to the operating record. The owner/operator of the MSWLF must also make all documents in the operating record available to the State Director for review at all reasonable times, or must furnish this information to the State upon request.

**Step 5** As described in the Federal Register notice promulgating the requirements of 40 CFR Part 258, the U.S. EPA believes that public access to MSWLF records, either directly from the owner/operator or through the State, is essential. Therefore, it requires that all information contained in the operating record must be furnished to the State upon request, or made available to the State at all reasonable times. (The information should be available to citizens in most States via a State Freedom of Information Act request.)

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# Chapter 8
# Groundwater Monitoring and Corrective Action for Municipal Solid Waste Landfills

**Contents**

## 8.1 Introduction

### 8.1.1 Background

Groundwater monitoring is necessary to provide an indication of the performance of the MSWLF's liner and to identify potential threats to human health and the environment.

In developing the regulations for groundwater monitoring at MSWLFs, EPA decided to allow owners and operators to consider the value of groundwater in setting the schedule for initiating and completing corrective action. For example, a tighter schedule may be set for initiating and completing a remedial action at an MSWLF located above a Class I aquifer than for a Class III aquifer. (A Class I aquifer is defined by EPA as "special groundwaters that are highly vulnerable to contamination and that are either irreplaceable sources of drinking water or are ecologically vital." A Class III aquifer is defined as "heavily saline groundwater or groundwater otherwise contaminated beyond the level allowing cleanup through methods commonly used by public water supply treatments.")

Approved States have the flexibility to consider the resource value of groundwater in determining the appropriate landfill design, monitoring, and corrective action requirements.

## 8.2 Module 8A: Applicability of Groundwater Monitoring Requirements

### 8.2.1 Introduction

The groundwater monitoring requirements apply to new units, lateral expansions, and existing MSWLFs. The groundwater monitoring requirements may be suspended by the Director of an approved State in those instances where the owner or operator of an MSWLF located in an approved State can demonstrate that there is no potential for migration of hazardous constituents from the MSWLF unit during its active life and the post-closure period.

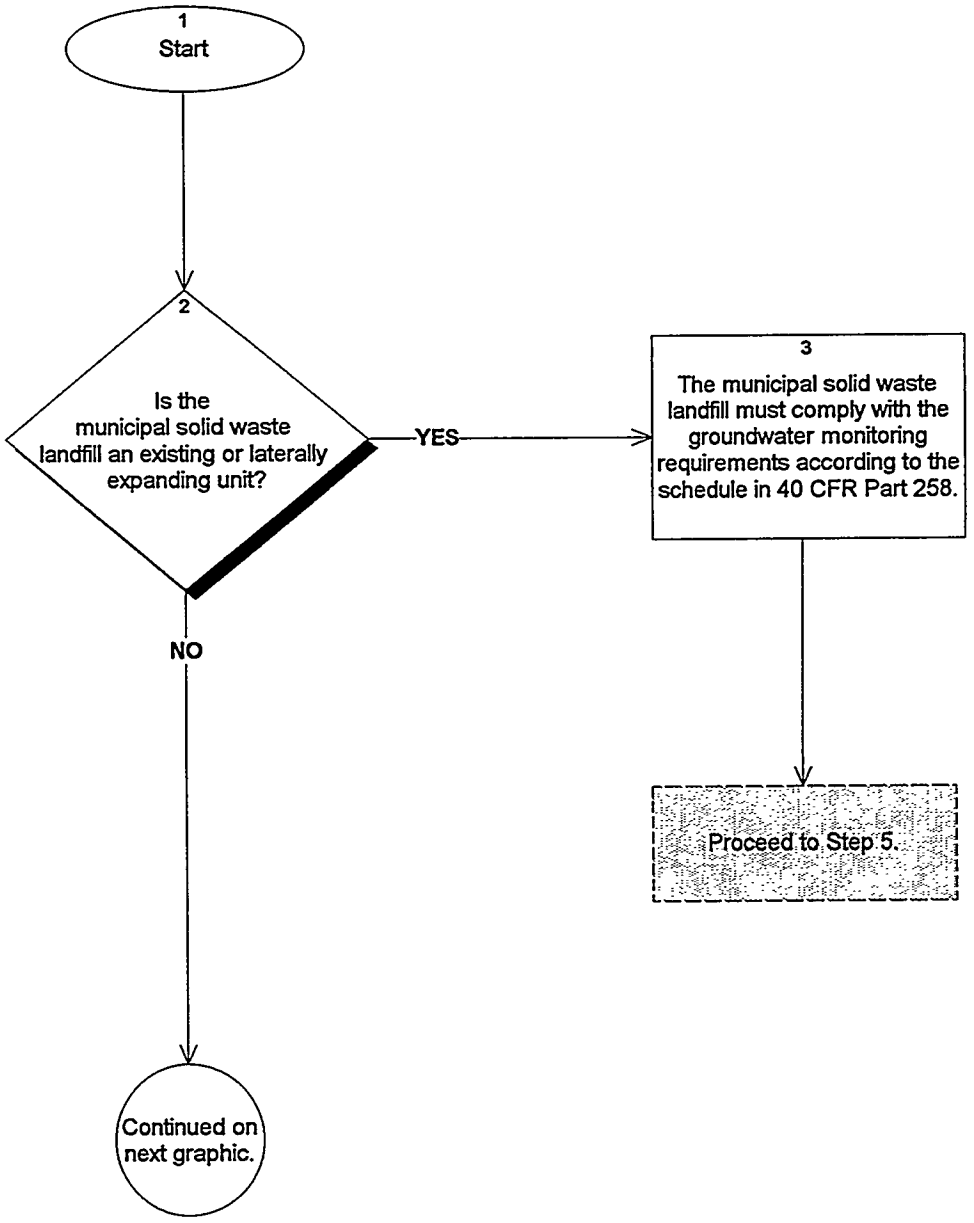
### 8.2.2 Milestones

***Has the applicability of the groundwater monitoring requirements been determined?***

The groundwater monitoring requirements are applicable to all units unless:

- The owner of an MSWLF located in an approved State has been able to prove that there is no potential for migration of hazardous constituents from the MSWLF.

# Figure 8A: Applicability of Groundwater Monitoring Requirements



**Step 1** Start.

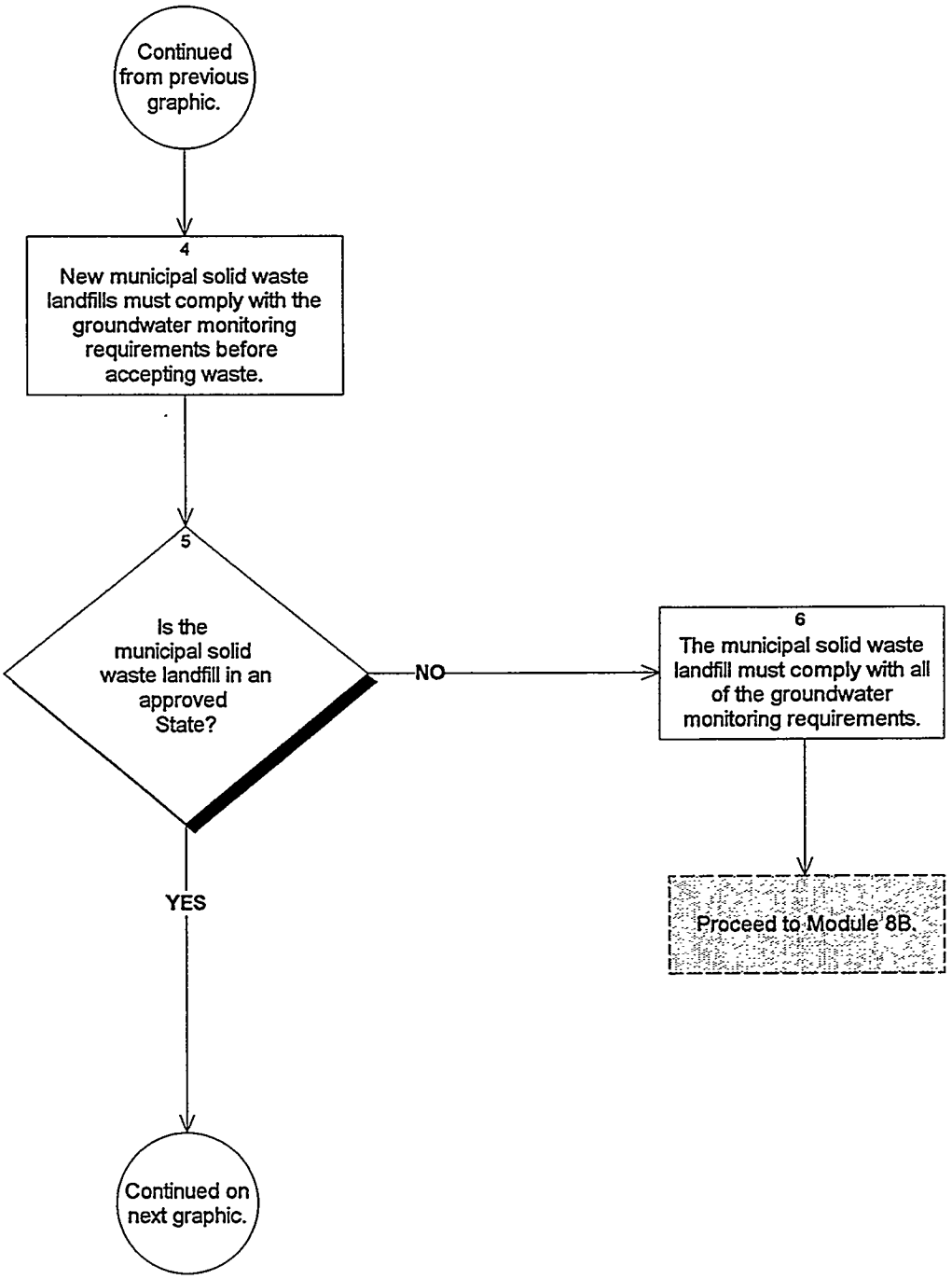
**Step 2** An existing MSWLF unit is any MSWLF unit that is receiving waste as of October 9, 1993. A laterally expanding MSWLF is one that has been extended along the horizontal boundaries of the existing MSWLF unit.

**Step 3** The EPA promulgated a phase-in of the groundwater monitoring requirements of 40 CFR 258 over a five-year time period beginning on 10/9/91. Existing MSWLFs and lateral expansions must comply with the groundwater monitoring requirements according to the following schedule:

| Date of Compliance | Distance from a drinking water intake (surface or subsurface) |
|---|---|
| 10/9/94 | < 1 mile |
| 10/9/95 | > 1 mile; and < 2 miles |
| 10/9/96 | > 2 miles |

Only approved States may specify an **alternative compliance schedule** for phasing in these groundwater monitoring requirements at existing units and lateral expansions. The alternative compliance schedules must ensure that half of all existing MSWLF units are in compliance by 10/9/94 and that all existing MSWLF units are in compliance by 10/9/96. In setting an alternative compliance schedule, approved States must consider the potential risks posed by each facility to human health and the environment based on the following factors:

(1) Proximity of human and environmental receptors;
(2) Design of the unit;
(3) Age of the unit;
(4) Size of the unit;
(5) Waste types (including sewage sludge) and quantities; and
(6) Resource value of the underlying aquifer, including:
    (i) Current and future uses;
    (ii) Proximity and withdrawal rate of users; and
    (iii) Groundwater quality and quantity.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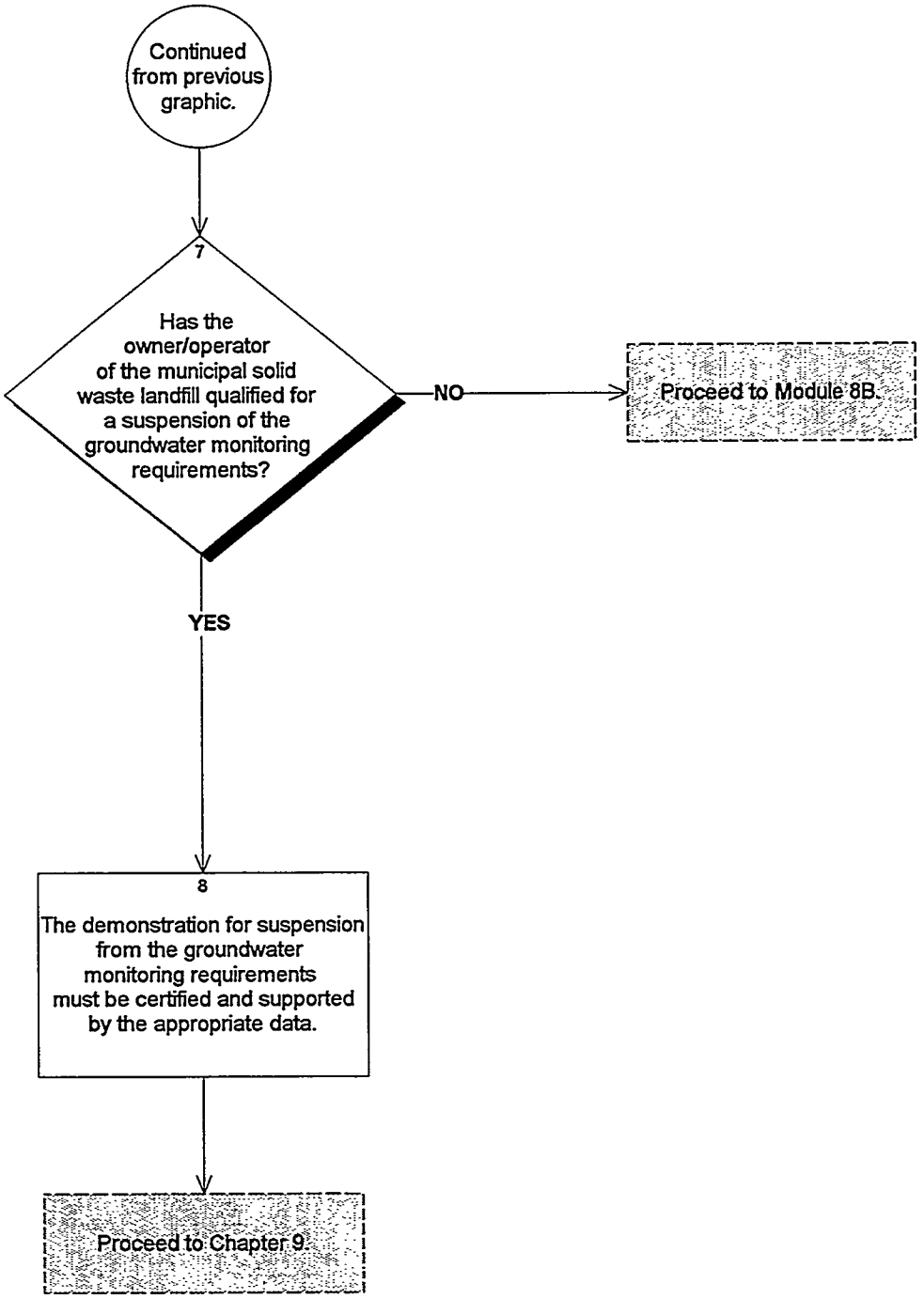
4
New municipal solid waste landfills must comply with the groundwater monitoring requirements before accepting waste.
5
Is the municipal solid waste landfill in an approved State?
NO
6
The municipal solid waste landfill must comply with all of the groundwater monitoring requirements.
Proceed to Module 8B.
YES
Continued on next graphic.

**Step 4** Because the need for groundwater monitoring systems can be anticipated in the planning process, new MSWLF units must comply with the groundwater monitoring requirements specified in 40 CFR 258 before accepting waste. Once established at an MSWLF unit, groundwater monitoring should be conducted throughout the active life and post-closure care period of the facility.

**Step 5** The U.S. EPA approves a State program by determining that the State has developed a municipal solid waste permit program (or other system of prior approval) adequate to ensure that each MSWLF that may receive household hazardous waste (HHW) or SQG waste will comply with 40 CFR Part 258. (The U.S. EPA plans to propose that Indian Tribes also be eligible for permit program approval.)

**Step 6** Because the MSWLF is not in an approved State, it is not eligible for a suspension of groundwater monitoring requirements and therefore must comply with all of the groundwater monitoring requirements specified in Modules A through E.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7
Has the owner/operator of the municipal solid waste landfill qualified for a suspension of the groundwater monitoring requirements?
NO
Proceed to Module 8B.
YES
8
The demonstration for suspension from the groundwater monitoring requirements must be certified and supported by the appropriate data.
Proceed to Chapter 9.

**Step 7** MSWLFs in approved States may qualify for suspension of the groundwater monitoring requirements. To qualify for such a waiver, the owner or operator of the MSWLF must demonstrate that there is no potential for migration of hazardous constituents from the unit to the "uppermost aquifer" during the active life and post-closure period of the unit. (The U.S. EPA does not believe that the current groundwater quality or potential future use of water is an appropriate factor for consideration in granting exemptions from groundwater monitoring).

**Step 8** This demonstration of no potential for migration must be certified by an independent "qualified groundwater scientist" (as defined in the Glossary) and be approved by the Director of an approved State.[1] In addition, this demonstration must be supported by the following:

(1) Site-specific measurements (i.e., actual field data collected at the site), sampling, and analysis of physical, chemical, and biological processes affecting contaminant fate and transport; and
(2) Contaminant fate and transport predictions (i.e., modeled estimates) that maximize [the potential for] contaminant migration and consider impacts on human health and the environment.

Field testing is necessary to establish the site's hydrogeological characteristics and should include an evaluation of unsaturated and saturated zone characteristics to ascertain the flow rate and pathway by which contaminants will migrate to groundwater. Predictions (i.e., models) should be based on actual field-collected data to adequately predict potential groundwater contamination. [56 *FR* 51062, 10/9/91]

Procedures for conducting these evaluations can be found in the USEPA/OSWER "Groundwater Monitoring Guidance Document for Owners and Operators of Interim Status Facilities" (1983).

[1]Because approved States may have hydrogeologists capable of reviewing and approving the ground-water monitoring demonstration, the owner or operator of the MSWLF may obtain the approval of the Director of an approved State in lieu of the certification of an independent, qualified ground-water scientist.

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## 8.3 Module 8B: Groundwater Monitoring System Design Criteria

### 8.3.1 Introduction

The design of the groundwater monitoring system must be based on site-specific information (including a thorough characterization of the thickness of the aquifer and the groundwater flow rate and direction), and a thorough characterization of the saturated and unsaturated geologic units and fill materials overlying the uppermost aquifer including, but not limited to: thickness, stratigraphy, lithology, hydraulic conductivities, and porosities. This information will enable the MSWLF owner or operator to identify potential pathways of contaminant migration.

In approved States, the Director may allow the use of a multi-unit groundwater monitoring system instead of separate systems for each MSWLF unit when the facility has several units, provided that the multi-unit system is as protective of human health and the environment as are individual systems.

The monitoring wells and all associated sampling and analytical devices must be operated and maintained so that they perform to design specifications throughout the life of the monitoring system.

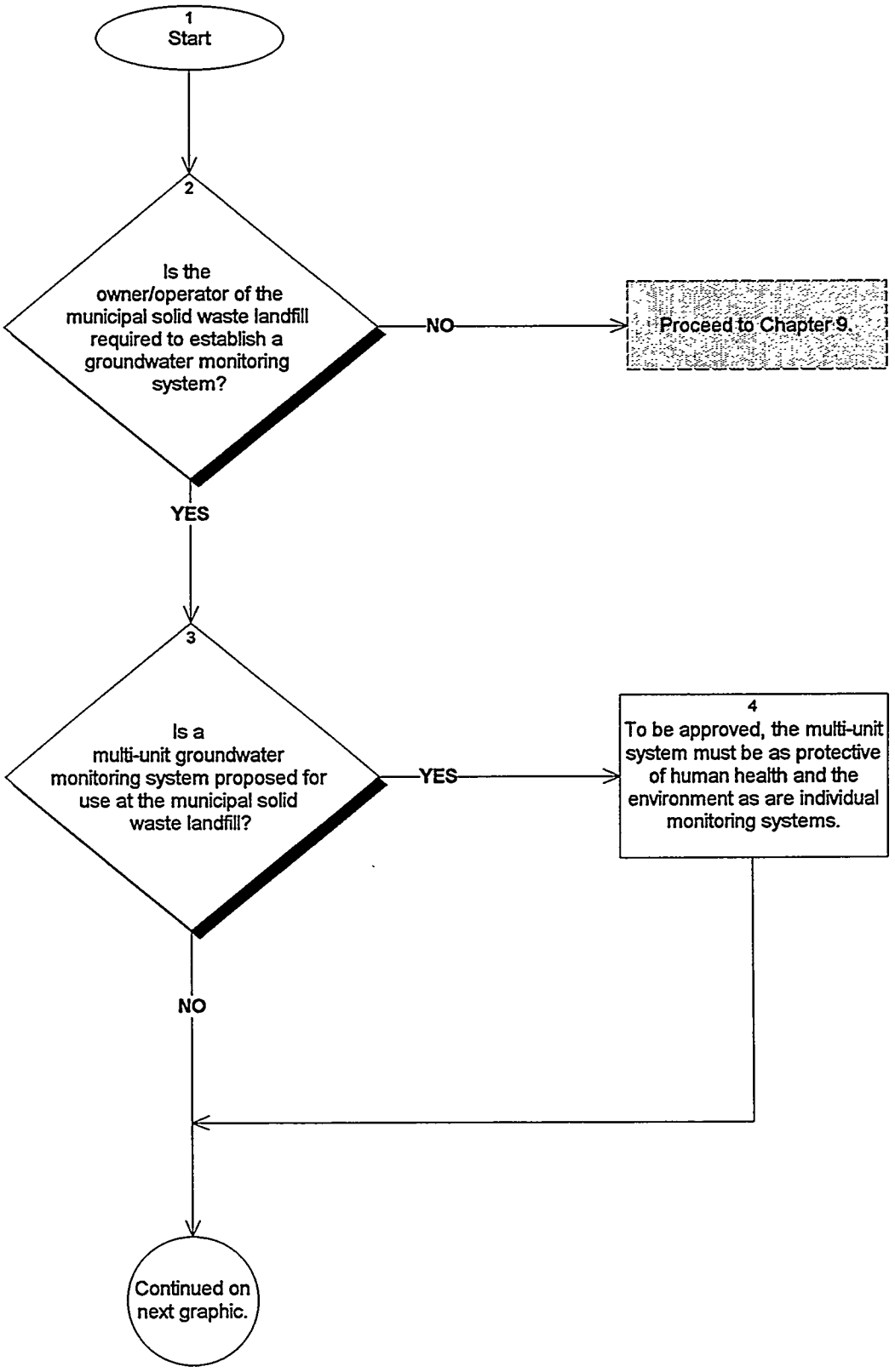
### 8.3.2 Milestones

***Have the designers of the groundwater monitoring system considered the impact of all applicable site-specific information on the design of the system?***

Required site-specific information includes:

- A thorough characterization of the thickness of the aquifer;
- A thorough characterization of the saturated and unsaturated geologic units and fill materials overlying the uppermost aquifer; and
- The groundwater flow rate and direction.

# Figure 8B: Groundwater Monitoring System Design Criteria



**Step 1** Start.

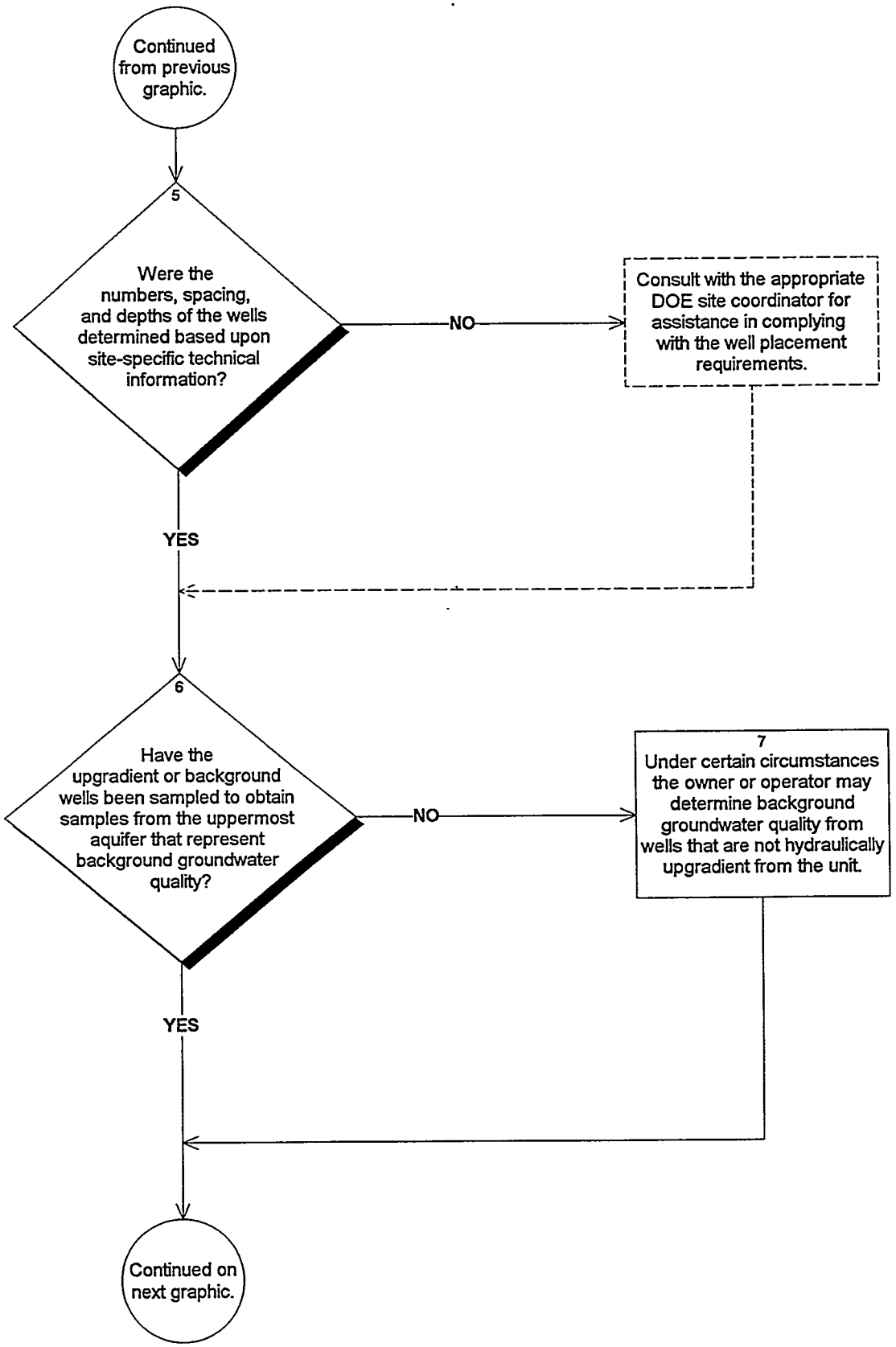
**Step 2** The preceeding module, Module 8A, should be used to determine whether the groundwater monitoring requirements apply to this MSWLF. If so, the owner or operator must establish a groundwater monitoring system at the MSWLF.

**Step 3** Only approved States may approve the use of a multi-unit groundwater monitoring system instead of separate groundwater monitoring systems for each MSWLF unit. Without this approval, the owner or operator is required to install a groundwater monitoring system for **each** individual unit.

**Step 4** States must also consider the following before determining that a multi-unit monitoring system is appropriate and protective:

(1) Number, spacing, and orientation of the units;
(2) Hydrogeologic setting;
(3) Site history;
(4) Engineering design of the units; and
(5) Type of waste accepted at the units.

When determining where to place monitoring wells in a multi-unit system, the State should draw an imaginary line around all units at the facility. The wells must be placed on this imaginary line, which constitutes the "relevant point of compliance" for the multi-unit system. Of course, the State must first make the determination that it is appropriate and protective to use a multi-unit monitoring system based on the factors described above. The multi-unit system must also meet the requirements of Steps 5 through 12. [56 *FR* 51068, 10/9/91]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5
Were the numbers, spacing, and depths of the wells determined based upon site-specific technical information?
NO
Consult with the appropriate DOE site coordinator for assistance in complying with the well placement requirements.
YES
6
Have the upgradient or background wells been sampled to obtain samples from the uppermost aquifer that represent background groundwater quality?
NO
7
Under certain circumstances the owner or operator may determine background groundwater quality from wells that are not hydraulically upgradient from the unit.
YES
Continued on next graphic.

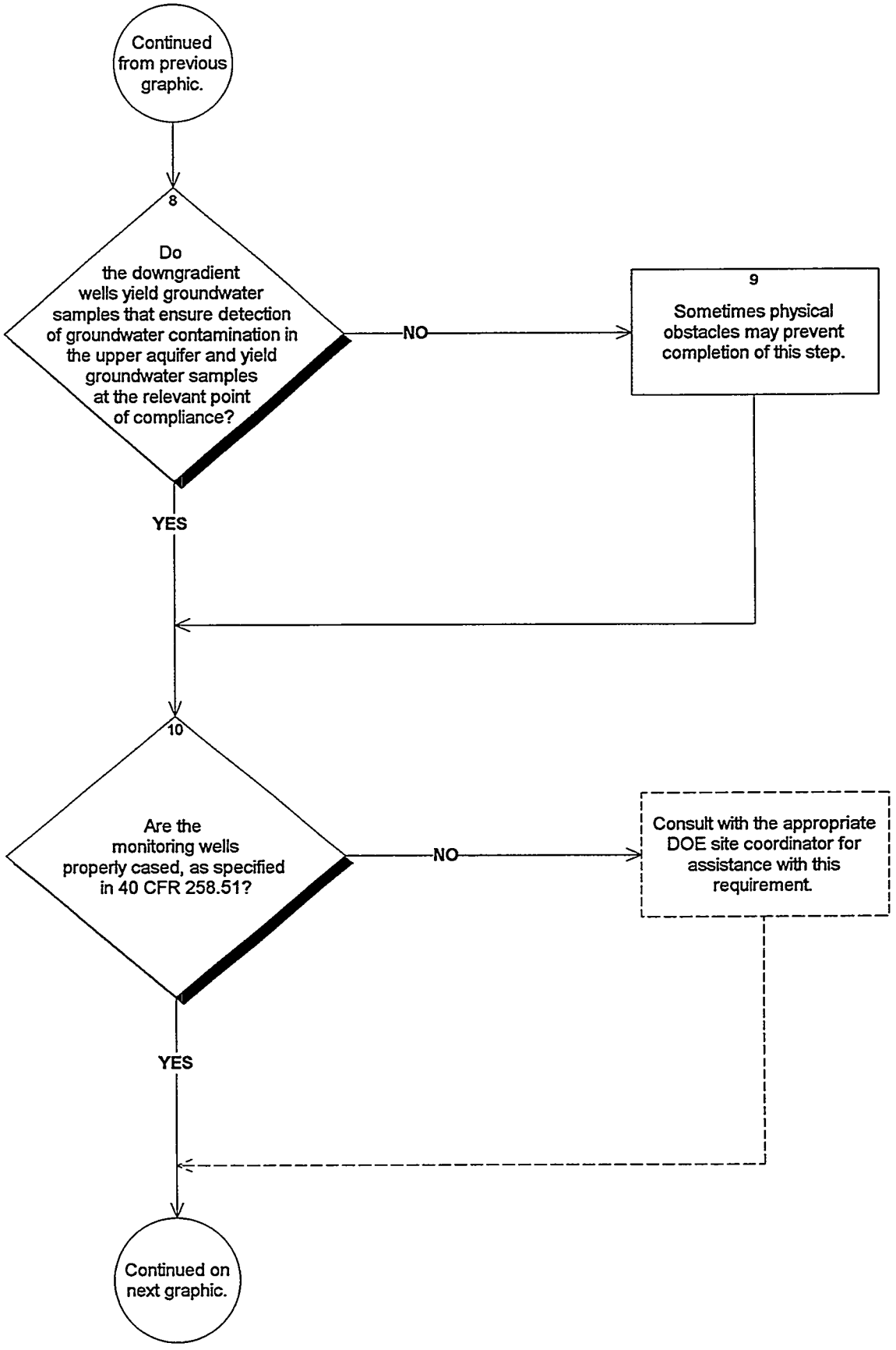
**Step 5** The number, spacing, and depths of wells should be determined based upon site-specific technical information, including the following:

(1) Aquifer thickness;
(2) Groundwater flow rate;
(3) Groundwater flow direction, including seasonal and temporal fluctuations in groundwater flow;
(4) Saturated and unsaturated geologic units and fill materials overlying the uppermost aquifer;
(5) Materials comprising the uppermost aquifer; and
(6) Materials comprising the confining unit which defines the lower boundary of the uppermost aquifer, including, but not limited to: thicknesses, stratigraphy, lithology, hydraulic conductivities, porosities, and effective porosities.

**Step 6** The upgradient or background wells should be appropriately located and screened to allow determination of background groundwater quality (quality of groundwater that has not been affected by leakage from the landfill unit) and should yield groundwater samples from the uppermost aquifer.

**Step 7** The owner/operator may determine background groundwater quality by sampling wells that are <u>not</u> hydraulically upgradient from the unit under either of the following two situations:

(1) Hydrogeologic conditions prevent the owner/operator from determining which wells are hydraulically upgradient; or
(2) Sampling at other wells will provide an indication of background groundwater quality that is as representative or more representative than that provided by the upgradient wells.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8
Do the downgradient wells yield groundwater samples that ensure detection of groundwater contamination in the upper aquifer and yield groundwater samples at the relevant point of compliance?
NO
9
Sometimes physical obstacles may prevent completion of this step.
YES
10
Are the monitoring wells properly cased, as specified in 40 CFR 258.51?
NO
Consult with the appropriate DOE site coordinator for assistance with this requirement.
YES
Continued on next graphic.

**Step 8** The downgradient wells should be appropriately located and screened to allow determination of groundwater contamination in the uppermost aquifer. These wells must also yield groundwater samples at the relevant POC in approved States or the waste management unit boundary in unapproved States.

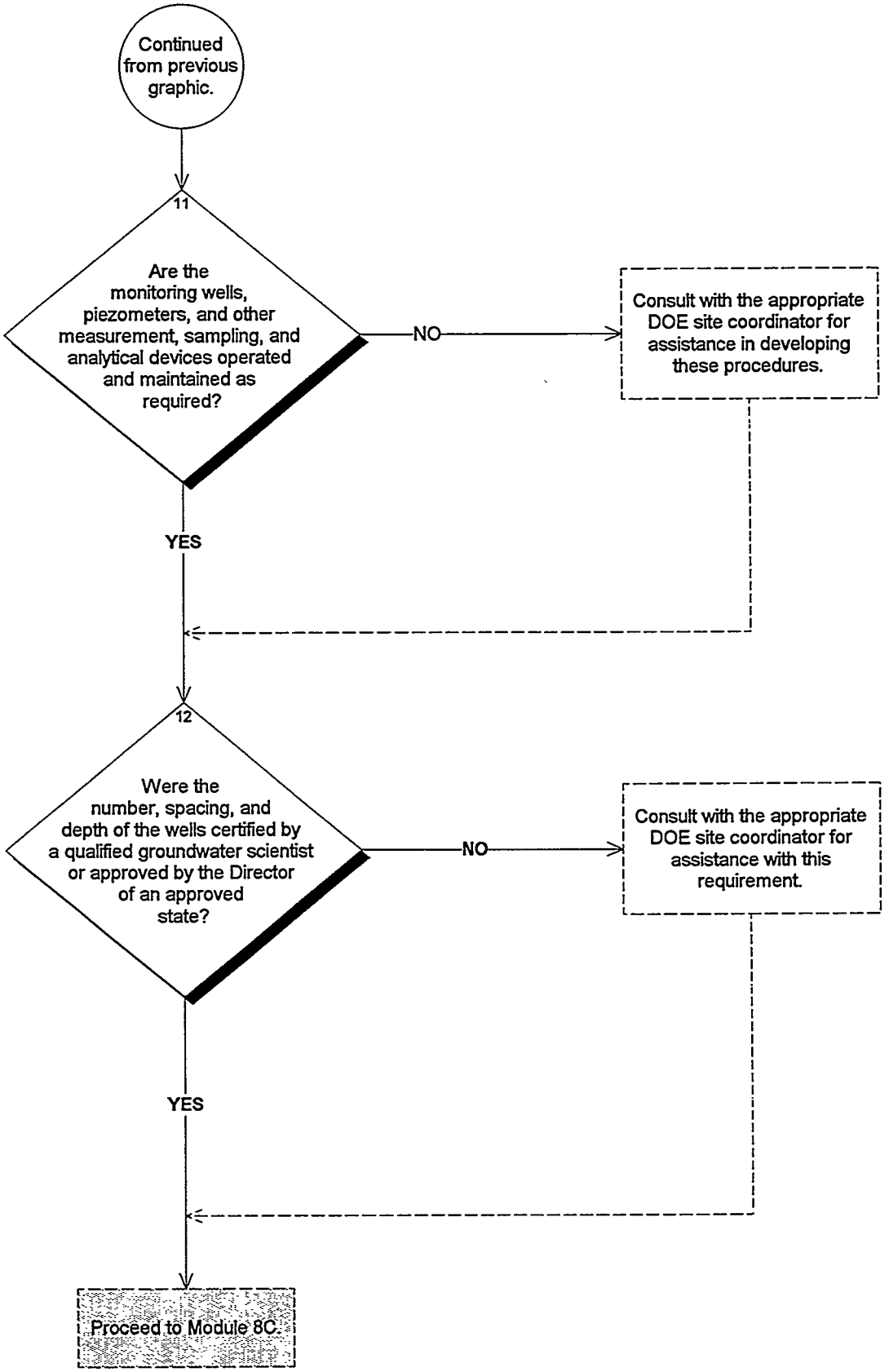
The relevant POC, which may only be specified by the Director of an approved State, must be no more than 150 meters from the waste management unit boundary on land owned by the MSWLF. In determining the "relevant point of compliance," the Director must consider, at a minimum, the following set of factors:

(1) The hydrogeologic characteristics of the facility and surrounding land;
(2) The volume and physical and chemical characteristics of the leachate;
(3) The quantity, quality, and direction of flow of groundwater;
(4) The proximity and withdrawal rate of the groundwater users;
(5) The availability of alternative drinking water supplies;
(6) The existing quality of the groundwater, including other sources of contamination and their cumulative impacts on the groundwater, and whether the groundwater is currently used or reasonably expected to be used for drinking water;
(7) Public health, safety, and welfare effects; and
(8) Practicable capability of the owner/operator.

**Step 9** When physical obstacles prevent the owner or operator from installing groundwater monitoring wells at the relevant POC at existing units, the down-gradient monitoring system may be installed at the closest practicable distance hydraulically down-gradient from the relevant POC that ensures detection of groundwater contamination in the uppermost aquifer.

**Step 10** Monitoring wells must be cased in a manner that maintains the integrity of the monitoring well bore hole. The casing must be screened or perforated and packed with gravel or sand, where necessary, to allow collection of groundwater samples.

In addition, the annular space (i.e., the space between the bore hole and well casing) above the sampling depth must be sealed to prevent contamination of samples and the groundwater.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11
Are the monitoring wells, piezometers, and other measurement, sampling, and analytical devices operated and maintained as required?
NO
Consult with the appropriate DOE site coordinator for assistance in developing these procedures.
YES
12
Were the number, spacing, and depth of the wells certified by a qualified groundwater scientist or approved by the Director of an approved state?
NO
Consult with the appropriate DOE site coordinator for assistance with this requirement.
YES
Proceed to Module 8C.

**Step 11** The monitoring wells, piezometers, and other measurement, sampling, and analytical devices must be operated and maintained so that they perform to their design specifications throughout the entire life of the groundwater monitoring program.

The owner/operator must notify the State Director when information concerning the following has been placed in the operating record for the facility: design, installation, development, and decommissioning of any monitoring wells, piezometers, and other measurement, sampling, and analyzing devices.

**Step 12** The number, spacing, and depths of the wells must be certified by a qualified groundwater scientist or approved by an approved State.

Within 14 days[2] of this certification, the owner or operator must notify the State Director that the certification has been placed in the operating record for the facility.

[2]Approved States have the flexibility to establish an alternative compliance schedule.

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## 8.4 Module 8C: Groundwater Sampling and Analysis Requirements

### 8.4.1 Introduction

Facilities are required to evaluate groundwater monitoring data using one of the five listed statistical methods. It is important to note that the owner or operator may choose from several alternative statistical methods including some forms of trend analysis as well as graphical methods such as control charts, as long as the specified performance standards are met. Guidance on choosing appropriate statistical methods can be found in "Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities."

This chapter provides several options for those who are responsible for choosing the statistical method, thus giving them the flexibility to consider site-specific factors when choosing those methods. Sampling procedures should be those specifically designated for detection monitoring, assessment monitoring, and corrective action.

The sampling procedures used for detection monitoring at the MSWLF should be consistent with and appropriate for groundwater sampling. As discussed in Module 8B, groundwater sampling at the MSWLF should ensure collection of samples that accurately represent groundwater quality at both the background and downgradient wells.

In addition, groundwater sampling should achieve the following general objectives:

(1) Accurately measure hazardous constituents and other monitoring parameters in groundwater samples; and
(2) Protect human health and the environment.

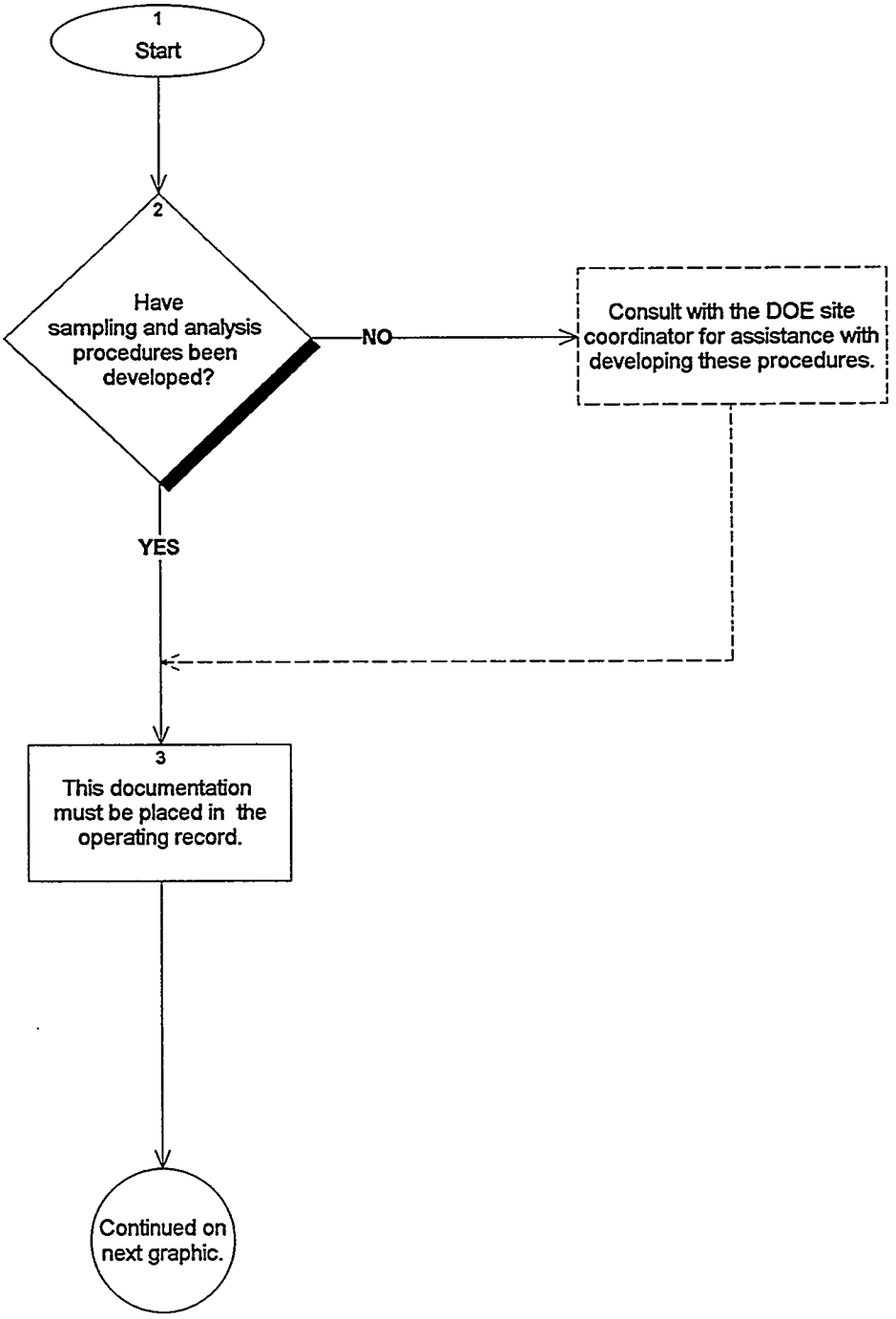
### 8.4.2 Milestones

***Has an appropriate method been chosen to evaluate the groundwater monitoring data?***

The statistical method chosen must be one of the following:

- Parametric analysis of variance (ANOVA);
- Analysis of variance (ANOVA) based on ranks;
- Tolerance or prediction interval procedure;
- Control chart approach; or
- Alternative approaches.

# Figure 8C: Groundwater Sampling and Analysis Requirements



**Step 1** Start.

**Step 2** The groundwater sampling and analysis program shall include procedures and techniques for each of the following:

Sampling

(1) Sample collection;
(2) Sample preservation and shipment;
(3) Analytical procedures;
(4) Chain of custody control; and
(5) Quality assurance and quality control.

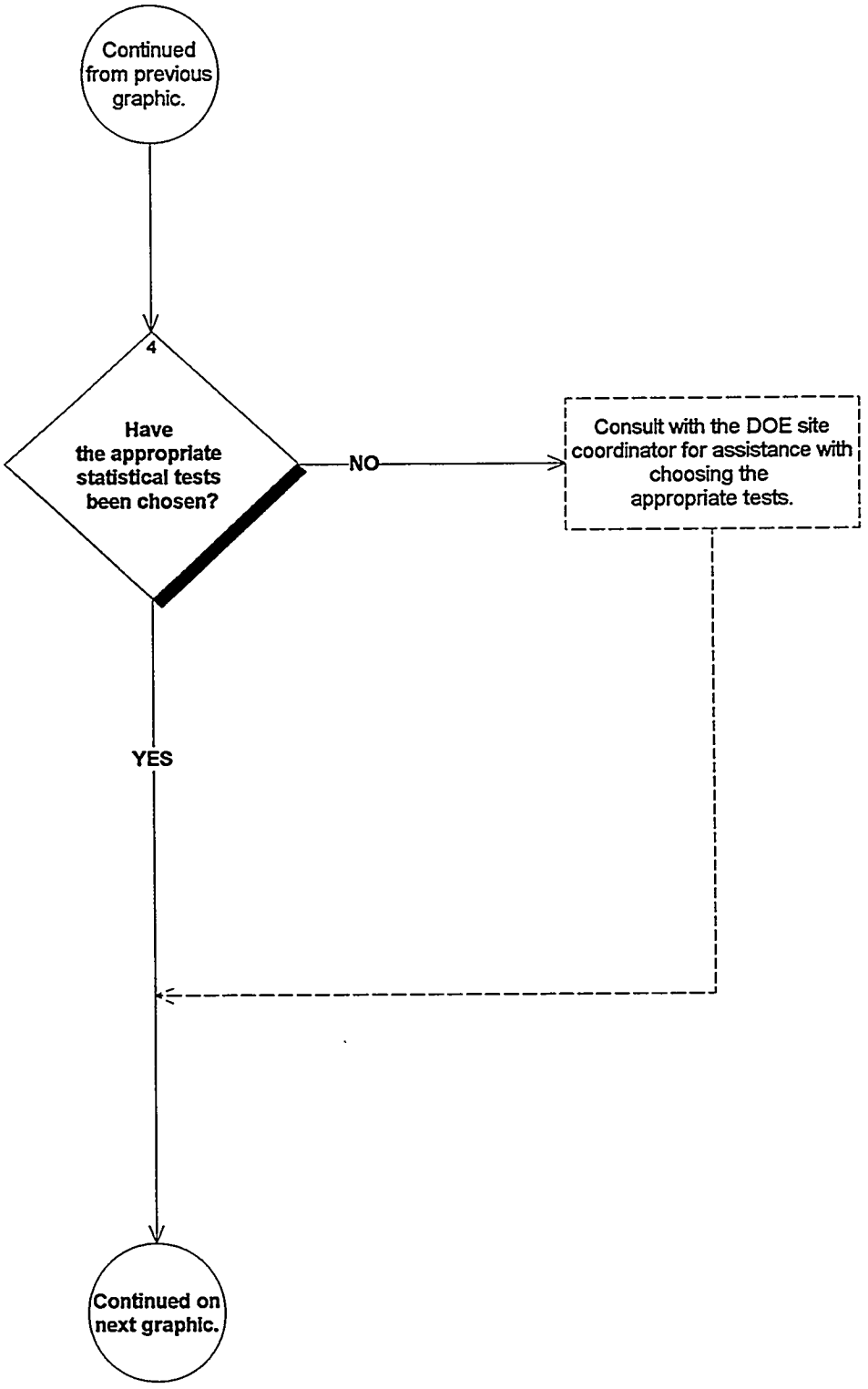
Additional requirements of the groundwater sampling program include the following:

(1) Samples shall not be field-filtered prior to laboratory analysis;
(2) The rate and direction of groundwater flow must be determined each time the groundwater is sampled;
(3) For wells that monitor the same waste management area, groundwater elevations should be measured within a period of time short enough to avoid temporal variations in groundwater flow. (These temporal variations could preclude accurate determination of groundwater flow rate and direction);
(4) Groundwater elevations must be measured in each well immediately prior to purging each time groundwater is sampled; and
(5) Ensure collection of samples that accurately represent groundwater quality at both the background and downgradient wells.

Analysis

The analysis procedures should be consistent with and appropriate for groundwater sampling, and must accurately measure hazardous constituents and other parameters in groundwater samples.

**Step 3** The owner/operator must notify the State Director that the sampling and analysis program documentation has been placed into the operating record.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4
Have the appropriate statistical tests been chosen?
NO
Consult with the DOE site coordinator for assistance with choosing the appropriate tests.
YES
Continued on next graphic.

**Step 4** The statistical test chosen for analysis of the groundwater monitoring data at the MSWLF should be conducted separately for **each** hazardous constituent in each well. In deciding which statistical test is appropriate, the owner or operator will need to consider the theoretical properties of the test, data availability, site hydrogeology, and the fate and transport characteristics of potential contaminants at the MSWLF. The owner or operator will then have to determine whether the procedure is appropriate for the site-specific conditions at the facility, and ensure that it meets the performance standards of Step 5. One of the following statistical methods can be used to evaluate these data:

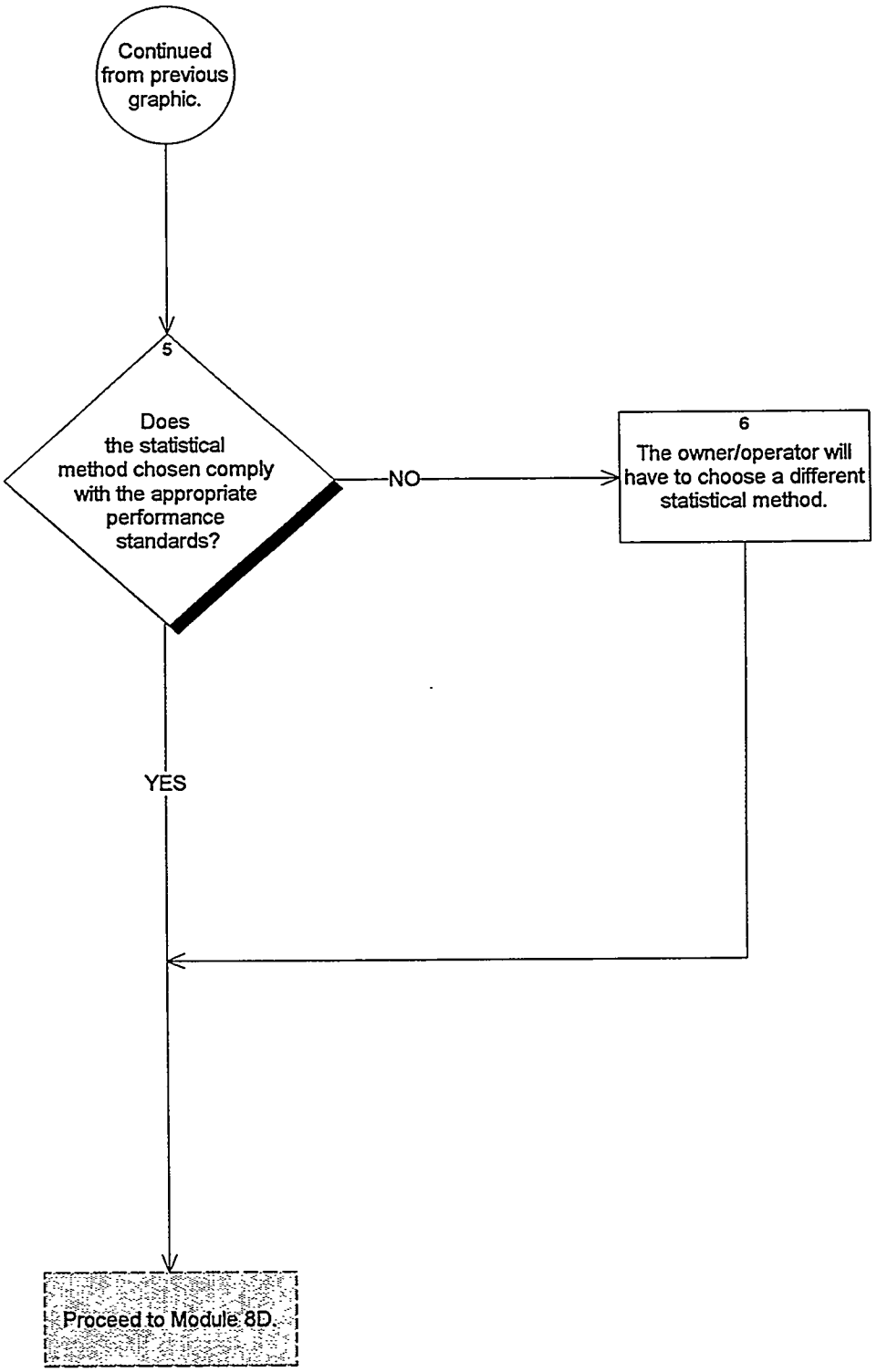
(1) Parametric Analysis of Variance (ANOVA). These tests should be followed by multiple comparisons procedures to identify statistically significant evidence of contamination. The method must include estimation and testing of the contrasts between each compliance well's mean and the background mean levels for each constituent.

(2) Analysis of Variance (ANOVA) Based on Ranks. This test is based on ranks followed by multiple comparisons procedures to identify significant evidence of contamination. The method must include estimation and testing of the contrasts between each compliance well's median and the background median levels for each constituent.

(3) Tolerance or Prediction Interval Procedure. In this test an interval for each constituent is established from the distribution of the background data, and the level of each constituent in each compliance well is compared to the upper tolerance or prediction limit.

(4) Control Chart Approach. This method should give control limits for each constituent.

(5) Alternative Approaches. The MSWLF may choose an alternative statistical test when the statistical tests listed above are inappropriate for a facility's specific circumstances. This alternative statistical method must meet each of the performance standards listed in Step 5. The owner or operator of the MSWLF must notify the State Director of the use of an alternative test and place a justification for the alternative in the facility's operating record.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5
Does the statistical method chosen comply with the appropriate performance standards?
NO
6
The owner/operator will have to choose a different statistical method.
YES
Proceed to Module 8D.

**Step 5** The statistical method must comply with the following performance standards, as appropriate:

(1) The statistical method chosen shall be appropriate for the distribution of chemical parameters or hazardous constituents. If the distribution is shown by the owner or operator to be inappropriate for a normal theory test, then the data should be transformed or a distribution-free theory test should be used. If the distributions for the constituents differ, more than one statistical method may be needed.

(2) If an individual well comparison procedure is used to compare an individual compliance well constituent concentration with background constituent concentrations or a groundwater protection standard, the test should be done at a Type I error level no less than **0.01** for each testing period. If a multiple comparisons procedure is used, the Type I experiment wise error rate for each testing period should be no less than **0.05**; however, the Type I error of no less than **0.01** for individual well comparisons must be maintained. This performance standard does not apply to tolerance intervals, prediction intervals, or control charts.

(3) If a control chart approach is used, the specific type of control chart and its associated parameter values should be protective of human health and the environment. The parameters should be determined after considering the number of samples in the background data base, the data distribution, and the range of the concentration values for each constituent of concern.

(4) If a tolerance interval or a predictional interval is used, the levels of confidence and, for tolerance intervals, the percentage of the population that the interval must contain, should be protective of human health and the environment. These parameters should be determined using the same criteria as in #3.

(5) The statistical method should account for data below the limit of detection with one or more statistical procedures that are protective of human health and the environment. Any practical quantification limit (PQL) that is used in the statistical method should be the lowest concentration level that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions that are available to the facility.

(6) If necessary, the statistical method should include procedures to control or correct for seasonal and spatial variability as well as temporal correlation in the data.

**Step 6** EPA believes that statistical analyses and sampling procedures that meet these performance standards will have a low probability of indicating contamination when it is not present and of failing to detect contamination when it is actually present.

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## 8.5 Module 8D: Detection Monitoring for Appendix I Constituents

### 8.5.1 Introduction

Owners and operators are required to establish background concentrations and sample at least semi-annually during the active life of the facility and post-closure periods for a set of detection monitoring parameters. These indicator parameters, found in Appendix I to 40 CFR Part 258, include 47 volatile organic compounds and 15 metals. The Director of an approved State may delete any of the constituents from Appendix I if it can be determined that a constituent is not reasonably expected to be contained in or derived from waste contained in the unit. The Director of an approved State may also establish an alternative list of inorganic indicator parameters in lieu of some or all of the heavy metals. In addition, the Director may establish an alternative sampling frequency, as long as that frequency is not less than annual.

### 8.5.2 Milestones

***Has the owner or operator established a detection monitoring program?***

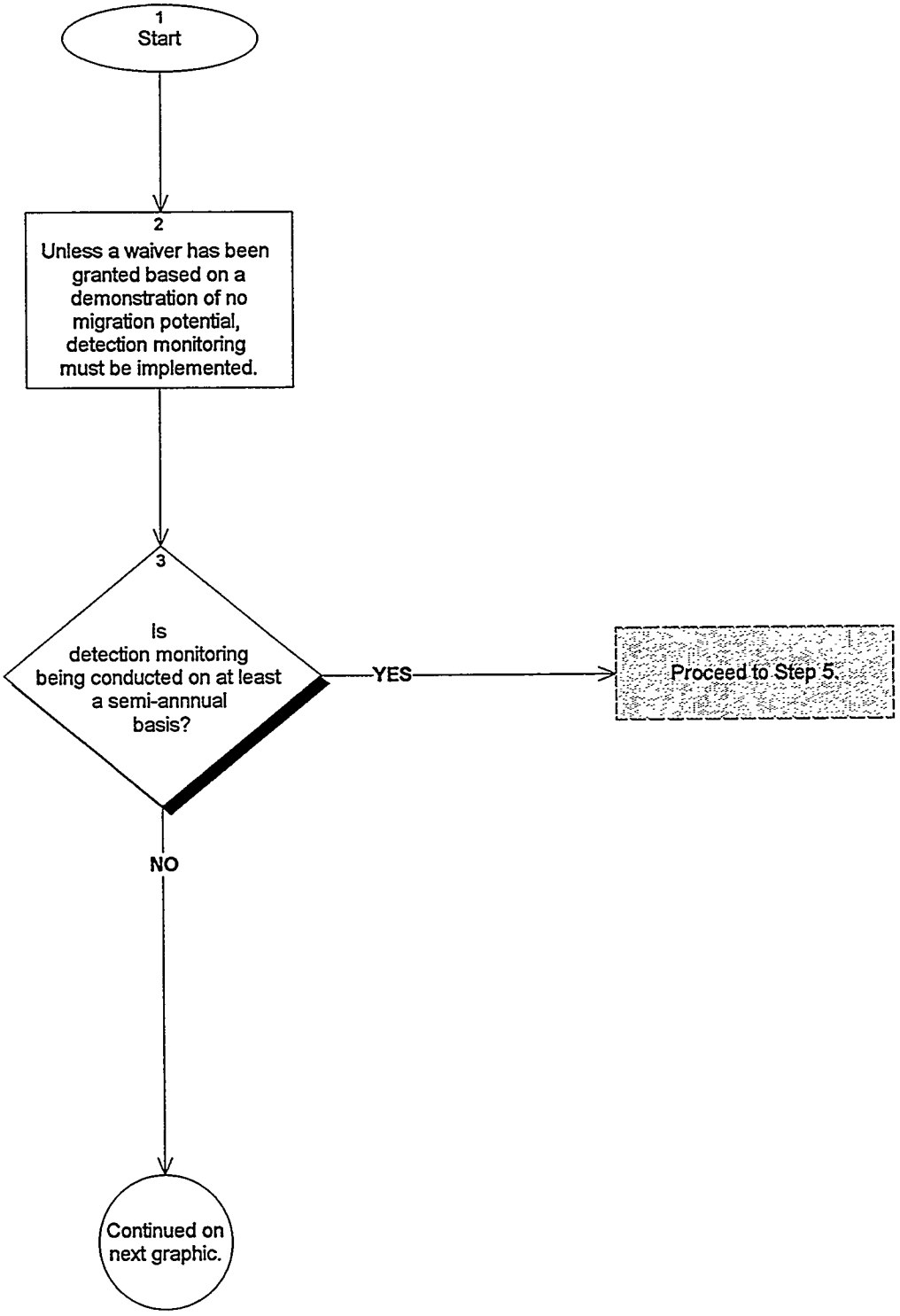
Unless the MSWLF is located in an approved State, the detection monitoring program must sample for:

- 47 volatile organic compounds; and
- 15 metals.

If the MSWLF is located in an approved State, the detection monitoring program must sample for:

- 47 volatile organic compounds (unless one or more of the compounds has been deleted by the State Director); and
- 15 metals (unless the Director establishes an alternative list of metals.)

# Figure 8D: Detection Monitoring for Appendix I Constituents



**Step 1** Start.

**Step 2** MSWLFs must provide detection monitoring for all of the constituents in Appendix I, unless a constituent has been deleted by an approved State. Approved States have the flexibility to delete any of the Appendix I monitoring parameters as long as it can be shown that the removed constituents are not reasonably expected to be in, or derived from, the waste contained in the unit. The Director of an approved State may also substitute inorganic indicator parameters for some or all of the heavy metals (constituents 1-15 only in Appendix I) if the alternative parameters provide a reliable indication of inorganic releases from the MSWLF unit to the groundwater. The Director must consider the following factors when establishing this alternative list:

(1) The types, quantities, and concentrations of constituents in wastes managed at the MSWLF unit;
(2) The mobility, stability, and persistence of waste constituents or their reaction products in the unsaturated zone beneath the MSWLF unit;
(3) The detectability of indicator parameters, waste constituents, and reaction products in the groundwater; and
(4) The concentration or values and coefficients of variation of monitoring parameters or constituents in the groundwater background.

This alternative list may only be granted by the State on a site-specific basis because groundwater chemistry may vary from site to site within a State.

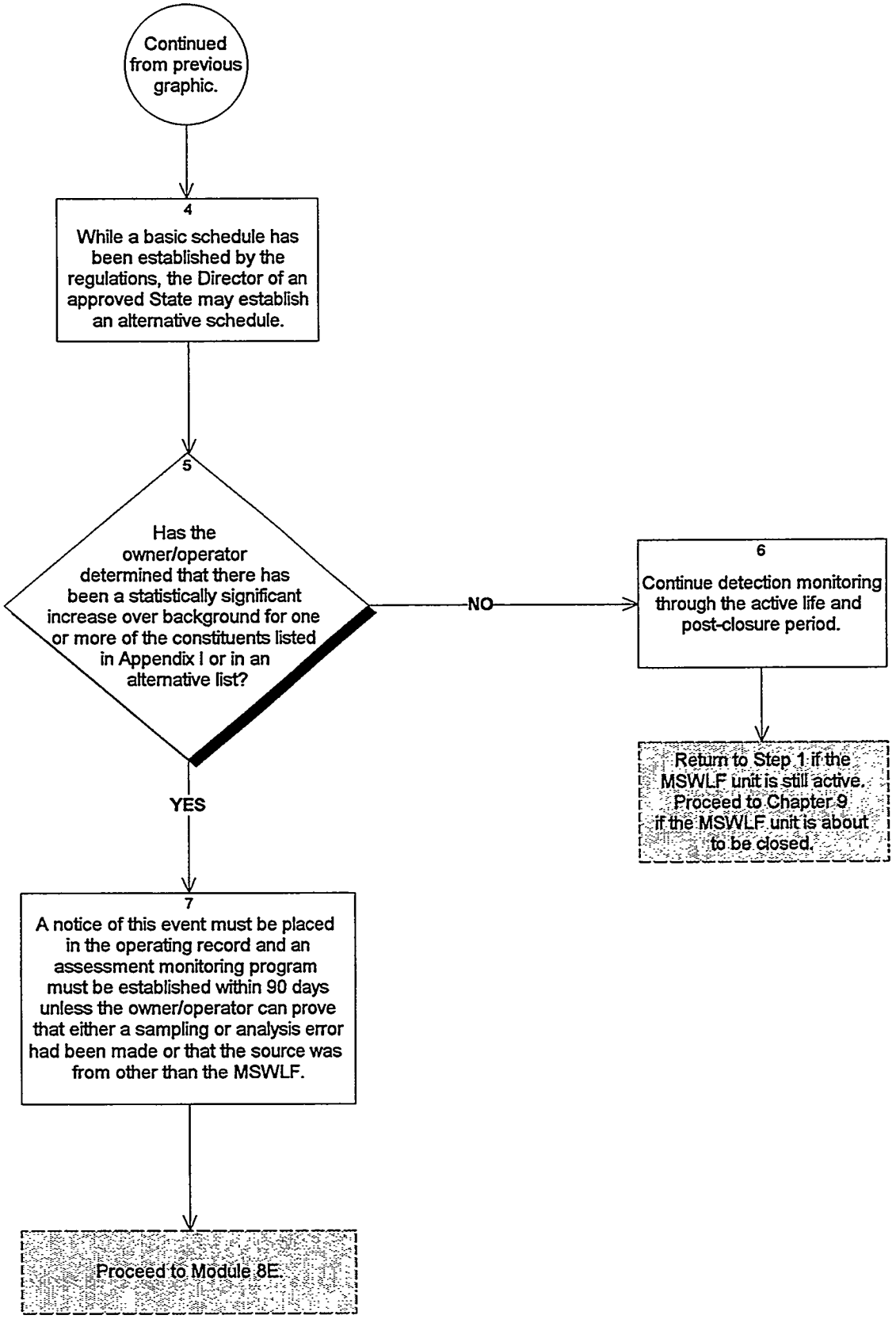
The suspension, or waiver of groundwater monitoring requirements, which would include the detection monitoring requirements, was discussed in Module 8A, Applicability of Groundwater Monitoring Requirements.

**Step 3** Monitoring for all the constituents listed in Appendix I or in the alternative list compiled by an approved State should occur at least semiannually to detect groundwater contamination during the active life of the facility (including closure) and the post-closure period, unless as provided for in Step 4 for approved States.

During the first semiannual sampling event, at least four independent samples from each well (background and downgradient) must be collected and analyzed for each monitoring parameter or constituent listed in Appendix I or in the alternative list prepared by an approved State.

During subsequent semiannual sampling, at least one sample from each well (background and downgradient) must be collected and analyzed for the required parameters. Additional samples may be required depending on the statistical method used or to meet the requirement that sampling procedures and frequency be protective of human health and the environment.

The number of samples collected to establish groundwater quality data must be consistent with the appropriate statistical procedures outlined in Module 8C, Step 4.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4
While a basic schedule has been established by the regulations, the Director of an approved State may establish an alternative schedule.
5
Has the owner/operator determined that there has been a statistically significant increase over background for one or more of the constituents listed in Appendix I or in an alternative list?
NO
6
Continue detection monitoring through the active life and post-closure period.
Return to Step 1 if the MSWLF unit is still active. Proceed to Chapter 9 if the MSWLF unit is about to be closed.
YES
7
A notice of this event must be placed in the operating record and an assessment monitoring program must be established within 90 days unless the owner/operator can prove that either a sampling or analysis error had been made or that the source was from other than the MSWLF.
Proceed to Module 8E.

**Step 4** Only the Director of an approved State may specify an appropriate alternative frequency for repeated sampling and analysis for Appendix I constituents, or the chemicals listed in the alternative list approved by the Director of an approved State. The alternative frequency should be no less than annual, must be protective of human health and the environment, and should be based on consideration of the following factors:

(1) Lithology of the aquifer and unsaturated zone;
(2) Hydraulic conductivity of the aquifer and unsaturated zone;
(3) Groundwater flow rates;
(4) Minimum distance between upgradient edge of the MSWLF unit and downgradient monitoring well screen (minimum distance of travel); and
(5) Resource value of the aquifer.

**Step 5** Before the owner/operator can make such a determination, he/she must establish background groundwater quality in a hydraulically upgradient or background well(s) for **each** of the required Appendix I parameters or constituents. (Background groundwater quality may be established at wells that are not located hydraulically upgradient from the MSWLF if it meets the requirements of 40 CFR 285.51(a)(1).)

**Step 6** Continue to monitor according to the schedule established in either Step 3 or 4.

**Step 7** A notice must be placed in the operating record indicating which constituents have shown statistically significant changes from background levels, and the State Director must be notified that this notice has been placed in the operating record. Also, an assessment monitoring program as described in Module 8E must be initiated unless the owner/operator can demonstrate that a source other than an MSWLF unit caused the contamination or that the statistically significant increase resulted from an error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality. A report documenting this demonstration must be certified by a qualified groundwater scientist or approved by the Director of an approved State and be placed in the operating record. If a successful demonstration is made and documented, the owner/operator may continue detection monitoring as described in this module. If, after 90 days, a successful demonstration is not made, the owner/operator must initiate an assessment monitoring program as described in Module 8E.

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## 8.6 Module 8E: Assessment Monitoring

### 8.6.1 Introduction

The purpose of assessment monitoring is to evaluate, rather than detect, contamination. Assessment monitoring is to be conducted for **Appendix II** constituents when constituents listed in **Appendix I** are found at a level that is statistically significant when compared to background levels. Appendix I contains a list of 15 metals and 47 organic constituents. Appendix II contains an expanded list of metals and inorganic constituents.

As briefly described in Step 7 of Module 8D, Detection Monitoring for Appendix I Constituents, the owner or operator may be able to demonstrate that assessment monitoring is not needed even though a statistically significant increase over background levels was detected for some, or all, of the Appendix I constituents or an approved alternative list. This demonstration may be made based upon the following:

**Natural Variation:** When the owner or operator suspects that a statistically significant increase in an Appendix I constituent is caused by temporal or spatial variability, he/she must demonstrate that this increase was due to natural variation to avoid the assessment monitoring requirements. If after 90 days the owner/operator has not made a successful demonstration, he/she must begin an assessment monitoring program. Owners and operators in approved States should note that the Director of an approved State may modify the 90-day time period for a successful demonstration.

**Errors:** Owners/operators may demonstrate that the statistically significant increase resulted from an error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality, or was caused by a source other than the landfill, but this activity does not waive the responsibility of the owner/operator to establish an assessment monitoring program 90 days after the initial finding.

If the demonstration proves, after assessment monitoring has been initiated, that the contamination was not from the MSWLF or was based on inaccurate results, the owner/operator may cease assessment monitoring and return to detection monitoring. The owner/operator must place a notice of the successful demonstration in the operating record and get the demonstration certified by a qualified groundwater scientist.

If the demonstration above cannot be made, the assessment monitoring program must be initiated according to the schedule described in this module.

### 8.6.2 Milestones

***Has the owner/operator demonstrated that assessment monitoring is not needed even though a statistically significant increase over background levels was detected for some or all Appendix I constituents?***

The demonstration may be based on one of the following:

- Natural variation; or
- Errors.

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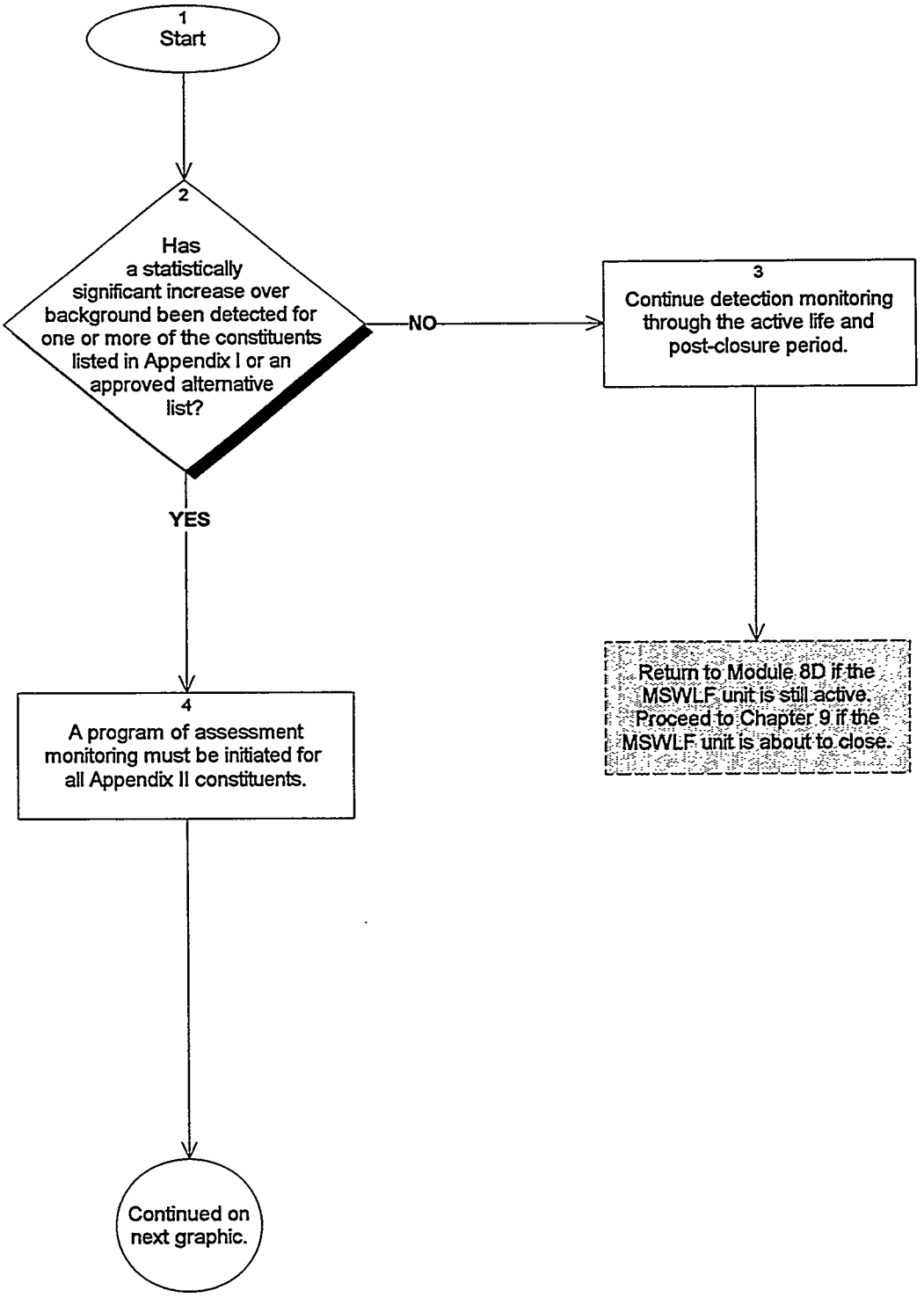
# Figure 8E: Assessment Monitoring



**Step 1** Start.

**Step 2** Owners/operators must begin assessment monitoring when there is a statistically significant increase over background for one or more of the constituents listed in Appendix I or on the alternative list approved by an approved State.

Owners/operators are required to place the finding(s) of a statistically significant increase over background in the facility's operating record within 14 days. Approved States have the flexibility to modify this time frame.

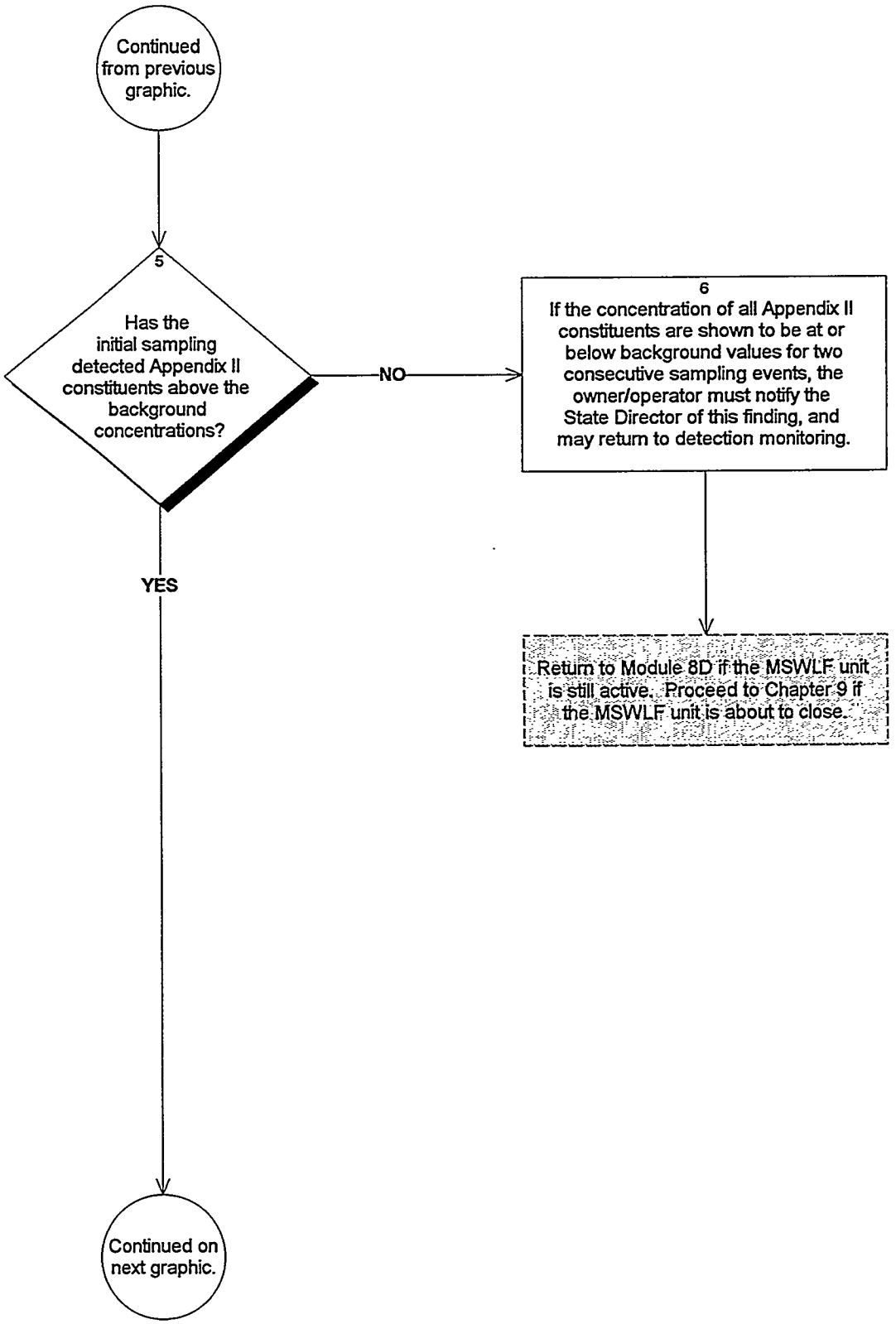
Background concentrations must be established for the Appendix II constituents that have been detected in groundwater and for the Appendix I constituents or an approved alternative list. EPA encourages owners/operators to determine the concentrations of a constituent in the samples through the use of one-point-in-time comparisons between background and downgradient wells. This approach will help reduce the components of seasonal variation by providing for simultaneous comparisons between background and downgradient well monitoring data.

A minimum of **one** sample from each downgradient well must be collected and analyzed during each annual assessment monitoring sampling event. If any constituent is detected during this complete Appendix II sampling event, at least **four** independent samples from each well (background and downgradient) must be collected and analyzed to establish background for the constituents.

**Step 3** Continue detection monitoring according to the schedule established in Module 8D.

**Step 4** Within 90 days of triggering an assessment monitoring program, and annually thereafter, the owner/operator must sample and analyze the groundwater for all constituents identified in Appendix II. Background groundwater quality in the hydraulically upgradient or background well(s) for each of the monitoring parameters or constituents listed in Appendix II should be determined.

Only the Director of an approved State may delete any of the Appendix II monitoring parameters if it can be shown that the removed constituents are not reasonably expected to be in or derived from the waste contained in the unit. In addition, owners and operators in these States may design their landfill in accordance with a performance standard based on a more limited set of compounds -- the constituents with EPA approved standards (i.e., MCLs).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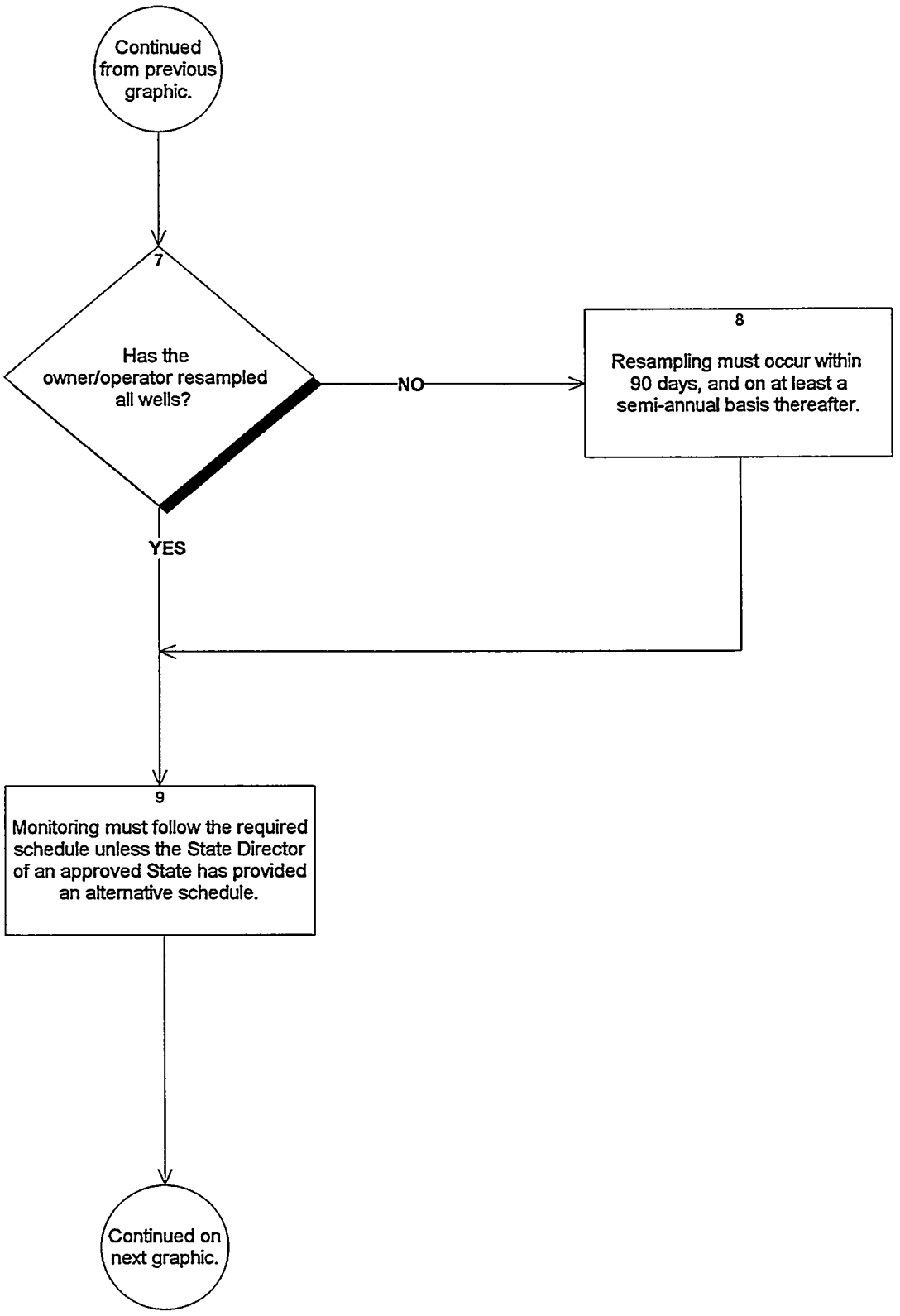
5
Has the initial sampling detected Appendix II constituents above the background concentrations?
NO
6
If the concentration of all Appendix II constituents are shown to be at or below background values for two consecutive sampling events, the owner/operator must notify the State Director of this finding, and may return to detection monitoring.
Return to Module 8D if the MSWLF unit is still active. Proceed to Chapter 9 if the MSWLF unit is about to close.
YES
Continued on next graphic.

**Step 5** After obtaining the results from the assessment monitoring sampling events, the owner or operator has 14 days to place a notice in the operating record identifying the Appendix II constituents that have been detected and to notify the State Director that this notice has been placed in the operating record. The Director of an approved State program may modify this time period. If the concentrations of any Appendix II constituents are above background levels but all concentrations are below the groundwater protection standards, the owner or operator must continue assessment monitoring.

**Step 6** The statistical procedures found in Module 8C: Groundwater Sampling and Analysis Requirements, must be used to analyze these concentrations of Appendix II constituents.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7
Has the owner/operator resampled all wells?
NO
8
Resampling must occur within 90 days, and on at least a semi-annual basis thereafter.
YES
9
Monitoring must follow the required schedule unless the State Director of an approved State has provided an alternative schedule.
Continued on next graphic.

**Step 7** After obtaining the results from the assessment monitoring sampling events, the owner or operator has 90 days to resample all wells, and to conduct analyses for all detection monitoring constituents and the assessment monitoring constituents that are detected after complete assessment monitoring. (At least one sample from each background and downgradient well must be collected and analyzed during these sampling events.) Also by this deadline, they must record these monitoring results in the facility's operating record. The owner or operator must meet these requirements on a semiannual basis thereafter.

Background concentrations must also be established for any constituents detected as a result of the resampling effort.

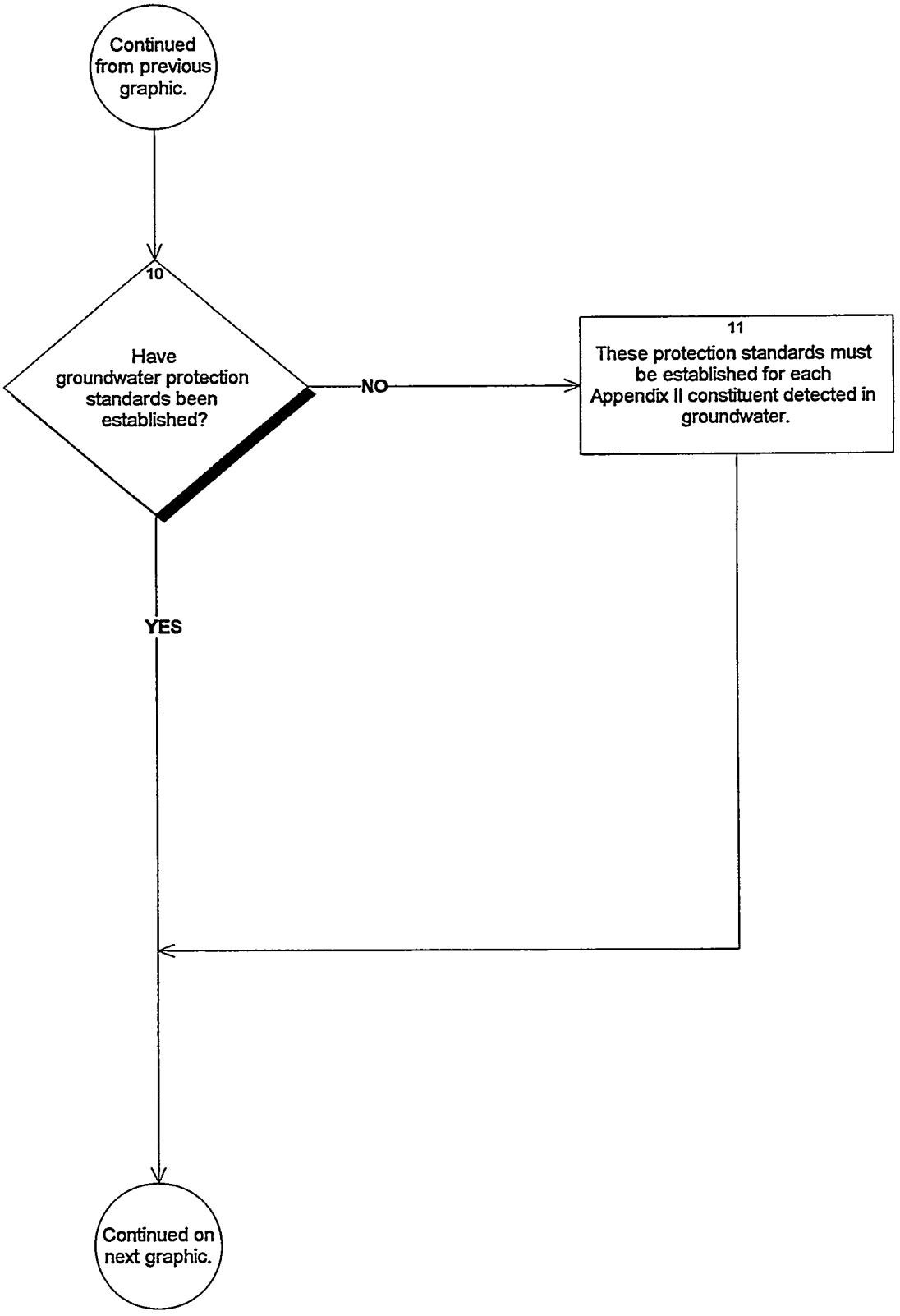
**Step 8** The Director of an approved State may specify an alternative monitoring frequency during the active life and the post-closure period for detected Appendix II constituents and for Appendix I constituents. The alternative frequency for Appendix I constituents or an alternative constituent list (see Module 8D, Step 2) during the active life shall be no less than annual. Owners and operators must place a notice in the operating record identifying Appendix II constituents that had not been identified through previous monitoring.

**Step 9** Periodic analyses for all the required assessment monitoring parameters are essential to ensure detection of groundwater contamination and for use in determining whether the design of an ongoing corrective action program (see Module 8F) must be changed to accommodate the treatment or removal of additional constituents. [56 *FR* 51062, 10/9/91] The owner or operator must also notify the State Director that this notice has been placed in the operating record.

The EPA set an **annual monitoring** frequency for repeated full analysis of the Appendix II parameters for MSWLF units. This minimum frequency is designed to ensure protection of human health and the environment from groundwater contamination resulting from MSWLFs. Approved States may require more frequent monitoring if it is warranted after considering the following:

(1) Lithology of the aquifer and unsaturated zone;
(2) Hydraulic conductivity of the aquifer and unsaturated zone;
(3) Groundwater flow rates;
(4) Minimum distance between upgradient edge of the MSWLF unit and downgradient monitoring well screen (minimum distance of travel);
(5) Resource value of the aquifer; and
(6) Nature (fate and transport) of any constituents detected.

**Semiannual monitoring** should be conducted throughout the active life, closure, and post-closure care period for those constituents that are detected in groundwater as a result of the annual assessment monitoring of all the Appendix II constituents. Approved States may elect to specify an alternative monitoring frequency, other than semiannually, for those constituents that are detected in groundwater as a result of a complete assessment monitoring analysis.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10
Have groundwater protection standards been established?
NO
11
These protection standards must be established for each Appendix II constituent detected in groundwater.
YES
Continued on next graphic.

**Step 10** After obtaining the results from the initial or subsequent sampling events, the owner/ operator must establish groundwater protection standards for each Appendix II constituent detected in the groundwater as a result of assessment monitoring. These groundwater protection standards should be:

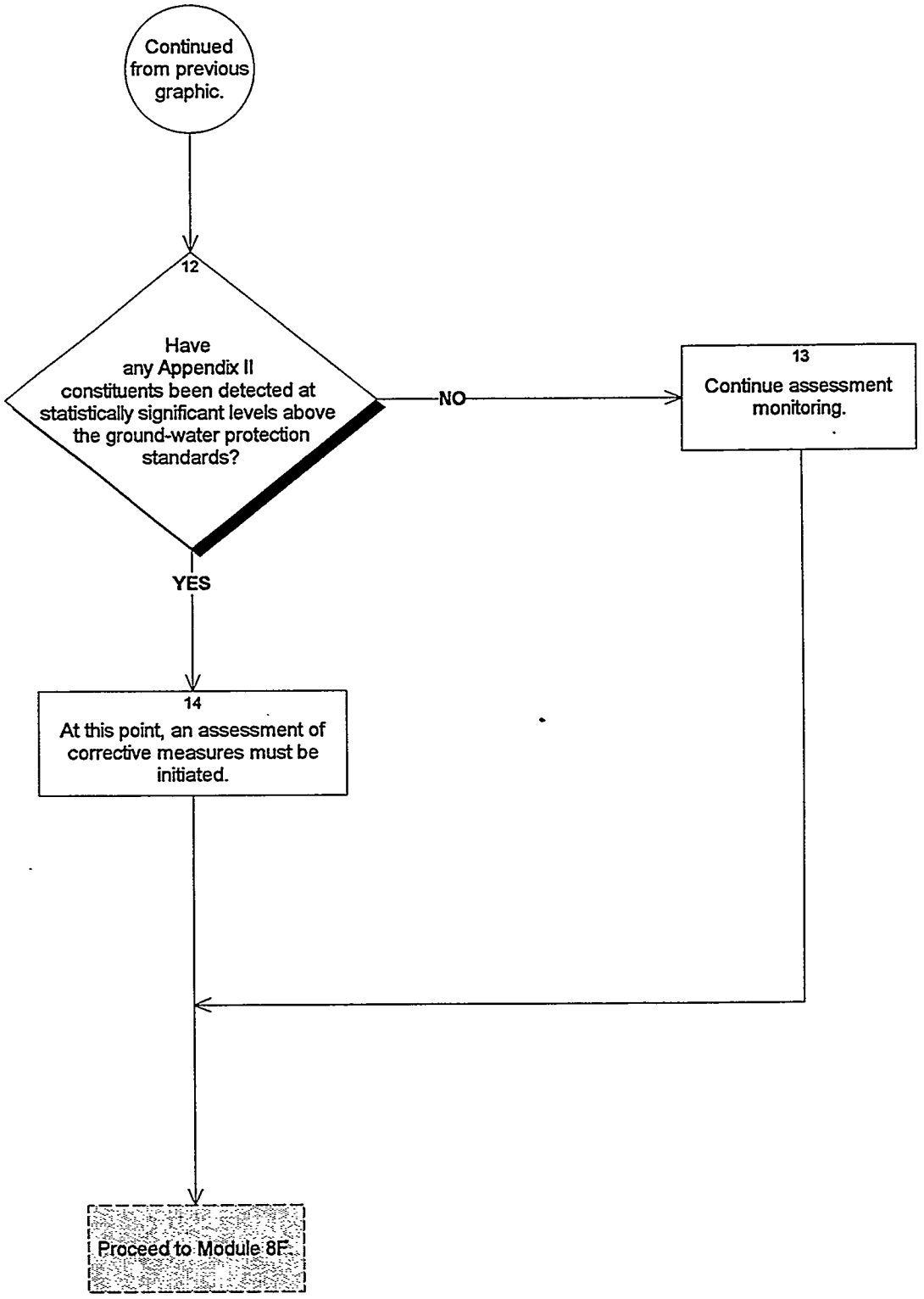
(1) The maximum contaminant level (MCL) for constituents for which an MCL has been promulgated under Section 1412 of the Safe Drinking Water Act (SDWA), codified under 40 CFR Part 141;
(2) The background concentration for the constituent established from wells in accordance with 40 CFR 258.51(a)(1) for constituents for which MCLs have not been promulgated; or
(3) The background concentration for constituents for which the background level is higher than the MCL that has been promulgated under Section 1412 of the SDWA or health-based levels described below.

The Director of an approved State may establish an alternative groundwater protection standard for constituents for which MCLs have not been established. These groundwater protection standards should be appropriate health based levels that satisfy the following criteria:

(1) The level is derived in a manner consistent with EPA guidelines for assessing the health risks of environmental pollutants [51 *FR* 33992, 34006, 34014, 34028, 9/24/86];
(2) The level is based on scientifically valid studies conducted in accordance with the TSCA Good Laboratory Practice Standards (40 CFR Part 792) or equivalent;
(3) For carcinogens, the level represents a concentration associated with an excess lifetime cancer risk level (due to continuous lifetime exposure) within the $1x10^{-4}$ to $1x10^{-6}$ range; and
(4) For systemic toxicants, the level represents a concentration to which the human population (including sensitive subgroups) could be exposed on a daily basis that is likely to be without appreciable risk of deleterious effects during a lifetime. For the purposes of this requirement, systemic toxicants include toxic chemicals that cause effects other than cancer or mutation.

**Step 11** In establishing these alternative groundwater protection standards, the Director of an approved State may consider the following:

(1) Multiple contaminants in the groundwater;
(2) Exposure threats to sensitive environmental receptors; and
(3) Other site-specific exposure or potential exposure to groundwater.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12
Have any Appendix II constituents been detected at statistically significant levels above the ground-water protection standards?
NO
13
Continue assessment monitoring.
YES
14
At this point, an assessment of corrective measures must be initiated.
Proceed to Module 8F.

**Step 12** If one or more Appendix II constituents are detected at statistically significant levels above the groundwater protection standards in any sampling event, the owner/operator must, within 14 days of this finding, place a notice in the operating record identifying the Appendix II constituents that have exceeded the groundwater protection standard. The owner or operator must also:

(1) Notify the State Director and all appropriate local government officials that the notice has been placed in the operating record;
(2) Characterize the nature and extent of the release by installing additional monitoring wells as necessary;
(3) Install at least one additional monitoring well at the facility boundary in the direction of contaminant migration and sample this well in accordance with the requirements; and
(4) Notify all persons who own the land or reside on the land that directly overlies any part of the plume of contamination if contaminants have migrated off-site (if indicated by sampling of wells).

The owner or operator may also demonstrate that a source other than an MSWLF unit caused the contamination, or that the statistically significant increase resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality. A report documenting this demonstration must be certified by a qualified groundwater scientist or approved by the Director of an approved State and placed in the operating record. If a successful demonstration is made, the owner or operator must continue monitoring in accordance with the assessment monitoring program outlined in this module, and may return to detection monitoring if the Appendix II constituents are at or below background for two consecutive sampling events as described in Step 6. Until a successful demonstration is made, the owner or operator must comply with the requirements of items (1) through (4) of Step 12, and that of Step 14.

**Step 13** The assessment monitoring must be continued in the manner described in this module.

**Step 14** The assessment of corrective measures must be initiated within 90 days.

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## 8.7 Module 8F: Assessment of Corrective Measures and Selection of the Corrective Action

### 8.7.1 Introduction

After conducting the assessment monitoring program, the owner/operator must evaluate the possible corrective measures and select the appropriate remedy. During this phase, the owner/operator is required to continue monitoring for all Appendix I constituents, and those Appendix II constituents that exceed the groundwater protection standards. As part of the evaluation process, the owner/operator must hold a public meeting to discuss those corrective measures under consideration, before the final selection is made.

After the remedy has been selected, the owner/operator is required to implement the corrective measure, which may include the establishment of a corrective action groundwater monitoring program, and any necessary interim measures.

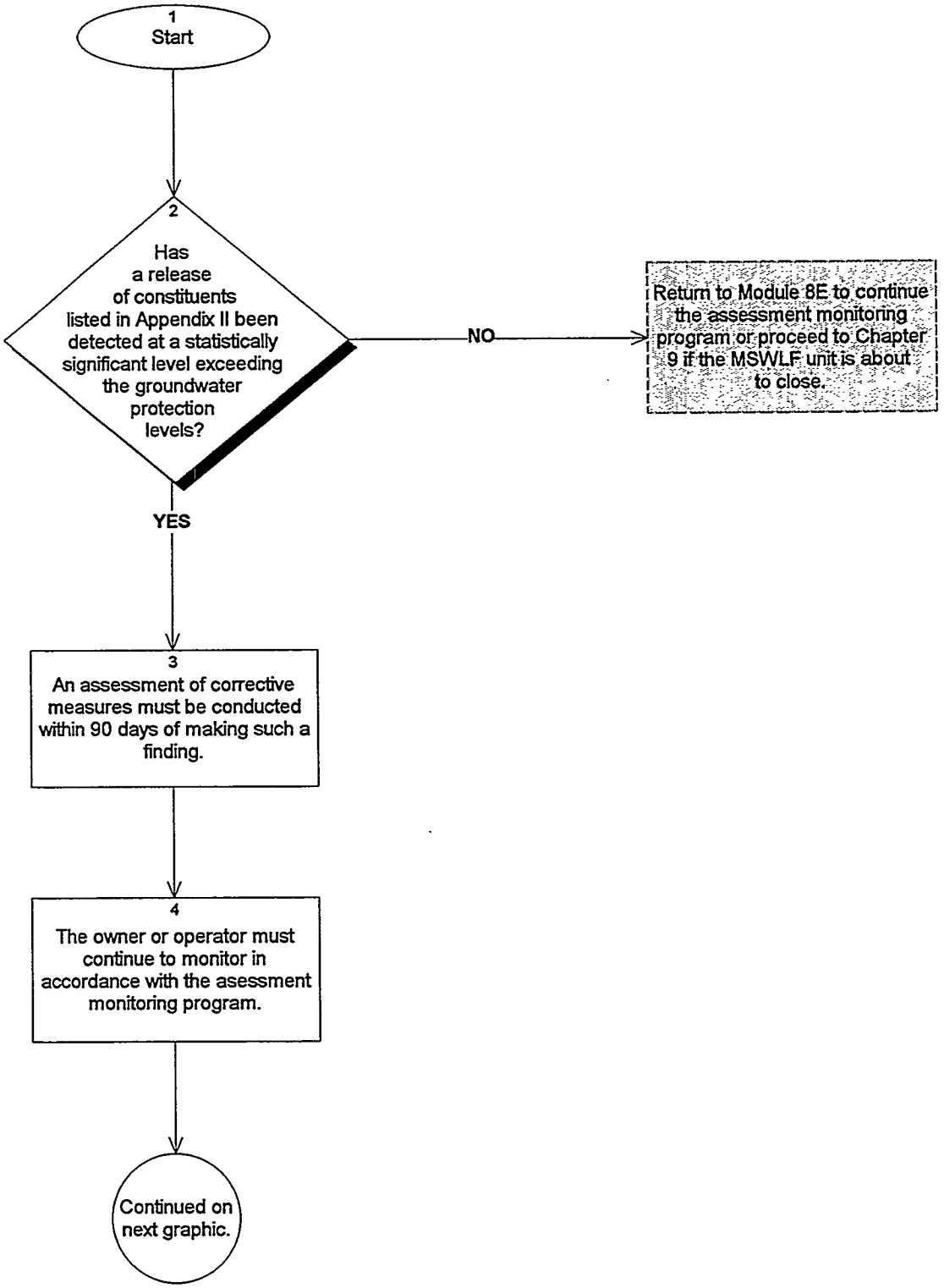
### 8.7.2 Milestones

***Has the selected remedy been designed to achieved the four required goals?***

The four required goals are:

- To protect human health and the environment;
- To attain the groundwater protection standard;
- To control the source(s) of releases so as to reduce or eliminate, to the maximum extent practicable, further releases of Appendix II constituents into the environment that may pose a threat to human health or the environment; and
- To comply with the standards for the management of wastes as specified in 40 CFR 258.57(d).

# Figure 8F: Assessment of Corrective Measures and Selection of the Corrective Action



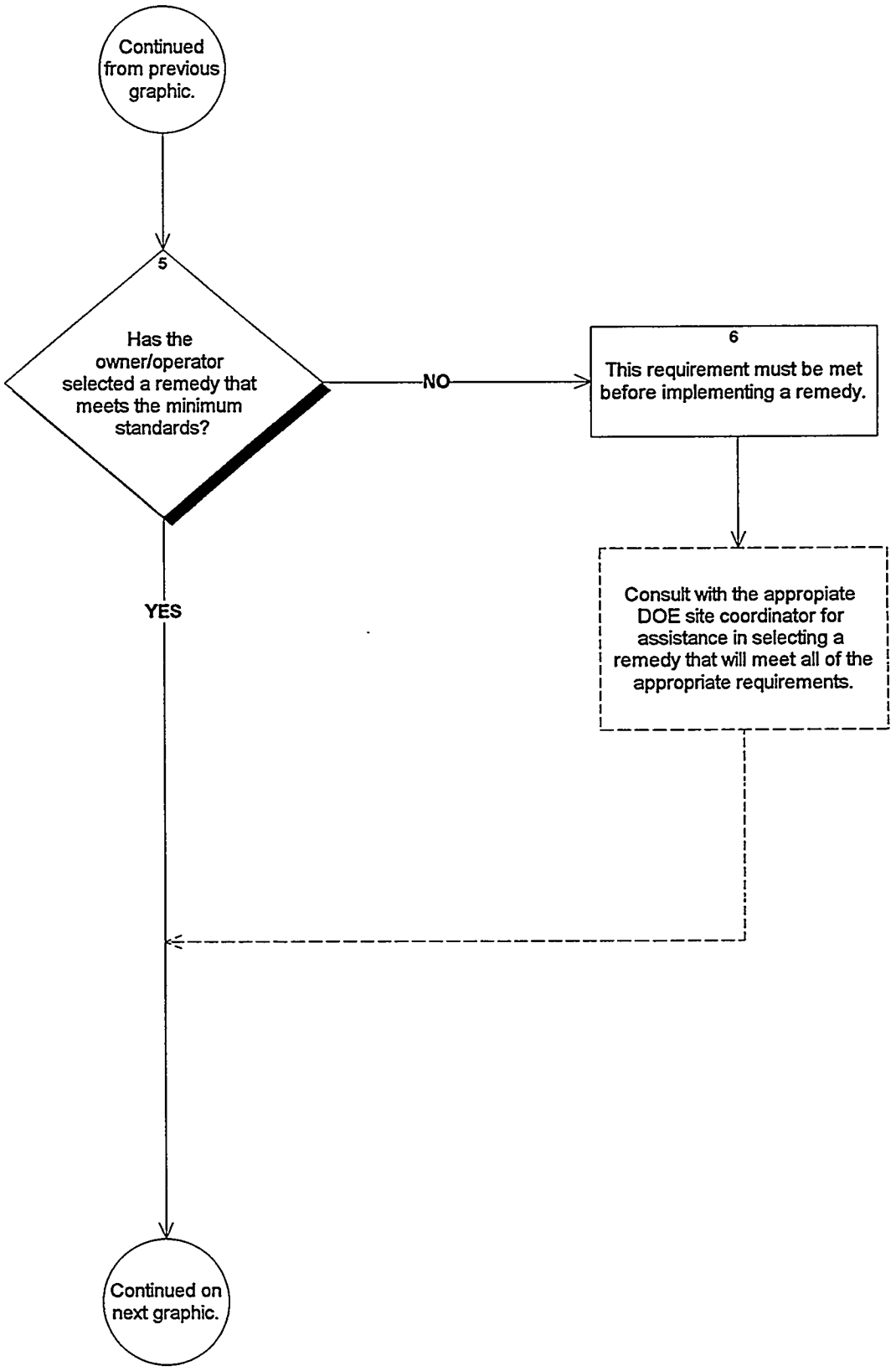
**Step 1** Start.

**Step 2** If there is no MCL promulgated for a detected constituent, the groundwater protection standard must be set at background. In cases where the background level is higher than the promulgated MCL for a constituent, the groundwater protection standard is to be set at the background level. [56 *FR* 51086, 10/9/91]

**Step 3** The assessment shall include an analysis of the effectiveness of potential corrective measures in meeting all of the requirements and objectives of the remedy and must address at least the following:

(1) The performance, reliability, ease of implementation, and potential impacts of appropriate potential remedies, including safety impacts, cross-media impacts, and control of exposure to any residual contamination;
(2) The time required to begin and complete the remedy;
(3) The costs of remedy implementation; and
(4) The institutional requirements such as State or local permit requirements or other environmental or public health requirements that may substantially affect implementation of the remedy(ies). The owner or operator must discuss the results of the corrective measures assessment, prior to the selection of remedy, in a public meeting with interested and affected parties.

**Step 4** The assessment monitoring program is described in Module 8E.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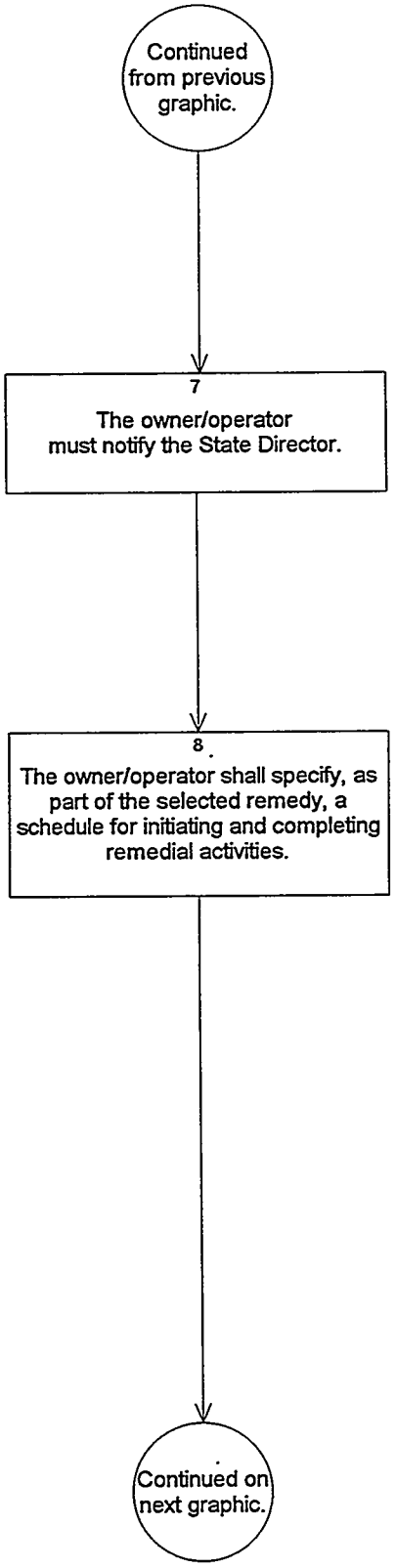
5
Has the owner/operator selected a remedy that meets the minimum standards?
NO
6
This requirement must be met before implementing a remedy.
Consult with the appropiate DOE site coordinator for assistance in selecting a remedy that will meet all of the appropriate requirements.
YES
Continued on next graphic.

**Step 5** Based on the results of the corrective measures assessment, the owner or operator must select a remedy that, at a minimum:

(1) Is protective of human health and the environment;
(2) Attains the ground-water protection standard;
(3) Controls the source(s) of release so as to reduce or eliminate, to the maximum extent practicable, further releases of Appendix II constituents into the environment that may pose a threat to human health or the environment;
(4) Complies with standards for management of wastes as specified in Step 4 of Module 8G.

**Step 6** In selecting a remedy, the owner/operator shall consider the long- and short-term effectiveness and protectiveness of the potential remedy(ies), and the degree of certainty that the remedy will be successful based on consideration of the following:

(1) Magnitude of reduction of existing risks;
(2) Magnitude of residual risks in terms of likelihood of further releases due to waste remaining following implementation of a remedy;
(3) The type and degree of long-term management required, including monitoring, operation, and maintenance;
(4) Short-term risks that might be posed to the community, workers, or the environment during implementation of such a remedy, including potential threats associated with excavation, transportation, and redisposal of containment;
(5) Time until full protection is achieved;
(6) Potential for exposure of humans and environmental receptors to remaining wastes, considering the potential threat to human health and the environment associated with excavation, transportation, redisposal, or containment;
(7) Long-term reliability of the engineering and institutional controls;
(8) Potential need for replacement of the remedy;
(9) The effectiveness of the remedy in controlling the source to reduce further releases based on consideration of the following factors:
    (i) The extent to which containment practices will reduce further releases;
    (ii) The extent to which treatment technologies may be used;
(10) The ease or difficulty of implementing a potential remedy(ies) based on consideration of the following types of factors:
    (i) Degree of difficulty associated with constructing the technology;
    (ii) Expected operational reliability of the technologies;
    (iii) Need to coordinate with and obtain necessary approvals and permits from other agencies;
    (iv) Availability of necessary equipment and specialists; and
    (v) Available capacity and location of needed treatment, storage, or disposal (TSD) services;
(11) Practicable capability of the owner or operator, including a consideration of technical and economic capability; and
(12) The degree to which community concerns are addressed by a potential remedy(ies).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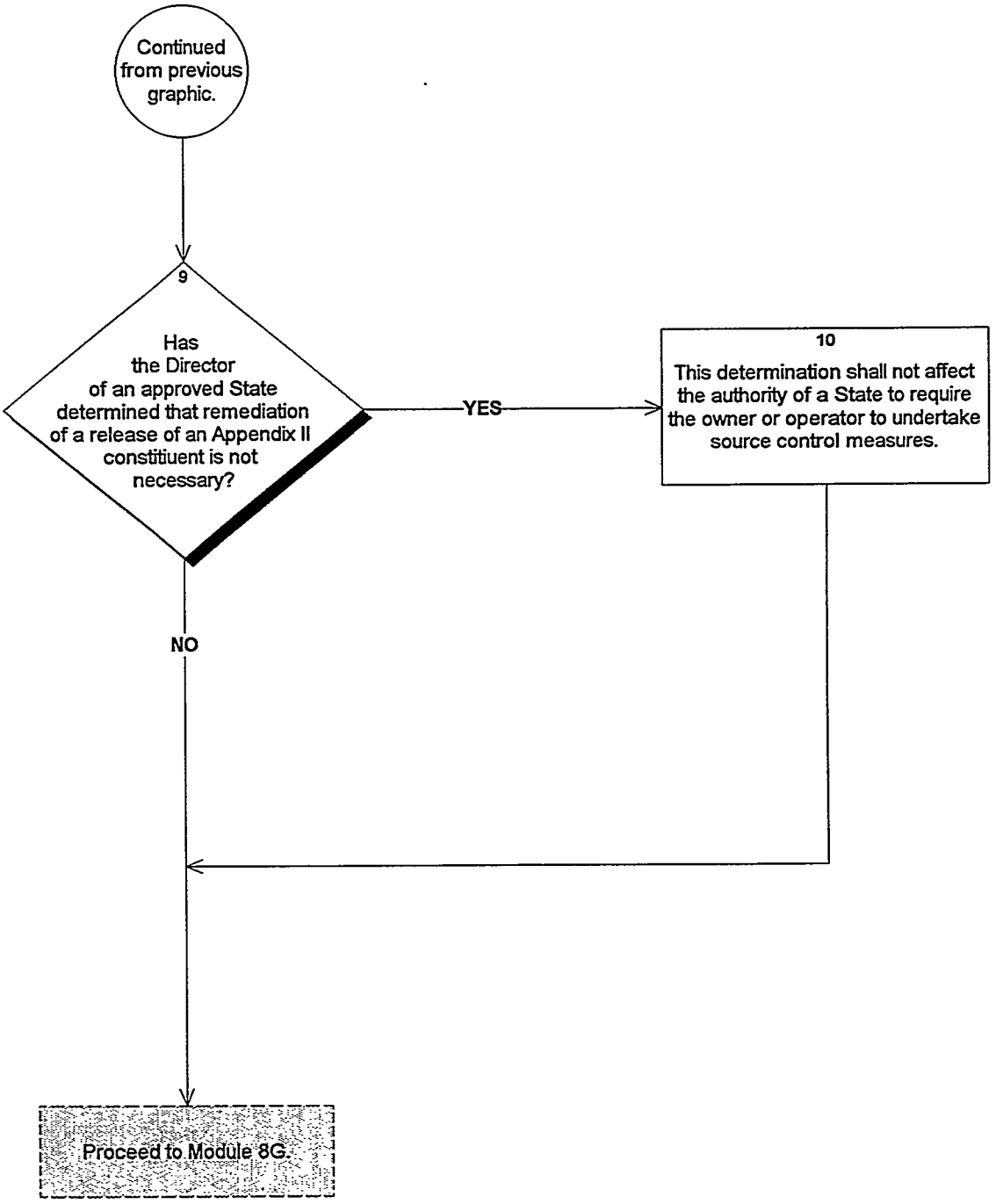
7
The owner/operator must notify the State Director.
8
The owner/operator shall specify, as part of the selected remedy, a schedule for initiating and completing remedial activities.
Continued on next graphic.

**Step 7** The owner/operator must notify the State Director within 14 days of selecting a remedy that a report describing the selected remedy has been placed in the operating record, and how the selected remedy meets the standards listed in Step 5.

**Step 8** The owner/operator shall specify as part of the selected remedy a schedule(s) for initiating and completing remedial activities. Such a schedule must take into consideration the following factors:

(1) Extent and nature of contamination;
(2) Practical capabilities of remedial technologies to achieve compliance with the groundwater protection standards and other objectives of the remedy;
(3) Availability of treatment or disposal capacity for wastes managed during implementation of the remedy;
(4) Desirability of utilizing technologies that are not currently available but which may offer significant advantages over already available technologies in terms of effectiveness, reliability, safety, or ability to achieve remedial objectives;
(5) Potential risks to human health and the environment from exposure to contamination prior to completion of the remedy;
(6) Resource value of the aquifer including:
    (i) Current and future uses;
    (ii) Proximity and withdrawal rate of users;
    (iii) Groundwater quantity and quality;
    (iv) The potential damage to wildlife, crops, vegetation, and physical structures caused by exposure to waste constituents;
    (v) The hydrogeologic characteristics of the facility and surrounding land;
    (vi) Groundwater removal and treatment costs; and
    (vii) The cost and availability of alternative water supplies;
(7) Practicable capability of the owner or operator; and
(8) Other relevant factors.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9
Has the Director of an approved State determined that remediation of a release of an Appendix II constituent is not necessary?
YES
10
This determination shall not affect the authority of a State to require the owner or operator to undertake source control measures.
NO
Proceed to Module 8G.

**Step 9** The Director of an approved State may determine that remediation of a release of an Appendix II constituent from an MSWLF unit is not necessary if the owner or operator demonstrates to the satisfaction of the Director of the approved State that:

(1) The groundwater is additionally contaminated by substances that have originated from a source other than an MSWLF unit and those substances are present in concentrations such that cleanup of the release from the MSWLF unit would provide no significant reduction in risk to actual or potential receptors; or
(2) The constituent(s) is present in groundwater that:
    (i) Is not currently or reasonably expected to be a source of drinking water; and
    (ii) Is not hydraulically connected with waters to which the hazardous constituents are migrating or are likely to migrate in a concentration(s) that would exceed the groundwater protection standards presented in Module 8E, Step 10; or
(3) Remediation of the release(s) is technically impracticable; or
(4) Remediation results in unacceptable cross-media impacts.

**Step 10** A determination by the Director of an approved State pursuant to Step 9 shall not affect the authority of the State to require the owner/operator to undertake source control measures or other measures that may be necessary to eliminate or minimize further releases to the groundwater, to prevent exposure to the groundwater, or to remediate the groundwater to concentrations that are technically practicable and that significantly reduce threats to human health or the environment.

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## 8.8 Module 8G: Implementation of Corrective Measures

### 8.8.1 Introduction

After the remedy has been selected, the owner/operator is required to implement the corrective measure, establish a corrective action groundwater monitoring program, and take any necessary interim measures.

During implementation of the corrective measure, the owner/operator may determine that requirements for the remedy cannot be met. In this situation, the owner/operator must obtain certification by a qualified groundwater scientist (or the Director of an approved State) that the requirement cannot be met, notify the State Director (if he is not the one providing the certification), and implement an alternative corrective measure.

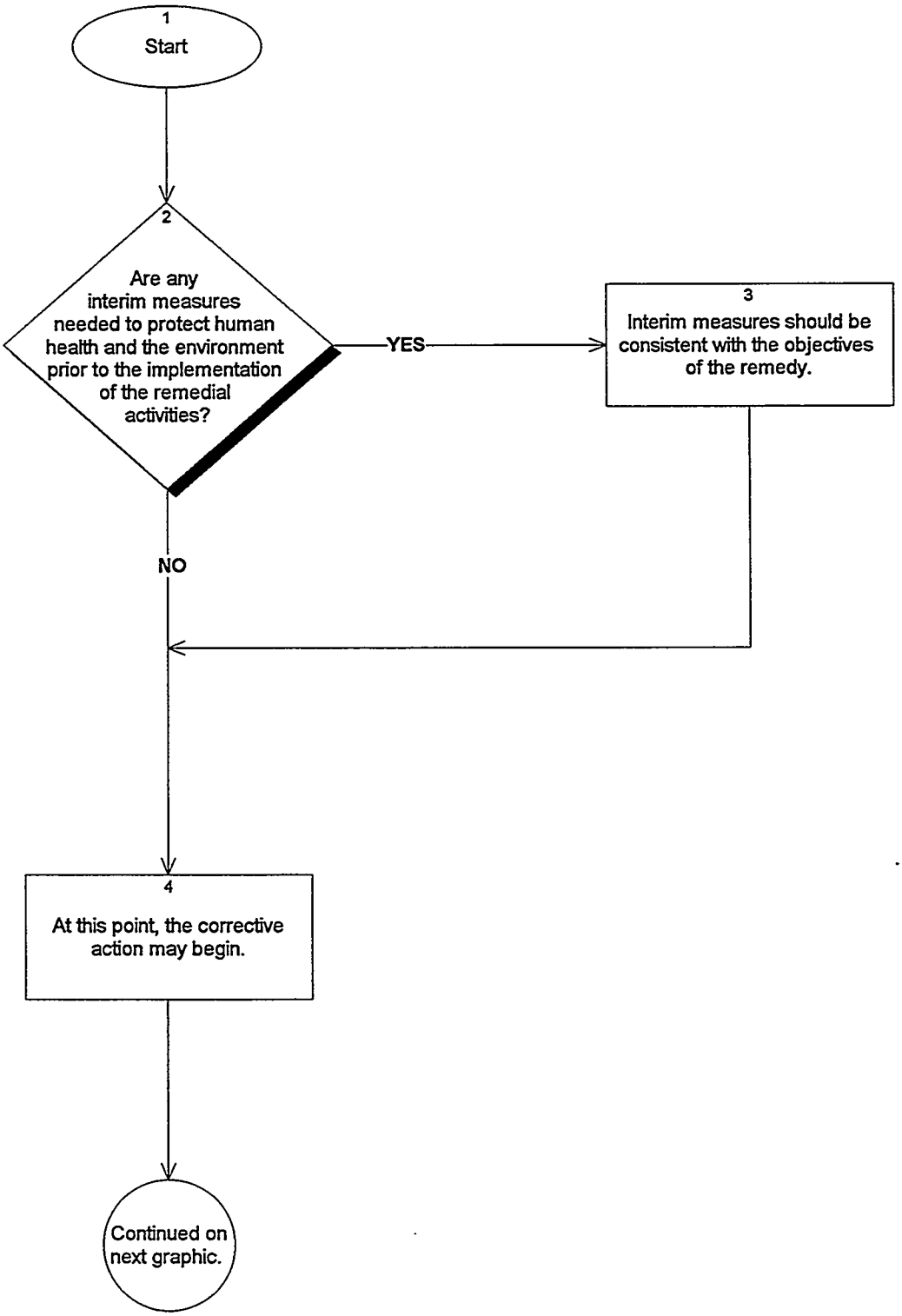
### 8.8.2 Milestones

***Has the corrective measures program been successfully implemented?***

The following demonstration must be met:

- Concentrations of Appendix II constituents must be shown to be below the groundwater protection standard for a period of three years.

# Figure 8G: Implementation of Corrective Measures



**Step 1** Start.

**Step 2** The following factors must be considered by an owner/operator in determining whether interim measures are necessary;

(1) Time required to develop and implement a final remedy;
(2) Actual or potential exposure of nearby populations or environmental receptors to hazardous constituents;
(3) Actual or potential contamination of drinking water supplies or sensitive ecosystems;
(4) Further degradation of the groundwater that may occur if remedial action is not initiated expeditiously;
(5) Weather conditions that may cause hazardous constituents to migrate or be released;
(6) Risks of fire or explosion, or potential for exposure to hazardous constituents as a result of an accident or failure of a container or handling system; and
(7) Other situations that may pose threats to human health and the environment.

**Step 3** To the greatest extent practicable, interim measures should be consistent with the objectives of and contribute to the performance of any remedy that may be required.

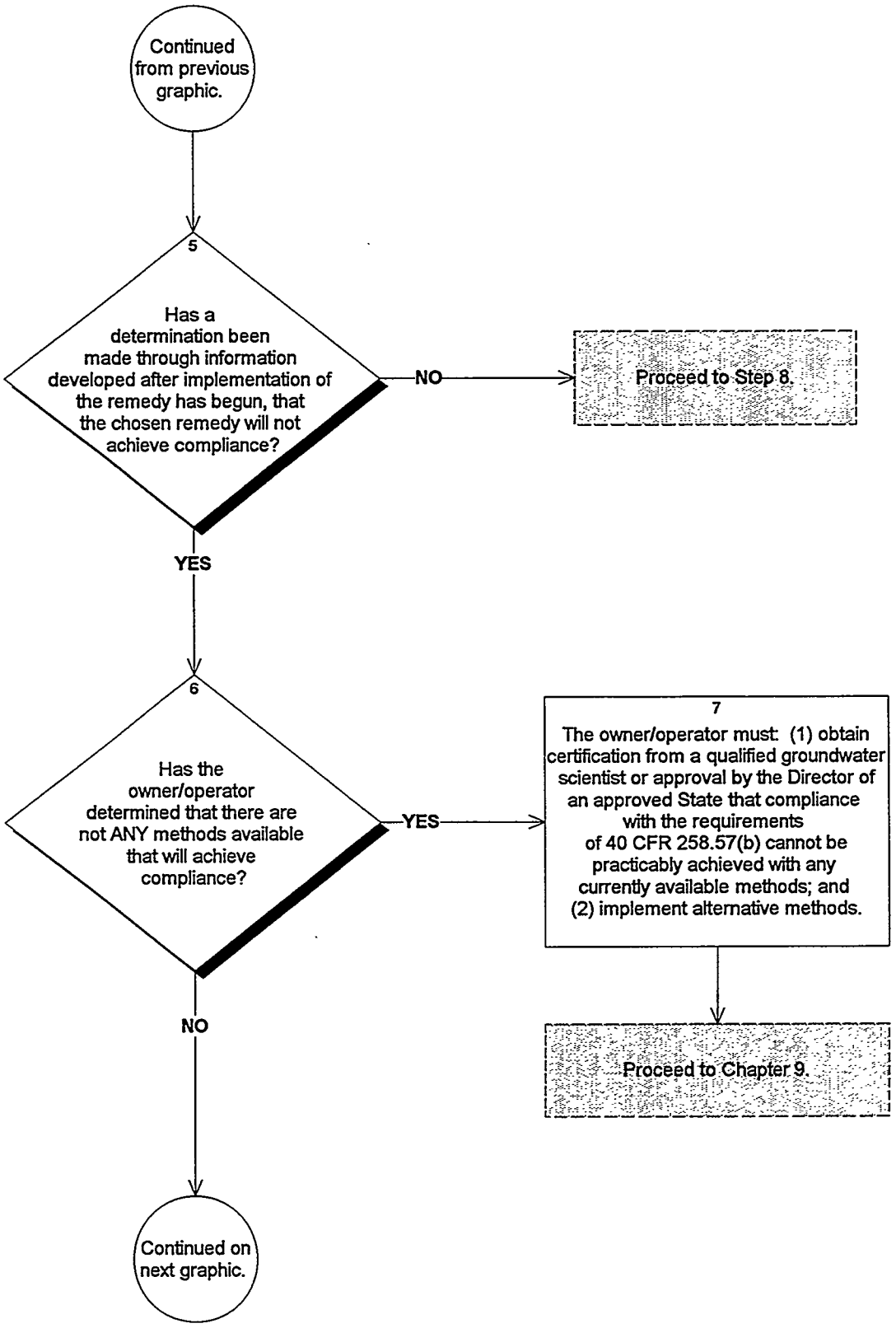
**Step 4** Based on the schedule described in Module 8F for initiation and completion of remedial activities, the owner/operator must implement the corrective action remedy that was selected. The owner/operator must establish and implement a corrective action ground-water monitoring program that:

(1) At a minimum, meets the requirements of an assessment monitoring program; and
(2) Demonstrates compliance with the groundwater protection standard.

The owner/operator must also indicate the effectiveness of the corrective action remedy.

All solid wastes that are managed pursuant to a remedy described in Module 8F, or an interim measure described above, shall be managed in a manner:

(1) That is protective of human health and the environment; and
(2) That complies with applicable RCRA requirements.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5
Has a determination been made through information developed after implementation of the remedy has begun, that the chosen remedy will not achieve compliance?
NO
Proceed to Step 8.
YES
6
Has the owner/operator determined that there are not ANY methods available that will achieve compliance?
YES
7
The owner/operator must: (1) obtain certification from a qualified groundwater scientist or approval by the Director of an approved State that compliance with the requirements of 40 CFR 258.57(b) cannot be practicably achieved with any currently available methods; and (2) implement alternative methods.
Proceed to Chapter 9.
NO
Continued on next graphic.

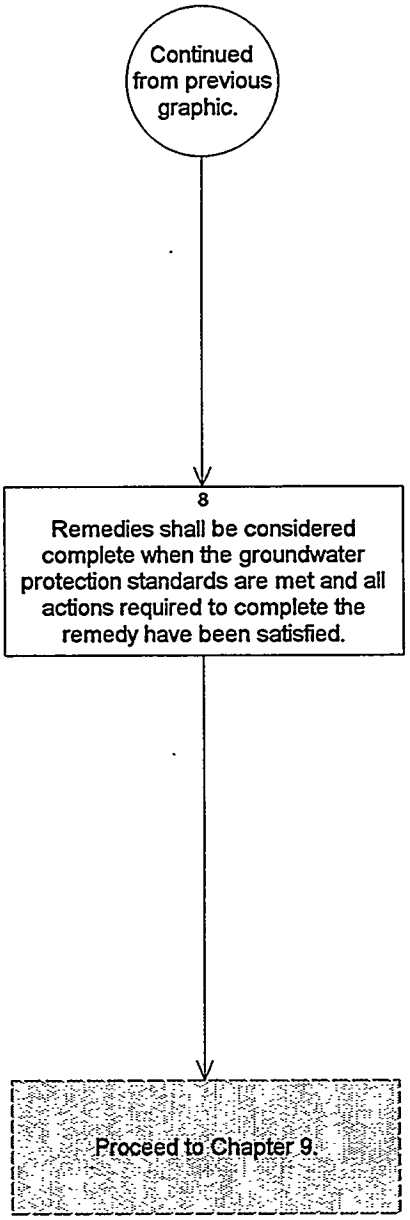
**Step 5** An owner/operator may determine, based on information developed after implementation of the remedy has begun or other information, that compliance with Module 8F, Step 5 is not being achieved through the remedy selected.

The owner/operator must implement other methods or techniques that could practicably achieve compliance with the requirements, unless the owner/operator makes the determination described in Step 7.

**Step 6** The owner or operator must obtain certification of a qualified groundwater scientist or approval by the Director of an approved State in the event that compliance with requirements under 40 CFR 258.57(b) (Module 8F, Assessment of Corrective Measures and Selection of the Corrective Action; Step 6) cannot be practically achieved with any currently available methods.

**Step 7** After obtaining the certification that compliance cannot be practicably achieved with any currently available methods, the owner/operator must:

(1) Implement alternative measures to control exposure of humans or the environment to residual contamination, as necessary to protect human health and the environment; and
(2) Implement alternative measures for control of the sources of contamination, or for removal or decontamination of equipment, units, devices, or structures that are:
    (i) Technically practicable; and
    (ii) Consistent with the overall objective of the remedy; and
(3) Notify the State Director within 14 days that a report justifying the alternative measures has been placed in the operating record. This must be completed prior to implementing the alternative measures.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8
Remedies shall be considered complete when the groundwater protection standards are met and all actions required to complete the remedy have been satisfied.
Proceed to Chapter 9.

**Step 8** The ground-water protection standards established under 40 CFR 258.55(h) or (i) (Module 8F, Step 2) must be met at all points within the plume of contamination that lie beyond the groundwater monitoring well system established under 40 CFR 258.51(a) (Module 8B, Groundwater Monitoring System Design Criteria).

Compliance with the ground-water protection standards established under 40 CFR 258.55(h) or (i) is achieved by demonstrating that concentrations of Appendix II constituents have not exceeded the ground-water protection standard(s) for a period of three consecutive years using the statistical procedures and performance standards in 40 CFR 258.53(g) and (h) (Module 8C, Groundwater Sampling and Analysis Requirements).

The Director of an approved State may specify an alternative length of time during which the owner or operator must demonstrate that concentrations of Appendix II constituents have not exceeded the groundwater protection standard(s) taking into consideration:

(1) Extent and concentration of the release(s);
(2) Behavior characteristics of the hazardous constituents in the groundwater:
(3) Accuracy of monitoring or modeling techniques, including any seasonal, meteorological, or other environmental variabilities that may affect the accuracy; and
(4) Characteristics of the groundwater.

Upon completion of the remedy, the owner or operator must notify the State Director within 14 days that a certification that the remedy has been completed in compliance with the requirements of §258.58(e) has been placed in the operating record. The certification must be signed by the owner or operator and by a qualified ground-water scientist or be approved by the Director of an approved State.

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# Chapter 9
# Closure and Post-closure Care for Municipal Solid Waste Landfills

**Contents**

## 9.1 Introduction

### 9.1.1 Background

Owners or operators of new MSWLF units, lateral expansions, and existing MSWLF units must close each unit in accordance with specified standards and monitor and maintain the units after closure. In addition, all owners or operators also must prepare closure and post-closure plans describing these activities and comply with a minimum set of procedural requirements.

All owners or operators of MSWLF units must install a final cover comprised of an erosion layer underlain by an infiltration layer. The final cover must have a permeability less than or equal to the permeability of the bottom liner system or natural subsoils, or no greater than $1x10^{-5}$ cm/sec, whichever is less. The erosion layer must be a minimum of six inches of earthen material that can sustain native plant growth. The infiltration layer must be a minimum of 18 inches of earthen material. The Director of an approved State may allow an alternative cover design if the cover layers achieve the same objectives as the design specified above.

All owners or operators must conduct post-closure care activities for a period of 30-years after the closure of each MSWLF unit. The Director of an approved State may either 1) reduce the 30-year post-closure period if the Director determines that a shorter period will be protective of human health and the environment or 2) increase the post-closure care period if he/she determines that a lengthened period is necessary to protect human health and the environment. During the post-closure care period, all owners or operators of MSWLF units must maintain the integrity and effectiveness of the final cover, and must continue groundwater monitoring, gas monitoring, and leachate management.

All owners or operators of MSWLF units are required to prepare closure and post-closure plans describing activities that will be undertaken to properly close each MSWLF unit and to maintain them after closure. These plans must be prepared and placed in the facility operating record no later than October 9, 1993, or by the initial receipt of waste, whichever is later.

The closure and post-closure care standards also include certain procedural requirements. First, prior to closing each landfill unit, an owner or operator must notify the State Director and include the notification in the facility operating record. Second, the owner or operator must begin closure of a landfill unit within 30 days after the final receipt of waste and complete closure within 180 days. Extensions of both of these deadlines may be granted only by the Director of an approved State and only if certain criteria are met. Third, following closure of the last landfill unit, owners or operators of all MSWLF units must record a notation in the deed to the property that indicates that the property has been used as an MSWLF unit and that its use is restricted. Finally, owners or operators of all MSWLFs must notify the State Director and place in the facility operating record

a certification signed by an independent registered professional engineer (or approved by the Director of an approved State) that verifies that closure and post-closure care activities have been conducted in accordance with the closure and post-closure plans.

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## 9.2 Module 9A: Closure Requirements

### 9.2.1 Introduction

Closure plans are critical documents for ensuring that owners/operators of MSWLFs have adequately planned for the activities necessary to ensure that all MSWLF units are closed in a manner that protects human health and the environment. After completion, these plans should be included in the facility operating record.

The closure plans should describe how the owner or operator will maintain and monitor systems at the site, including the leachate collection system and the final cover.

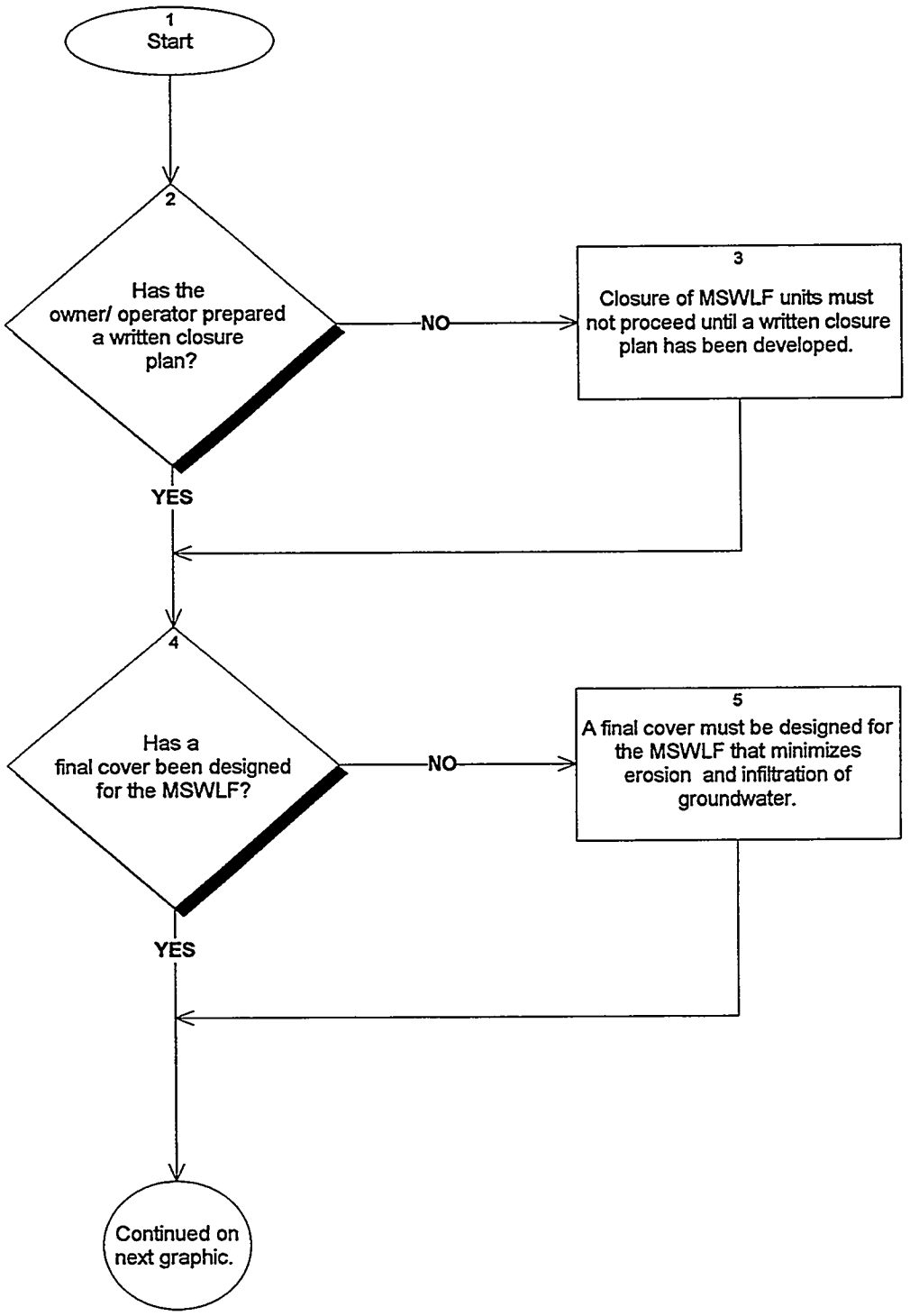
### 9.2.2 Milestones

***Have closure plans been developed for the MSWLF?***

Closure plans typically include:

- A description of the final cover;
- An estimate of the maximum inventory of wastes ever on-site during the active life of the facility; and
- A schedule for completing all closure activities.

# Figure 9A: Closure Requirements



**Step 1** Start.

**Step 2** The owner/operator must prepare a written closure plan that describes the steps necessary to close all MSWLF units at any point during the active life of the facility in accordance with the cover design requirements described in Step 5 of this module. The closure plan, at a minimum, must include the following information:

(1) A description of the final cover, designed in accordance with Step 5 of this module, and the methods and procedures to be used to install the cover;
(2) An estimate of the largest area of the MSWLF unit ever requiring a final cover at any time during the active life of the landfill;
(3) An estimate of the maximum inventory of wastes ever on-site over the active life of the facility; and
(4) A schedule for completing all activities necessary to satisfy the closure criteria specified in this module.

**Step 3** The owner/operator must notify the State Director that a closure plan has been prepared and placed in the operating record no later than October 9, 1993 or by the initial receipt of waste, whichever is later.

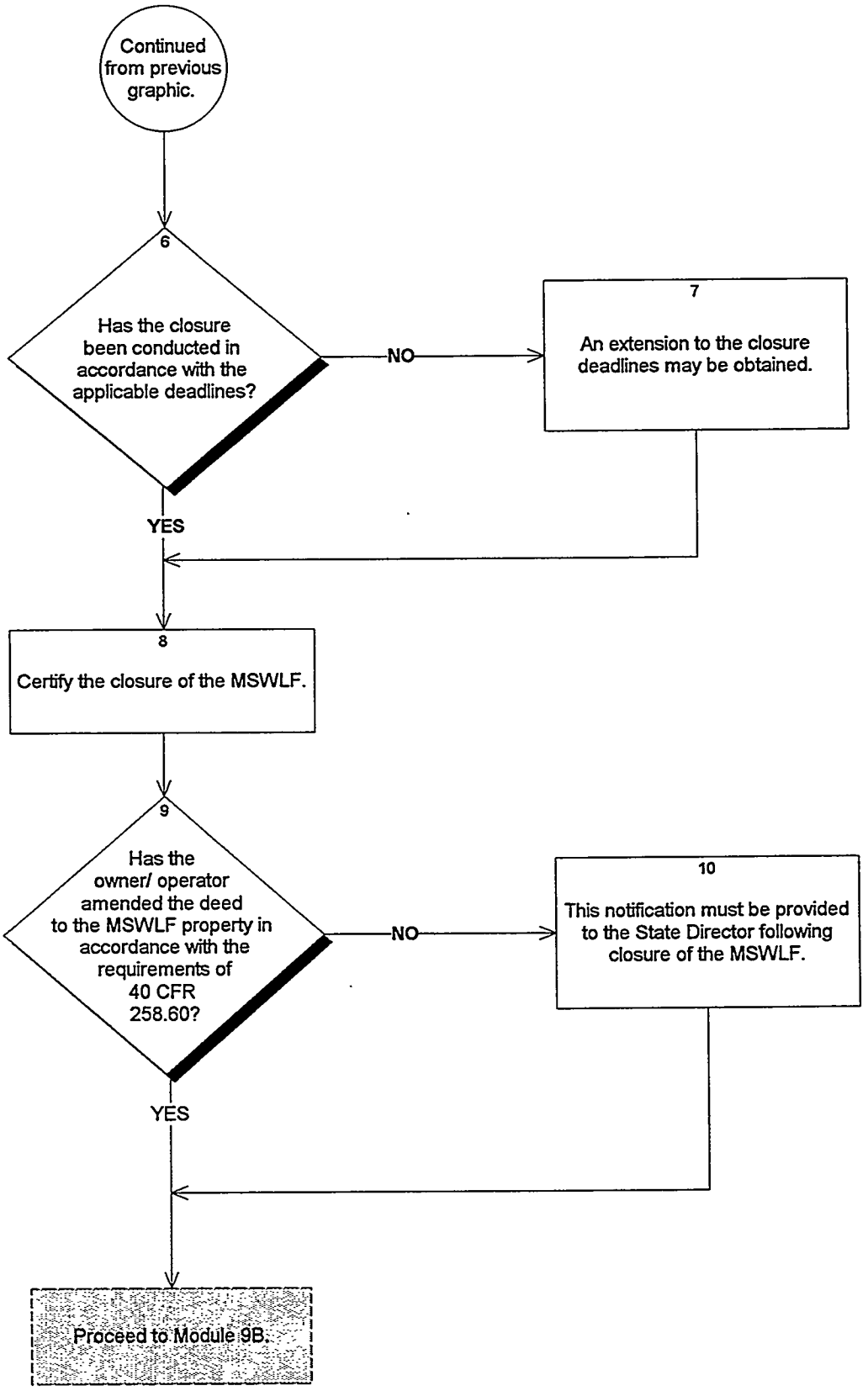
**Step 4** Owners/operators of all MSWLF units are required to install a final cover system.

**Step 5** The final cover system must have a permeability less than or equal to the permeability of any bottom liner system or natural subsoils present, or a permeability no greater than 1 x 10-5 cm/sec, whichever is less. Also, it must be comprised of an erosion layer underlain by an infiltration layer as follows:

(1) The infiltration layer must be comprised of a minimum of 18 inches of earthen material; and
(2) The erosion layer must consist of a minimum of 6 inches of earthen material that is capable of sustaining native plant growth.

The Director of an approved State may approve an alternative final cover design that includes:

(1) An infiltration layer that achieves an equivalent reduction in infiltration as the infiltration layer specified in this step; and
(2) An erosion layer that provides equivalent protection from wind and water erosion as the erosion layer specified in this step.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6
Has the closure been conducted in accordance with the applicable deadlines?
NO
7
An extension to the closure deadlines may be obtained.
YES
8
Certify the closure of the MSWLF.
9
Has the owner/ operator amended the deed to the MSWLF property in accordance with the requirements of 40 CFR 258.60?
NO
10
This notification must be provided to the State Director following closure of the MSWLF.
YES
Proceed to Module 9B.

**Step 6** The owner/operator must begin closure activities no later than 30 days after the date on which the known final receipt of wastes occurs, or, if the MSWLF unit has remaining capacity and there is a reasonable likelihood that the MSWLF unit will receive additional wastes, no later than one year after the most recent receipt of wastes. Prior to beginning closure of each MSWLF unit, an owner/operator must notify the State Director that a notice of intent to close the unit has been placed in the operating record.

**Step 7** Extensions beyond the one-year deadline for beginning closure may be granted by the Director of an approved State if the owner/operator demonstrates that the MSWLF unit has the capacity to receive additional wastes and the owner/operator has taken and will continue to take all steps necessary to prevent threats to human health and the environment from the unclosed MSWLF unit.

The owner/operator of all MSWLF units must complete closure activities of each MSWLF unit in accordance with the closure plan within 180 days following the beginning of closure. Extensions of the closure period may be granted by the Director of an approved State if the owner/operator demonstrates that closure will, of necessity, take longer than 180 days and he/she has taken and will continue to take all steps to prevent threats to human health and the environment from the unclosed MSWLF unit.

**Step 8** Following closure of each MSWLF unit, the owner/operator must notify the State Director that a certification signed by an independent registered professional engineer or approved by the Director of an approved State and verifying that closure has been completed in accordance with the closure plan has been placed in the operating record.

**Step 9** Following closure of all MSWLF units, the owner/operator must record a notation on the deed to the landfill facility, or some other instrument that is normally examined during a title search, and notify the State Director that the notation has been recorded and a copy has been placed in the operating record. The notation on the deed must in perpetuity notify any potential purchaser of the property that:

(1) The land has been used as a landfill facility; and
(2) Its use is restricted under 40 CFR 258.61(c)(3) (specified in Module 9B, Step 2, item 3).

**Step 10** The owner/operator may request permission from the Director of an approved State to remove the notation from the deed if all wastes are removed from the facility.

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## 9.3 Module 9B: Post-closure Care Requirements

### 9.3.1 Introduction

Post-closure plans should describe how the owner/operator will maintain and monitor systems at the site including the leachate collection system and the final cover. The final cover may be susceptible to erosion, subsidence, or settlement. Monitoring systems may be susceptible to mechanical failure. Maintenance and monitoring must be conducted for 30 years unless otherwise indicated by the Director of an approved State.

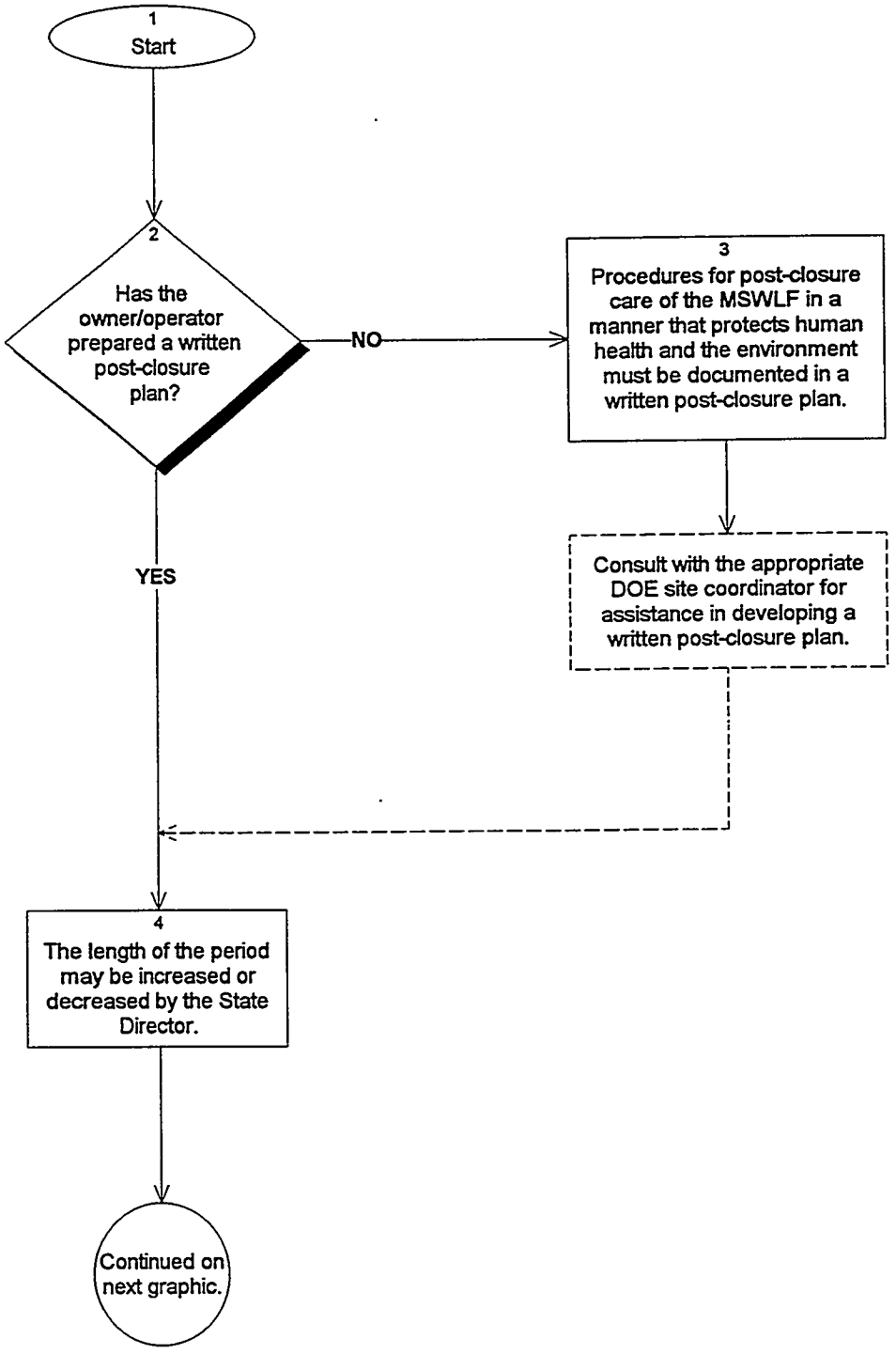
### 9.3.2 Milestones

***Have adequate post-closure plans been developed for the MSWLF?***

Post-closure plans must include plans to maintain the operation and integrity of:

- The final cover;
- The gas monitoring system; and
- The leachate collection system.

# Figure 9B: Post-closure Care Requirements



**Step 1** Start.

**Step 2** The owner/operator must prepare a written post-closure plan that includes, at a minimum, the following information:

(1) A description of the monitoring and maintenance activities identified in this module for each MSWLF unit, and the frequency at which these activities will be performed;
(2) Name, address, and telephone number of the person or office to contact about the facility during the post-closure period; and
(3) A description of the planned uses of the property during the post-closure period. Post-closure use of the property shall not disturb the integrity of the final cover, liner(s), or any other components of the containment system, or the function of the monitoring systems unless necessary to comply with the requirements in 40 CFR Part 258. The Director of an approved State may approve any other disturbance if the owner/operator demonstrates that disturbance of the final cover, liner, or other component of the containment system, including any removal of waste, will not increase the potential threat to human health or the environment.

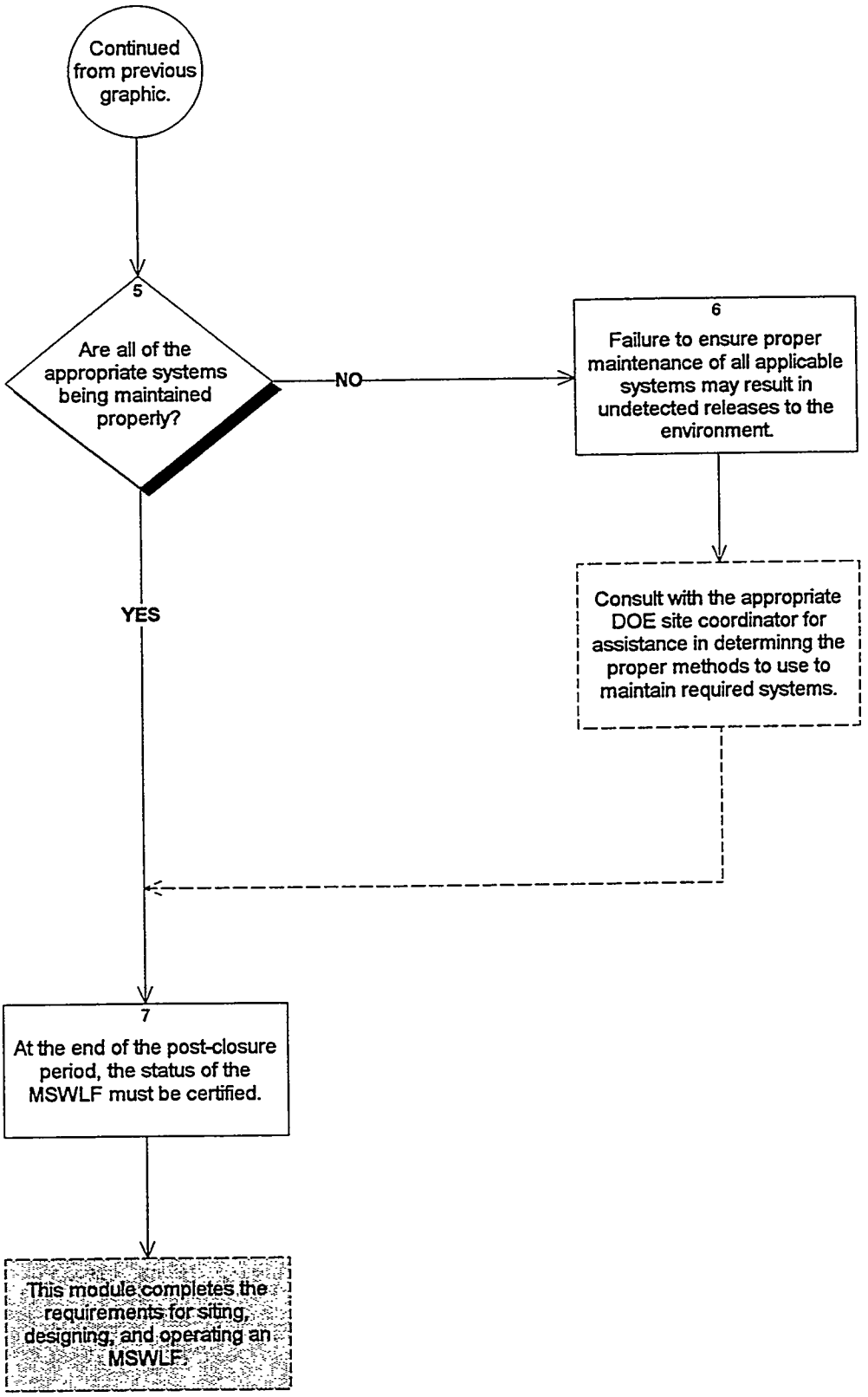
The owner/operator must notify the State Director that a post-closure plan has been prepared and placed in the operating record no later than October 9, 1991, or by the initial receipt of waste, whichever is later.

**Step 3** Following closure of each MSWLF unit, the owner/operator must conduct post-closure care. Post-closure care must be conducted for 30 years, except as provided under Step 4, and must consist of at least the following:

(1) Maintaining the integrity and effectiveness of any final cover, including making repairs to the cover as necessary to correct the effects of settlement, subsidence, erosion, or other events; and
(2) Preventing run-on and run-off from eroding or otherwise damaging the final cover.

**Step 4** The length of the post-closure care period may be:

(1) Decreased by the Director of an approved State if the owner/operator demonstrates that the reduced period is sufficient to protect human health and the environment and this demonstration is approved by the Director of an approved State; or
(2) Increased by the Director of an approved State if he/she determines that the lengthened period is necessary to protect human health and the environment.


Continued from previous graphic.
5
Are all of the appropriate systems being maintained properly?
NO
6
Failure to ensure proper maintenance of all applicable systems may result in undetected releases to the environment.
Consult with the appropriate DOE site coordinator for assistance in determinng the proper methods to use to maintain required systems.
YES
7
At the end of the post-closure period, the status of the MSWLF must be certified.
This module completes the requirements for siting, designing, and operating an MSWLF.

**Step 5** Systems which must be maintained and operated include:

(1) The leachate collection system, although the Director of an approved State may allow the owner/operator to stop managing leachate if the owner/operator demonstrates that leachate no longer poses a threat to human health and the environment; and
(2) The gas monitoring system.

**Step 6** In addition to maintaining and operating systems at the closed MSWLF, the groundwater must be monitored in accordance with the requirements of Chapter 8 and the ground-water monitoring system must be maintained.

**Step 7** Following completion of the post-closure care period for each MSWLF unit, a certification verifying completion of the post-closure care in accordance with the plan must be placed in the operating record. This certification must be signed by an independent, registered professional engineer or approved by the Director of an approved State. Also, the State Director must be notified that this certification has been placed in the operating record.

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# Appendix A: Glossary

## Appendix A: Glossary

**Active life** means the period of operation beginning with the initial receipt of solid waste and ending at completion of closure activities in accordance with 40 CFR 258.60. (40 CFR 258.2)

**Active portion** means that part of a facility or unit that has received or is receiving wastes and that has not been closed in accordance with 40 CFR 258.60. (40 CFR 258.2)

**Approved States** are those that have received the approval of the U.S. EPA to regulate their own State programs. This approval is based on the U.S. EPA's determination that the State has developed a program that is at least as stringent as the Federal program as detailed in 40 CFR Part 258. State programs are sometimes more stringent than the Federal program, so the owners and operators of MSWLFs should stay apprised of changes to their State's program. Approved State programs are also allowed more flexibility in the implementation of certain regulations than are unapproved programs. (40 CFR 258.2)

**Aquifer** means a geological formation, group of formations, or portion of a formation capable of yielding significant quantities of ground water to wells or springs. (40 CFR 258.2)

**Cell** means compacted solid wastes that are enclosed by natural soil or cover material in a land disposal site. (40 CFR 241.101)

**Commercial solid waste** means all types of solid waste generated by stores, offices, restaurants, warehouses, and other nonmanufacturing activities, excluding residential and industrial wastes. (40 CFR 258.2)

**Cover material** means soil or other suitable material that is used to cover compacted solid wastes in a land disposal site. (40 CFR 241.101)

**Daily cover** means cover material that is spread and compacted on the top and side slopes of compacted solid waste at least at the end of each operating day in order to control disease vectors, fire, moisture, and erosion, and to assure an aesthetic appearance. (40 CFR 241.101)

**Director of an approved State** means the chief administrative officer of a State agency responsible for implementing the State municipal solid waste permit program or other system of prior approval that is deemed to be adequate by EPA under regulations published pursuant to Sections 2002 and 4005 of RCRA. (40 CFR 258.2)

**Disposal** means the discharge, deposit, injection, dumping, spilling, leaking, or placing of any solid waste or hazardous waste into or on any land or water so that such solid waste or hazardous waste or any constituent thereof may enter the environment or be emitted into the air or discharged into any waters, including ground waters. (40 CFR 257.2)

**Existing municipal solid waste landfill unit** means any MSWLF unit that is receiving solid waste as of October 9, 1993. Waste placement in existing units must be consistent with past operating practices or modified practices to ensure good management. (40 CFR 258.2)

**Facility** means all contiguous land and structures, other appurtenances, and improvements on the land used for the disposal of solid waste. (40 CFR 258.2)

**Final cover** means cover material that serves the same functions as daily cover but, in addition, may be permanently exposed on the surface. (40 CFR 241.101)

**Free moisture** means liquid that will drain freely by gravity from solid materials. (40 CFR 241.101)

**Ground water** means water below the land surface in a zone of saturation. (40 CFR 258.2)

**Hazardous wastes** means any waste or combination of wastes which poses a substantial present or potential hazard to human health or living organisms because such wastes are nondegradable or persistent in nature or because they can be biologically magnified, or because they can be lethal, or because they may otherwise cause or tend to cause detrimental cumulative effects. (40 CFR 241.101)

**Household waste** means any solid waste (including garbage, trash, and sanitary waste in septic tanks) derived from households (including single and multiple residences, hotels and motels, bunkhouses, ranger stations, crew quarters, campgrounds, picnic grounds, and day-use recreation areas). (40 CFR 258.2)

**Industrial solid waste** means solid waste generated by manufacturing or industrial processes that is not a hazardous waste regulated under Subtitle C of RCRA. Such waste may include, but is not limited to, waste resulting from the following manufacturing processes: electric power generation; fertilizer/agricultural chemicals; food and related products/by-products; inorganic chemicals; iron and steel manufacturing; leather and leather products; nonferrous metals manufacturing/foundries; organic chemicals; plastics and resins manufacturing; pulp and paper manufacturing; rubber and miscellaneous plastic products; stone, glass, clay, and concrete products; textile manufacturing; transportation equipment; and water treatment. This term does not include mining waste or oil and gas waste. (40 CFR 258.2)

**Infectious waste** means (1) equipment, instruments, utensils, and fomites (any substance that may harbor or transmit pathogenic organisms) of a disposable nature from the rooms of patients who are suspected to have or have been diagnosed as having a communicable disease and must, therefore, be isolated as required by public health agencies; (2) laboratory wastes, such as pathological specimens (e.g., all tissues, specimens of blood elements, excreta, and secretions obtained from patients or laboratory animals) and disposable fomites attendant thereto; (3) surgical operating room pathologic specimens and disposable fomites attendant thereto and similar disposable materials from outpatient areas and emergency rooms. (40 CFR 241.101)

**Injection well** means a "well" into which "fluids" are being injected. (40 CFR 144.3)

**Intermediate cover** means cover material that serves the same functions as daily cover but must resist erosion for a longer period of time because it is applied on areas where additional cells are not to be constructed for extended periods of time. (40 CFR 241.101)

**Land application unit** means an area where wastes are applied onto or incorporated into the soil surface (excluding manure spreading operations) for agricultural purposes or for treatment and disposal. (40 CFR 257.2)

**Landfill** means an area of land or an excavation in which wastes are placed for permanent disposal and that is not a land application unit, surface impoundment, injection well, or waste pile. (40 CFR 257.2)

**Lateral expansion** means a horizontal expansion of the waste boundaries of an existing MSWLF unit. (40 CFR 258.2)

**Leachate** means a liquid that has passed through or emerged from solid waste and contains soluble, suspended, or miscible materials removed from such waste. (40 CFR 258.2)

**Municipal solid waste landfill unit** means a discrete area of land or an excavation that receives household waste, and that is not a land application unit, surface impoundment, injection well, or waste pile as those terms are defined under 40 CFR 257.2. An MSWLF unit also may receive other types of RCRA Subtitle D wastes, such as commercial solid waste, nonhazardous sludge, small quantity generator waste, and industrial solid waste. Such a landfill may be publicly or privately owned. An MSWLF unit may be a new MSWLF unit, an existing MSWLF, or a lateral expansion. (40 CFR 258.2)

**Municipal solid wastes** means normally residential and commercial solid waste generated within a community. (40 CFR 241.101)

**New municipal solid waste landfill unit** means any MSWLF unit that had not received waste prior to October 9, 1993. (40 CFR 258.2)

**Open burning** means the combustion of solid waste without: (1) control of combustion air to maintain adequate temperature for efficient combustion, (2) containment of the combustion reaction in an enclosed device to provide sufficient residence time and mixing for complete combustion, and (3) control of the emission of the combustion products. (40 CFR 258.2)

**Open dump** means a facility for the disposal of solid waste which does not comply with the standard contained in 40 CFR 257.2.

**Open dump** means a land site at which solid waste disposal occurs in a manner that does not protect the environment, is susceptible to open burning, and is exposed to the elements, disease vectors, and scavengers. (40 CFR 241.101)

**Operator** means the person(s) responsible for the overall operation of a facility or part of a facility. (40 CFR 258.2)

**Owner** means the person(s) who owns a facility or part of a facility. (40 CFR 258.2)

**Pile** means any non-containerized accumulation of solid, nonflowing hazardous waste that is used for treatment or storage (see waste pile). (40 CFR 257.2)

**Plans** means reports and drawings, including a narrative operating description, prepared to describe the land disposal site and its proposed operation. (40 CFR 241.101)

**Practice** means the act of disposal of solid waste. (40 CFR 257.2)

**Qualified groundwater scientist** is a scientist or engineer who has received a baccalaureate or post-graduate degree in the natural sciences or engineering and has sufficient training and experience in groundwater hydrology and related fields as may be demonstrated by State registration, professional Certifications, or completion of accredited university programs that enable that individual to make sound professional judgements regarding ground-water monitoring, contaminant fate and transport, and corrective-action. (40 CFR 258.50)

**Residue** means all the solids that remain after completion of thermal processing, including bottom ash, fly ash, and grate siftings. (40 CFR 241.101)

**Responsible agency** means the organizational element that has the legal duty to ensure that owners, operators, or users of land disposal sites comply with 40 CFR Part 241. (40 CFR 241.101)

**Run-off** means any rainwater, leachate, or other liquid that drains over land from any part of a facility. (40 CFR 258.2)

**Run-on** means any rainwater, leachate, or other liquid that drains over land onto any part of a facility. (40 CFR 258.2)

**Salvaging** means the controlled removal of waste materials for utilization. (40 CFR 241.101)

**Sanitary landfill** means a facility for the disposal of solid waste which complies with 40 CFR Part 257. (40 CFR 257.2)

**Sanitary landfill** means a land disposal site employing an engineered method of disposing of solid wastes on land in a manner that minimizes environmental hazards by spreading the solid wastes in thin layers, compacting the solid wastes to the smallest practical volume, and applying and compacting cover material at the end of each operating day. (40 CFR 241.101)

**Saturated zone** means that part of the earth's crust in which all voids are filled with water. (40 CFR 258.2)

**Scavenging** means uncontrolled removal of solid waste materials. (40 CFR 241.101)

**Sludge** means:
- any solid, semi-solid, or liquid waste generated from a municipal, commercial, or industrial wastewater treatment plant, water supply treatment plant, or air

pollution control facility exclusive of the treated effluent from a wastewater treatment plant. (40 CFR 258.2)

- any solid, semisolid, or liquid waste generated from a municipal, commercial, or industrial wastewater treatment plant, water supply treatment plant, or air pollution control facility or any other such waste having similar characteristics and effect. (40 CFR 257.2)

- the accumulated semiliquid suspension of settled solids deposited from wastewaters or other fluids in tanks or basins. It does not include solids or dissolved material in domestic sewage or other significant pollutants in water resources, such as silt, dissolved or suspended solids in industrial wastewater effluents, dissolved materials in irrigation return flows, or other common water pollutants. (40 CFR 241.101)

**Solid waste** means (1) any garbage or refuse, (2) sludge from a wastewater treatment plant, water supply treatment plant, or air pollution control facility, and (3) other discarded material, including solid, liquid, semi-solid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations, and from community activities. This definition but does not include (1) solid or dissolved materials in domestic sewage, or (2) solid or dissolved materials in irrigation return flows or industrial discharges that are point sources subject to permit under 33 U.S.C. 1342, or (3) source, special nuclear, or by-product material as defined by the Atomic Energy Act of 1954, as amended (68 Stat. 923). (40 CFR 258.2)

**Solid waste** means garbage, refuse, sludges, and other discarded solid materials resulting from industrial and commercial operations and from community activities. It does not include solids or dissolved material in domestic sewage or other significant pollutants in water resources, such as silt, dissolved or suspended solids in industrial wastewater effluents, dissolved materials in irrigation return flows, or other common water pollutants. (40 CFR 241.101)

**State Director** means the chief administrative officer of the State agency responsible for implementing the State municipal solid waste permit program or other system of prior approval. (40 CFR 258.2)

**State** means any of the several States, the District of Columbia, the Commonwealth of Puerto Rico, the Virgin Islands, Guam, American Samoa, and the Commonwealth of the Northern Mariana Islands. (40 CFR 258.2)

**Surface impoundment or impoundment** means a facility or part of a facility that is a natural topographic depression, human-made excavation, or diked area formed primarily of earthen materials (although it may be lined with human-made materials) that is designed to hold an accumulation of liquid wastes or wastes containing free liquids and that is not an injection well. Examples of surface impoundments are holding, storage, settling, and aeration pits, ponds, and lagoons. (40 CFR 257.2)

**Uppermost aquifer** means the geologic formation nearest the natural ground surface that is an aquifer, as well as lower aquifers that are hydraulically interconnected with this aquifer within the facility's property boundary. (40 CFR 258.2)

**Vector** means a carrier, usually an arthropod, that is capable of transmitting a pathogen from one organism to another. (40 CFR 241.101)

**Waste management unit boundary** means a vertical surface located at the hydraulically downgradient limit of the unit. This vertical surface extends down into the uppermost aquifer. (40 CFR 258.2)

**Waste pile** means any noncontainerized accumulation of solid, nonflowing waste that is used for treatment or storage (see pile). (40 CFR 257.2)

**Water table** means the upper water level of a body of groundwater. (40 CFR 241.101)

**Working face** means that portion of the land disposal site where solid wastes are discharged and are spread and compacted prior to the placement of cover material. (40 CFR 241.101)

# Appendix B: Hazardous Organic and Inorganic Constituents - Detection Monitoring

## Appendix B: Hazardous Organic and Inorganic Constituents - Detection Monitoring[1]

### Inorganic Constituents:[2]

(1) Antimony
(2) Arsenic
(3) Barium
(4) Beryllium
(5) Cadmium
(6) Chromium
(7) Cobalt
(8) Copper
(9) Lead
10) Nickel
(11) Selenium
(12) Silver
(13) Thallium
(14) Vanadium
(15) Zinc

### Organic Constituents:[2]

(16) Acetone
(17) Acrylonitrile
(18) Benzene
(19) Bromochloromethane
(20) Bromodichloromethane
(21) Bromoform; Tribromomethane
(22) Carbon disulfide
(23) Carbon tetrachloride
(24) Chlorobenzene
(25) Chloroethane; Ethyl chloride
(26) Chloroform; Trichloromethane
(27) Dibromochloromethane; Chlorodibromomethane
(28) 1,2-Dibromo-3-chloropropane; DBCP
(29) 1,2-Dibromoethane; Ethylene dibromide; EDB
(30) o-Dichlorobenzene; 1,2-Dichlorobenzene
(31) p-Dichlorobenzene; 1,4-Dichlorobenzene
(32) trans-1,4-Dichloro-2-butene
(33) 1,1-Dichloroethane; Ethylidene chloride
(34) 1,2-Dichloroethane; Ethylene dichloride
(35) 1,1-Dichloroethylene; 1,1-Dichloroethene; Vinylidene chloride
(36) cis-1,2-Dichloroethylene; cis-1,2-Dichloroethene

(37) trans-1,2-Dichloroethylene; trans-1,2-Dichloroethene
(38) 1,2-Dichloropropane; Propylene dichloride
(39) cis-1,3-Dichloropropene
(40) trans-1,3-Dichloropropene
(41) Ethylbenzene
(42) 2-Hexanone; Methyl butyl ketone
(43) Methyl bromide; Bromomethane
(44) Methyl chloride; Chloromethane
(45) Methylene bromide; Dibromomethane
(46) Methylene chloride; Dichloromethane
(47) Methyl ethyl ketone; MEK; 2-Butanone
(48) Methyl iodide; Iodomethane
(49) 4-Methyl-2-pentanone; Methyl isobutyl ketone
(50) Styrene
(51) 1,1,1,2-Tetrachloroethane
(52) 1,1,2,2-Tetrachloroethane
(53) Tetrachloroethylene; Tetrachloroethene; Perchloroethylene
(54) Toluene
(55) 1,1,1-Trichloroethane; Methylchloroform
(56) 1,1,2-Trichloroethane
(57) Trichloroethylene; Trichloroethene
(58) Trichlorofluoromethane; CFC-11
(59) 1,2,3-Trichloropropane
(60) Vinyl acetate
(61) Vinyl chloride
(62) Xylenes

/1/ This list contains 47 volatile organics for which possible analytical procedures provided in EPA Report SW-846 "Test Methods for Evaluating Solid Waste," third edition, November 1986, as revised December 1987, includes Method 8260; and 15 metals for which SW-846 provides either Method 6010 or a method from the 7000 series of methods.

/2/ Common names are those widely used in government regulations, scientific publications, and commerce; synonyms exist for many chemicals.

# Appendix C: Hazardous Organic and Inorganic Constituents - Assessment Monitoring

# Appendix C: Hazardous Organic and Inorganic Constituents - Assessment Monitoring

APPENDIX II TO PART 258—LIST OF HAZARDOUS INORGANIC AND ORGANIC CONSTITUENTS [1]

| Common Name [2] | CAS RN [3] | Chemical abstracts service index name [4] | Suggested methods [5] | PQL (µg/L) [6] |
|---|---|---|---|---|
| Acenaphthene | 83-32-9 | Acenaphthylene, 1,2-dihydro- | 8100 | 200 |
| | | | 8270 | 10 |
| Acenaphthylene | 208-96-8 | Acenaphthylene | 8100 | 200 |
| | | | 8270 | 10 |
| Acetone | 67-64-1 | 2-Propanone | 8260 | 100 |
| Acetonitrile; Methyl cyanide | 75-05-8 | Acetonitrile | 8015 | 100 |
| Acetophenone | 98-86-2 | Ethanone, 1-phenyl- | 8270 | 10 |
| 2-Acetylaminofluorene; 2-AAF | 53-96-3 | Acetamide, N-9H-fluoren-2-yl- | 8270 | 20 |
| Acrolein | 107-02-8 | 2-Propenal | 8030 | 5 |
| | | | 8260 | 100 |
| Acrylonitrile | 107-13-1 | 2-Propenenitrile | 8030 | 5 |
| | | | 8260 | 200 |
| Aldrin | 309-00-2 | 1,4:5,8-Dimethanonaphthalene, 1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro- (1α,4α,4aβ,5α,8α,8aβ)- | 8080 | 0.05 |
| | | | 8270 | 10 |
| Allyl chloride | 107-05-1 | 1-Propene, 3-chloro- | 8010 | 5 |
| | | | 8260 | 10 |
| 4-Aminobiphenyl | 92-67-1 | [1,1'-Biphenyl]-4-amine | 8270 | 20 |
| Anthracene | 120-12-7 | Anthracene | 8100 | 200 |
| | | | 8270 | 10 |
| Antimony | (Total) | Antimony | 6010 | 300 |
| | | | 7040 | 2000 |
| | | | 7041 | 30 |
| Arsenic | (Total) | Arsenic | 6010 | 500 |
| | | | 7060 | 10 |
| | | | 7061 | 20 |
| Barium | (Total) | Barium | 6010 | 20 |
| | | | 7080 | 1000 |

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| Common Name [2] | CAS RN [3] | Chemical abstracts service index name [4] | Suggested methods [5] | PQL (µg/L) [6] |
|---|---|---|---|---|
| Chloroform; Trichloromethane | 67-66-3 | Methane, trichloro- | 8010 | 0.5 |
| | | | 8021 | 0.2 |
| | | | 8260 | 5 |
| 2-Chloronaphthalene | 91-58-7 | Naphthalene, 2-chloro- | 8120 | 10 |
| | | | 8270 | 10 |
| 2-Chlorophenol | 95-57-8 | Phenol, 2-chloro- | 8040 | 5 |
| | | | 8270 | 10 |
| 4-Chlorophenyl phenyl ether | 7005-72-3 | Benzene, 1-chloro-4-phenoxy- | 8110 | 40 |
| | | | 8270 | 10 |
| Chloroprene | 126-99-8 | 1,3-Butadiene, 2-chloro- | 8010 | 50 |
| | | | 8260 | 20 |
| Chromium | (Total) | Chromium | 6010 | 70 |
| | | | 7190 | 500 |
| | | | 7191 | 10 |
| Chrysene | 218-01-9 | Chrysene | 8100 | 200 |
| | | | 8270 | 10 |
| Cobalt | (Total) | Cobalt | 6010 | 70 |
| | | | 7200 | 500 |
| | | | 7201 | 10 |
| Copper | (Total) | Copper | 6010 | 60 |
| | | | 7210 | 200 |
| | | | 7211 | 10 |
| m-Cresol; 3-methylphenol | 108-39-4 | Phenol, 3-methyl- | 8270 | 10 |
| o-Cresol; 2-methylphenol | 95-48-7 | Phenol, 2-methyl- | 8270 | 10 |
| p-Cresol; 4-methylphenol | 106-44-5 | Phenol, 4-methyl- | 8270 | 10 |
| Cyanide | 57-12-5 | Cyanide | 9010 | 200 |
| 2,4-D; 2,4-Dichlorophenoxyacetic acid | 94-75-7 | Acetic acid, (2,4-dichlorophenoxy)- | 8150 | 10 |
| 4,4'-DDD | 72-54-8 | Benzene 1,1'-(2,2-dichloroethylidene)bis[4-chloro-. | 8080 | 0.1 |
| | | | 8270 | 10 |
| 4,4'-DDE | 72-55-9 | Benzene, 1,1'-(dichloroethenylidene)bis[4-chloro-. | 8080 | 0.05 |
| | | | 8270 | 10 |
| 4,4'-DDT | 50-29-3 | Benzene, 1,1'-(2,2,2-trichloroethylidene)bis[4-chloro-. | 8080 | 0.1 |
| | | | 8270 | 10 |
| Diallate | 2303-16-4 | Carbamothioic acid, bis(1-methylethyl)-,S-(2,3-dichloro-2-propenyl) ester. | 8270 | 10 |
| Dibenz[a,h]anthracene | 53-70-3 | Dibenz[a,h]anthracene | 8100 | 200 |
| | | | 8270 | 10 |
| Dibenzofuran | 132-64-9 | Dibenzofuran | 8270 | 10 |
| Dibromochloromethane; Chlorodibromomethane. | 124-48-1 | Methane, dibromochloro- | 8010 | 1 |
| | | | 8021 | 0.3 |
| | | | 8260 | 5 |
| 1,2-Dibromo-3-chloropropane; DBCP | 96-12-8 | Propane, 1,2-dibrome-3-chloro- | 8011 | 0.1 |
| | | | 8021 | 30 |
| | | | 8260 | 25 |
| 1,2-Dibromoethane; Ethylene dibromide; EDB. | 106-93-4 | Ethane, 1,2-dibromo- | 8011 | 0.1 |
| | | | 8021 | 10 |
| | | | 8260 | 5 |
| Di-n-butyl phthalate | 84-74-2 | 1,2-Benzenedicarboxylic acid, dibutyl ester. | 8060 | 5 |
| | | | 8270 | 10 |
| o-Dichlorobenzene; 1,2-Dichlorobenzene | 95-50-1 | Benzene, 1,2-dichloro- | 8010 | 2 |
| | | | 8020 | 5 |
| | | | 8021 | 0.5 |
| | | | 8120 | 10 |
| | | | 8260 | 5 |
| | | | 8270 | 10 |
| m-Dichlorobenzene; 1,3-Dichlorobenzene | 541-73-1 | Benzene, 1,3-Dichloro- | 8010 | 5 |
| | | | 8020 | 5 |
| | | | 8021 | 0.2 |
| | | | 8120 | 10 |
| | | | 8260 | 5 |
| | | | 8270 | 10 |
| p-Dichlorobenzene; 1,4-Dichlorobenzene | 106-46-7 | Benzene, 1,4-dichloro- | 8010 | 2 |
| | | | 8020 | 5 |
| | | | 8021 | 0.1 |
| | | | 8120 | 15 |
| | | | 8260 | 5 |
| | | | 8270 | 10 |

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| Common Name [2] | CAS RN [3] | Chemical abstracts service index name [4] | Suggested methods [5] | PQL (µg/L) [6] |
|---|---|---|---|---|
| Benzene | 71-43-2 | Benzene | 8020 | 2 |
| | | | 8021 | 0.1 |
| | | | 8260 | 5 |
| Benzo[a]anthracene; Benzanthracene | 56-55-3 | Benz[a]anthracene | 8100 | 200 |
| | | | 8270 | 10 |
| Benzo[b]fluoranthene | 205-99-2 | Benz[e]acephenanthrylene | 8100 | 200 |
| | | | 8270 | 10 |
| Benzo[k]fluoranthene | 207-08-9 | Benzo[k]fluoranthene | 8100 | 200 |
| | | | 8270 | 10 |
| Benzo[ghi]perylene | 191-24-2 | Benzo[ghi]perylene | 8100 | 200 |
| | | | 8270 | 10 |
| Benzo[a]pyrene | 50-32-8 | Benzo[a]pyrene | 8100 | 200 |
| | | | 8270 | 10 |
| Benzyl alcohol | 100-51-6 | Benzenemethanol | 8270 | 20 |
| Beryllium | (Total) | Beryllium | 6010 | 3 |
| | | | 7090 | 50 |
| | | | 7091 | 2 |
| alpha-BHC | 319-84-6 | Cyclohexane, 1,2,3,4,5,6-hexachloro-, (1α,2α,3β,4α,5β,6β)-. | 8080 | 0.05 |
| | | | 8270 | 10 |
| beta-BHC | 319-85-7 | Cyclohexane, 1,2,3,4,5,6-hexachloro-, (1α,2β,3α,4β,5α,6β)-. | 8080 | 0.05 |
| | | | 8270 | 20 |
| delta-BHC | 319-86-8 | Cyclohexane, 1,2,3,4,5,6-hexachloro-, (1α,2α,3α,4β,5α,6β)-. | 8080 | 0.1 |
| | | | 8270 | 20 |
| gamma-BHC; Lindane | 58-89-9 | Cyclohexane, 1,2,3,4,5,6-hexachloro-, (1α,2α,3β,4α,5α,6β)-. | 8080 | 0.05 |
| | | | 8270 | 20 |
| Bis(2-chloroethoxy)methane | 111-91-1 | Ethane, 1,1'-[methylenebis(oxy)]bis[2-chloro-. | 8110 | 5 |
| | | | 8270 | 10 |
| Bis(2-chloroethyl) ether; Dichloroethyl ether. | 111-44-4 | Ethane, 1,1'-oxybis[2-chloro- | 8110 | 3 |
| | | | 8270 | 10 |
| Bis-(2-chloro-1-methylethyl) ether; 2,2'-Dichlorodiisopropyl ether; DCIP. See note 7 | 108-60-1 | Propane, 2,2'-oxybis[1-chloro- | 8110 | 10 |
| | | | 8270 | 10 |
| Bis(2-ethylhexyl) phthalate | 117-81-7 | 1,2-Benzenedicarboxylic acid, bis(2-ethylhexyl) ester. | 8060 | 20 |
| Bromochloromethane; Chlorobromomethane. | 74-97-5 | Methane, bromochloro- | 8021 | 0.1 |
| | | | 8260 | 5 |
| Bromodichloromethane; Dibromochloromethane. | 75-27-4 | Methane, bromodichloro- | 8010 | 1 |
| | | | 8021 | 0.2 |
| | | | 8260 | 5 |
| Bromoform; Tribromomethane | 75-25-2 | Methane, tribromo- | 8010 | 2 |
| | | | 8021 | 15 |
| | | | 8260 | 5 |
| 4-Bromophenyl phenyl ether | 101-55-3 | Benzene, 1-bromo-4-phenoxy- | 8110 | 25 |
| | | | 8270 | 10 |
| Butyl benzyl phthalate; Benzyl butyl phthalate. | 85-68-7 | 1,2-Benzenedicarboxylic acid, butyl phenylmethyl ester. | 8060 | 5 |
| | | | 8270 | 10 |
| Cadmium | (Total) | Cadmium | 6010 | 40 |
| | | | 7130 | 50 |
| | | | 7131 | 1 |
| Carbon disulfide | 75-15-0 | Carbon disulfide | 8260 | 100 |
| Carbon tetrachloride | 56-23-5 | Methane, tetrachloro- | 8010 | 1 |
| | | | 8021 | 0.1 |
| | | | 8260 | 10 |
| Chlordane | See Note 8 | 4,7-Methano-1H-indene, 1,2,4,5,6,7,8,8-octachloro-2,3,3a,4,7,7a-hexahydro-. | 8080 | 0.1 |
| | | | 8270 | 50 |
| p-Chloroaniline | 106-47-8 | Benzenamine, 4-chloro- | 8270 | 20 |
| Chlorobenzene | 108-90-7 | Benzene, chloro- | 8010 | 2 |
| | | | 8020 | 2 |
| | | | 8021 | 0.1 |
| | | | 8260 | 5 |
| Chlorobenzilate | 510-15-6 | Benzeneacetic acid, 4-chloro-α-(4-chlorophenyl)-α-hydroxy-, ethyl ester. | 8270 | 10 |
| p-Chloro-m-cresol; 4-Chloro-3-methylphenol. | 59-50-7 | Phenol, 4-chloro-3-methyl- | 8040 | 5 |
| | | | 8270 | 20 |
| Chloroethane; Ethyl chloride | 75-00-3 | Ethane, chloro- | 8010 | 5 |
| | | | 8021 | 1 |
| | | | 8260 | 10 |

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| Common Name [2] | CAS RN [3] | Chemical abstracts service index name [4] | Suggested methods [5] | PQL (µg/L) [6] |
|---|---|---|---|---|
| 3,3'-Dichlorobenzidine | 91-94-1 | [1,1'-Biphenyl]-4,4'-diamine, 3,3'-dichloro-. | 8270 | 20 |
| trans-1,4-Dichloro-2-butene | 110-57-6 | 2-Butene, 1,4-dichloro-, (E)- | 8260 | 100 |
| Dichlorodifluoromethane; CFC 12: | 75-71-8 | Methane, dichlorodifluoro- | 8021 | 0.5 |
| | | | 8260 | 5 |
| 1,1-Dichloroethane; Ethylidene chloride | 75-34-3 | Ethane, 1,1-dichloro- | 8010 | 1 |
| | | | 8021 | 0.5 |
| | | | 8260 | 5 |
| 1,2-Dichloroethane; Ethylene dichloride | 107-06-2 | Ethane, 1,1-dichloro- | 8010 | 0.5 |
| | | | 8021 | 0.3 |
| | | | 8260 | 5 |
| 1,1-Dichloroethylene; 1,1-Dichloroethene; Vinylidene chloride. | 75-35-4 | Ethene, 1,1-dichloro- | 8010 | 1 |
| | | | 8021 | 0.5 |
| | | | 8260 | 5 |
| cis-1,2-Dichloroethylene; cis-1,2-Dichloroethene. | 156-59-2 | Ethene, 1,2-dichloro-, (Z)- | 8021 | 0.2 |
| | | | 8260 | 5 |
| trans-1,2-Dichloroethylene trans-1,2-Dichloroethene. | 156-60-5 | Ethene, 1,2-dichloro-, (E)- | 8010 | 1 |
| | | | 8021 | 0.5 |
| | | | 8260 | 5 |
| 2,4-Dichlorophenol | 120-83-2 | Phenol, 2,4-dichloro- | 8040 | 5 |
| | | | 8270 | 10 |
| 2,6-Dichlorophenol | 87-65-0 | Phenol, 2,6-dichloro- | 8270 | 10 |
| 1,2-Dichloropropane; Propylene dichloride | 78-87-5 | Propane, 1,2-dichloro- | 8010 | 0.5 |
| | | | 8021 | 0.05 |
| | | | 8260 | 5 |
| 1,3-Dichloropropane; Trimethylene dichloride. | 142-28-9 | Propane, 1,3-dichloro- | 8021 | 0.3 |
| | | | 8260 | 5 |
| 2,2-Dichloropropane; Isopropylidene chloride. | 594-20-7 | Propane, 2,2-dichloro- | 8021 | 0.5 |
| | | | 8260 | 15 |
| 1,1-Dichloropropene | 563-58-6 | 1-Propene, 1,1-dichloro- | 8021 | 0.2 |
| | | | 8260 | 5 |
| cis-1,3-Dichloropropene | 10061-01-5 | 1-Propene, 1,3-dichloro-, (Z)- | 8010 | 20 |
| | | | 8260 | 10 |
| trans-1,3-Dichloropropene | 10061-02-6 | 1-Propene, 1,3-dichloro-, (E)- | 8010 | 5 |
| | | | 8260 | 10 |
| Dieldrin | 60-57-1 | 2,7:3,6-Dimethanonaphth[2,3-b]oxirene, 3,4,5,6,9,9-hexa, chloro-1a,2,2a,3,6,6a,7,7a-octahydro-, (1aα,2β,2aα,3β,6β,6aα,7β,7aα)-. | 8080 | 0.05 |
| | | | 8270 | 10 |
| Diethyl phthalate | 84-66-2 | 1,2-Benzenedicarboxylic acid, diethyl ester. | 8060 | 5 |
| | | | 8270 | 10 |
| 0,0-Diethyl 0-2-pyrazinyl phosphorothioate; Thionazin. | 297-97-2 | Phosphorothioic acid, 0,0-diethyl 0-pyrazinyl ester. | 8141 | 5 |
| | | | 8270 | 20 |
| Dimethoate | 60-51-5 | Phosphorodithioic acid, 0,0-dimethyl S-[2-(methylamino)-2-oxoethyl] ester. | 8141 | 3 |
| | | | 8270 | 20 |
| p-(Dimethylamino)azobenzene | 60-11-7 | Benzenamine, N,N-dimethyl-4-(phenylazo)-. | 8270 | 10 |
| 7,12-Dimethylbenz[a]anthracene | 57-97-6 | Benz[a]anthracene, 7,12-dimethyl- | 8270 | 10 |
| 3,3'-Dimethylbenzidine | 119-93-7 | [1,1'-Biphenyl]-4,4'-diamine, 3,3'-dimethyl-. | 8270 | 10 |
| 2,4-Dimethylphenol; m-Xylenol | 105-67-9 | Phenol, 2,4-dimethyl- | 8040 | 5 |
| | | | 8270 | 10 |
| Dimethyl phthalate | 131-11-3 | 1,2-Benzenedicarboxylic acid, dimethyl ester. | 8060 | 5 |
| | | | 8270 | 10 |
| m-Dinitrobenzene | 99-65-0 | Benzene, 1,3-dinitro- | 8270 | 20 |
| 4,6-Dinitro-o-cresol 4,6-Dinitro-2-methylphenol. | 534-52-1 | Phenol, 2-methyl-4,6-dinitro | 8040 | 150 |
| | | | 8270 | 50 |
| 2,4-Dinitrophenol; | 51-28-5 | Phenol, 2,4-dinitro- | 8040 | 150 |
| | | | 8270 | 50 |
| 2,4-Dinitrotoluene | 121-14-2 | Benzene, 1-methyl-2,4-dinitro- | 8090 | 0.2 |
| | | | 8270 | 10 |
| 2,6-Dinitrotoluene | 606-20-2 | Benzene, 2-methyl-1,3-dinitro- | 8090 | 0.1 |
| | | | 8270 | 10 |
| Dinoseb; DNBP; 2-sec-Butyl-4,6-dinitrophenol. | 88-85-7 | Phenol, 2-(1-methylpropyl)-4,6-dinitro- | 8150 | 1 |
| | | | 8270 | 20 |
| Di-n-octyl phthalate | 117-84-0 | 1,2-Benzenedicarboxylic acid, dioctyl ester. | 8060 | 30 |
| | | | 8270 | 10 |
| Diphenylamine | 122-39-4 | Benzenamine, N-phenyl- | 8270 | 10 |

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| Common Name [2] | CAS RN [3] | Chemical abstracts service index name [4] | Suggested methods [5] | PQL (µg/L) [6] |
|---|---|---|---|---|
| Disulfoton | 298-04-4 | Phosphorodithioic acid, 0,0-diethyl S-[2-(ethylthio)ethyl] ester. | 8140<br>8141<br>8270 | 2<br>0.5<br>10 |
| Endosulfan I | 959-98-8 | 6,9-Methano-2,4,3-benzodioxathiepin, 6,7,8,9,10,10-hexa- chloro-1,5,5a,6,9,9a-hexahydro-, 3-oxide. | 8080<br>8270 | 0.1<br>20 |
| Endosulfan II | 33213-65-9 | 6,9-Methano-2,4,3-benzodioxathiepin, 6,7,8,9,10,10-hexa- chloro-1,5,5a,6,9,9a-hexahydro-, 3-oxide, (3α,5aα,6β,9β,9aα)-. | 8080<br>8270 | 0.05<br>20 |
| Endosulfan sulfate | 1031-07-8 | 6,9-Methano-2,4,3-benzodioxathiepin, 6,7,8,9,10,10-hexa- chloro-1,5,5a,6,9,9a-hexahydro-,3-3-dioxide. | 8080<br>8270 | 0.5<br>10 |
| Endrin | 72-20-8 | 2,7:3,6-Dimethanonaphth[2,3-b]oxirene, 3,4,5,6,9,9-hexachloro-1a,2,2a,3,6,6a,7,7a-octahydro-, (1aα, 2β,2aβ,3α,6α,6aβ,7β,7aα)-. | 8080<br>8270 | 0.1<br>20 |
| Endrin aldehyde | 7421-93-4 | 1,2,4-Methenocyclopenta[cd]pentalene-5-carboxaldehyde, 2,2a,3,3,4,7-hexachlor-odecahydro-, (1α,2β,2aβ,4β ,4aβ,5β,6aβ,6bβ,7R*)-. | 8080<br>8270 | 0.2<br>10 |
| Ethylbenzene | 100-41-4 | Benzene, ethyl- | 8020<br>8221<br>8260 | 2<br>0.05<br>5 |
| Ethyl methacrylate | 97-63-2 | 2-Propenoic acid, 2-methyl-, ethyl ester | 8015<br>8260<br>8270 | 5<br>10<br>10 |
| Ethyl methanesulfonate | 62-50-0 | Methanesulfonic acid, ethyl ester | 8270 | 20 |
| Famphur | 52-85-7 | Phosphorothioic acid, 0-[4-[(dimethylamino)sulfonyl]phenyl] 0,0-dimethyl ester. | 8270 | 20 |
| Fluoranthene | 206-44-0 | Fluoranthene | 8100<br>8270 | 200<br>10 |
| Fluorene | 86-73-7 | 9H-Fluorene | 8100<br>8270 | 200<br>10 |
| Heptachlor | 76-44-8 | 4,7-Methano-1H-indene, 1,4,5,6,7,8,8-heptachloro-3a,4,7,7a-tetrahydro-. | 8080<br>8270 | 0.05<br>10 |
| Heptachlor epoxide | 1024-57-3 | 2,5-Methano-2H-indeno[1,2-b]oxirene, 2,3,4,5,6,7,7-heptachloro-1a,1b,5,5a,6,6a-hexahydro-, (1aα, 1bβ, 2α, 5α, 5aβ, 6β, 6aα). | 8080<br>8270 | 1<br>10 |
| Hexachlorobenzene | 118-74-1 | Benzene, hexachloro- | 8120<br>8270 | 0.5<br>10 |
| Hexachlorobutadiene | 87-68-3 | 1,3-Butadiene, 1,1,2,3,4,4-hexachloro- | 8021<br>8120<br>8260<br>8270 | 0.5<br>5<br>10<br>10 |
| Hexachlorocyclopentadiene | 77-47-4 | 1,3-Cyclopentadiene, 1,2,3,4,5,5-hexachloro-. | 8120<br>8270 | 5<br>10 |
| Hexachloroethane | 67-72-1 | Ethane, hexachloro- | 8120<br>8260<br>8270 | 0.5<br>10<br>10 |
| Hexachloropropene | 1888-71-7 | 1-Propene, 1,1,2,3,3,3-hexachloro- | 8270 | 10 |
| 2-Hexanone; Methyl butyl ketone | 591-78-6 | 2-Hexanone | 8260 | 50 |
| Indeno(1,2,3-cd)pyrene | 193-39-5 | Indeno(1,2,3-cd)pyrene | 8100<br>8270 | 200<br>10 |
| Isobutyl alcohol | 78-83-1 | 1-Propanol, 2-methyl- | 8015<br>8240 | 50<br>100 |
| Isodrin | 465-73-6 | 1,4,5,8-Dimethanonaphthalene,1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a hexahydro-(1α,4α,4aβ,5β,8β,8aβ)-. | 8270<br>8260 | 20<br>10 |
| Isophorone | 78-59-1 | 2-Cyclohexen-1-one, 3,5,5-trimethyl- | 8090<br>8270 | 60<br>10 |
| Isosafrole | 120-58-1 | 1,3-Benzodioxole, 5-(1-propenyl)- | 8270 | 10 |
| Kepone | 143-50-0 | 1,3,4-Metheno-2H-cyclobuta[cd]pentalen-2-one, 1,1a,3,3a,4,5,5,5a,5b,6-decachlorooctahydro-. | 8270 | 20 |

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| Common Name [2] | CAS RN [3] | Chemical abstracts service index name [4] | Suggested methods [5] | PQL (µg/L) [6] |
|---|---|---|---|---|
| Lead | (Total) | Lead | 6010 | 400 |
| | | | 7420 | 1000 |
| | | | 7421 | 10 |
| Mercury | (Total) | Mercury | 7470 | 2 |
| Methacrylonitrile | 126-98-7 | 2-Propenenitrile, 2-methyl- | 8015 | 5 |
| | | | 8260 | 100 |
| Methapyrilene | 91-80-5 | 1,2-Ethanediamine, N,N-dimethyl-N'-2-pyridinyl-N1/2-thienylmethyl)-. | 8270 | 100 |
| Methoxychlor | 72-43-5 | Benzene,1,1'-(2,2,2,trichloroethylidene)bis[4-methoxy-. | 8080 | 2 |
| | | | 8270 | 10 |
| Methyl bromide; Bromomethane | 74-83-9 | Methane, bromo- | 8010 | 20 |
| | | | 8021 | 10 |
| Methyl chloride; Chloromethane | 74-87-3 | Methane, chloro- | 8010 | 1 |
| | | | 8021 | 0.3 |
| 3-Methylcholanthrene | 56-49-5 | Benz[j]aceanthrylene, 1,2-dihydro-3-methyl-. | 8270 | 10 |
| Methyl ethyl ketone; MEK; 2-Butanone | 78-93-3 | 2-Butanone | 8015 | 10 |
| | | | 8260 | 100 |
| Methyl iodide; Iodomethane | 74-88-4 | Methane, iodo- | 8010 | 40 |
| | | | 8260 | 10 |
| Methyl methacrylate | 80-62-6 | 2-Propenoic acid, 2-methyl-, methyl ester | 8015 | 2 |
| | | | 8260 | 30 |
| Methyl methanesulfonate | 66-27-3 | Methanesulfonic acid, methyl ester | 8270 | 10 |
| 2-Methylnaphthalene | 91-57-6 | Naphthalene, 2-methyl- | 8270 | 10 |
| Methyl parathion; Parathion methyl | 298-00-0 | Phosphorothioic acid, 0,0-dimethyl | 8140 | 0.5 |
| | | | 8141 | 1 |
| | | | 8270 | 10 |
| 4-Methyl-2-pentanone; Methyl isobutyl ketone. | 108-10-1 | 2-Pentanone, 4-methyl- | 8015 | 5 |
| | | | 8260 | 100 |
| Methylene bromide; Dibromomethane | 74-95-3 | Methane, dibromo- | 8010 | 15 |
| | | | 8021 | 20 |
| | | | 8260 | 10 |
| Methylene chloride; Dichloromethane | 75-09-2 | Methane, dichloro- | 8010 | 5 |
| | | | 8021 | 0.2 |
| | | | 8260 | 10 |
| Naphthalene | 91-20-3 | Naphthalene | 8021 | 0.5 |
| | | | 8100 | 200 |
| | | | 8260 | 5 |
| | | | 8270 | 10 |
| 1,4-Naphthoquinone | 130-15-4 | 1,4-Naphthalenedione | 8270 | 10 |
| 1-Naphthylamine | 134-32-7 | 1-Naphthalenamine | 8270 | 10 |
| 2-Naphthylamine | 91-59-8 | 2-Naphthalenamine | 8270 | 10 |
| Nickel | (Total) | Nickel | 6010 | 150 |
| | | | 7520 | 400 |
| o-Nitroaniline; 2-Nitroaniline | 88-74-4 | Benzenamine, 2-nitro- | 8270 | 50 |
| m-Nitroaniline; 3-Nitroanile | 99-09-2 | Benzenamine, 3-nitro- | 8270 | 50 |
| p-Nitroaniline; 4-Nitroaniline | 100-01-6 | Benzenamine, 4-nitro | 8270 | 20 |
| Nitrobenzene | 98-95-3 | Benzene, nitro- | 8090 | 40 |
| | | | 8270 | 10 |
| o-Nitrophenol; 2-Nitrophenol | 88-75-5 | Phenol, 2-nitro- | 8040 | 5 |
| | | | 8270 | 10 |
| p-Nitrophenol; 4-Nitrophenol | 100-02-7 | Phenol, 4-nitro- | 8040 | 10 |
| | | | 8270 | 50 |
| N-Nitrosodi-n-butylamine | 924-16-3 | 1-Butanamine, N-butyl-N-nitroso- | 8270 | 10 |
| N-Nitrosodiethylamine | 55-18-5 | Ethanamine, N-ethyl-N-nitroso- | 8270 | 20 |
| N-Nitrosodimethylamine | 62-75-9 | Methanamine, N-methyl-N-nitroso- | 8070 | 2 |
| N-Nitrosodiphenylamine | 86-30-6 | Benzenamine, N-nitroso-N-phenyl- | 8070 | 5 |
| N-Nitrosodipropylamine; N-Nitroso-N-dipropylamine; Di-n-propylnitrosamine. | 621-64-7 | 1-Propanamine, N-nitroso-N-propyl- | 8070 | 10 |
| N-Nitrosomethylethalamine | 10595-95-6 | Ethanamine, N-methyl-N-nitroso- | 8270 | 10 |
| N-Nitrosopiperidine | 100-75-4 | Pipendine, 1-nitroso- | 8270 | 20 |
| N-Nitrosopyrrolidine | 930-55-2 | Pyrrolidine, 1-nitroso- | 8270 | 40 |
| 5-Nitro-o-toluidine | 99-55-8 | Benzenamine, 2-methyl-5-nitro- | 8270 | 10 |
| Parathion | 56-38-2 | Phosphorothioic acid, 0,0-diethyl 0-(4-nitrophenyl) ester. | 8141 | 0.5 |
| | | | 8270 | 10 |
| Pentachlorobenzene | 608-93-5 | Benzene, pentachloro- | 8270 | 10 |
| Pentachloronitrobenzene | 82-68-8 | Benzene, pentachloronitro- | 8270 | 20 |

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| Common Name [2] | CAS RN [3] | Chemical abstracts service index name [4] | Suggested methods [5] | PQL (µg/L) [6] |
|---|---|---|---|---|
| Pentachlorophenol | 87-86-5 | Phenol, pentachloro- | 8040 | 5 |
| | | | 8270 | 50 |
| Phenacetin | 62-44-2 | Acetamide, N-(4-ethoxyphenl) | 8270 | 20 |
| Phenanthrene | 85-01-8 | Phenanthrene | 8100 | 200 |
| | | | 8270 | 10 |
| Phenol | 108-95-2 | Phenol | 8040 | 1 |
| p-Phenylenediamine | 106-50-3 | 1,4-Benzenediamine | 8270 | 10 |
| Phorate | 298-02-2 | Phosphorodithioic acid, 0,0-diethyl S-[(ethylthio)methyl] ester. | 8140 | 2 |
| | | | 8141 | 0.5 |
| | | | 8270 | 10 |
| Polychlorinated biphenyls; PCBs; Aroclors | See Note 9 | 1,1'-Biphenyl, chloro derivatives | 8080 | 50 |
| | | | 8270 | 200 |
| Pronamide | 23950-58-5 | Benzamide, 3,5-dichloro-N-(1,1-dimethyl-2-propynyl)-. | 8270 | 10 |
| Propionitrile; Ethyl cyanide | 107-12-0 | Propanenitrile | 8015 | 60 |
| | | | 8260 | 150 |
| Pyrene | 129-00-0 | Pyrene | 8100 | 200 |
| | | | 8270 | 10 |
| Safrole | 94-59-7 | 1,3-Benzodioxole, 5-(2-propenyl)- | 8270 | 10 |
| Selenium | (Total) | Selenium | 6010 | 750 |
| | | | 7740 | 20 |
| | | | 7741 | 20 |
| Silver | (Total) | Silver | 6010 | 70 |
| | | | 7760 | 100 |
| | | | 7761 | 10 |
| Silvex; 2,4,5-TP | 93-72-1 | Propanoic acid, 2-(2,4,5-trichlorophenoxy)-. | 8150 | 2 |
| Styrene | 100-42-5 | Benzene, ethenyl- | 8020 | 1 |
| | | | 8021 | 0.1 |
| | | | 8260 | 10 |
| Sulfide | 18496-25-8 | Sulfide | 9030 | 4000 |
| 2,4,5-T; 2,4,5-Trichlorophenoxyacetic acid | 93-76-5 | Acetic acid, (2,4,5-trichlorophenoxy)- | 8150 | 2 |
| 1,2,4,5-Tetrachlorobenzene | 95-94-3 | Benzene, 1,2,4,5-tetrachloro- | 8270 | 10 |
| 1,1,1,2-Tetrachloroethane | 630-20-6 | Ethane, 1,1,1,2-tetrachloro- | 8010 | 5 |
| | | | 8021 | 0.05 |
| | | | 8260 | 5 |
| 1,1,2,2-Tetrachloroethane | 79-34-5 | Ethane, 1,1,2,2-tetrachloro- | 8010 | 0.5 |
| | | | 8021 | 0.1 |
| | | | 8260 | 5 |
| Tetrachloroethylene; Tetrachloroethene; Perchloroethylene. | 127-18-4 | Ethene, tetrachloro- | 8010 | 0.5 |
| | | | 8021 | 0.5 |
| | | | 8260 | 5 |
| 2,3,4,6-Tetrachlorophenol | 58-90-2 | Phenol, 2,3,4,6-tetrachloro- | 8270 | 10 |
| Thallium | (Total) | Thallium | 6010 | 400 |
| | | | 7840 | 1000 |
| | | | 7841 | 10 |
| Tin | (Total) | Tin | 6010 | 40 |
| Toluene | 108-88-3 | Benzene, methyl- | 8020 | 2 |
| | | | 8021 | 0.1 |
| | | | 8260 | 5 |
| o-Toluidine | 95-53-4 | Benzenamine, 2-methyl- | 8270 | 10 |
| Toxaphene | See Note 10 | Toxaphene | 8080 | 2 |
| 1,2,4-Trichlorobenzene | 120-82-1 | Benzene, 1,2,4-trichloro- | 8021 | 0.3 |
| | | | 8120 | 0.5 |
| | | | 8260 | 10 |
| | | | 8270 | 10 |
| 1,1,1-Trichloroethane; Methylchloroform | 71-55-6 | Ethane, 1,1,1-trichloro- | 8010 | 0.3 |
| | | | 8021 | 0.3 |
| | | | 8260 | 5 |
| 1,1,2-Trichloroethane | 79-00-5 | Ethane, 1,1,2-trichloro- | 8010 | 0.2 |
| | | | 8260 | 5 |
| Trichloroethylene; Trichloroethene | 79-01-6 | Ethene, trichloro- | 8010 | 1 |
| | | | 8021 | 0.2 |
| | | | 8260 | 5 |
| Trichlorofluoromethane; CFC-11 | 75-69-4 | Methane, trichlorofluoro- | 8010 | 10 |
| | | | 8021 | 0.3 |
| | | | 8260 | 5 |
| 2,4,5-Trichlorophenol | 95-95-4 | Phenol, 2,4,5-trichloro- | 8270 | 10 |

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| Common Name [2] | CAS RN [3] | Chemical abstracts service index name [4] | Suggested methods [5] | PQL (µg/L) [6] |
|---|---|---|---|---|
| 2,4,6-Trichlorophenol | 88-06-2 | Phenol, 2,4,6-trichloro- | 8040 | 5 |
| | | | 8270 | 10 |
| 1,2,3-Trichloropropane | 96-18-4 | Propane, 1,2,3-trichloro- | 8010 | 10 |
| | | | 8021 | 5 |
| | | | 8260 | 15 |
| 0,0,0-Triethyl phosphorothioate | 126-68-1 | Phosphorothioic acid, 0,0,0-triethylester | 8270 | 10 |
| sym-Trinitrobenzene | 99-35-4 | Benzene, 1,3,5-trinitro- | 8270 | 10 |
| Vanadium | (Total) | Vanadium | 6010 | 80 |
| | | | 7910 | 2000 |
| | | | 7911 | 40 |
| Vinyl acetate | 108-05-4 | Acetic acid, ethenyl ester | 8260 | 50 |
| Vinyl chloride; Chloroethene | 75-01-4 | Ethene, chloro- | 8010 | 2 |
| | | | 8021 | 0.4 |
| | | | 8260 | 10 |
| Xylene (total) | See Note 11 | Benzene, dimethyl- | 8020 | 5 |
| | | | 8021 | 0.2 |
| | | | 8260 | 5 |
| Zinc | (Total) | Zinc | 6010 | 20 |
| | | | 7950 | 50 |
| | | | 7951 | 0.5 |

Notes

[1] The regulatory requirements pertain only to the list of substances; the right hand columns (Methods and PQL) are given for informational purposes only. See also footnotes 5 and 6.

[2] Common names are those widely used in government regulations, scientific publications, and commerce; synonyms exist for many chemicals.

[3] Chemical Abstracts Service registry number. Where "Total" is entered, all species in the ground water that contain this element are included.

[4] CAS index are those used in the 9th Collective Index.

[5] Suggested Methods refer to analytical procedure numbers used in EPA Report SW-846 "Test Methods for Evaluating Solid Waste", third edition, November 1986, as revised, December 1987. Analytical details can be found in SW-846 and in documentation on file at the agency. CAUTION: The methods listed are representative SW-846 procedures and may not always be the most suitable method(s) for monitoring an analyte under the regulations.

[6] Practical Quantitation Limits (PQLs) are the lowest concentrations of analytes in ground waters that can be reliably determined within specified limits of precision and accuracy by the indicated methods under routine laboratory operating conditions. The PQLs listed are generally stated to one significant figure. PQLs are based on 5 mL samples for volatile organics and 1 L samples for semivolatile organics. CAUTION: The PQL values in many cases are based only on a general estimate for the method and not on a determination for individual compounds; PQLs are not a part of the regulation.

[7] This substance is often called Bis(2-chloroisopropyl) ether, the name Chemical Abstracts Service applies to its noncommercial isomer, Propane, 2,2'-oxybis[2-chloro- (CAS RN 39638-32-9).

[8] Chlordane: This entry includes alpha-chlordane (CAS RN 5103-71-9), beta-chlordane (CAS RN 5103-74-2), gamma-chlordane (CAS RN 5566-34-7), and constituents of chlordane (CAS RN 57-74-9 and CAS RN 12789-03-6). PQL shown is for technical chlordane. PQLs of specific isomers are about 20 µg/L by method 8270.

[9] Polychlorinated biphenyls (CAS RN 1336-36-3); this category contains congener chemicals, including constituents of Aroclor 1016 (CAS RN 12674-11-2), Aroclor 1221 (CAS RN 11104-28-2), Aroclor 1232 (CAS RN 11141-16-5), Aroclor 1242 (CAS RN 53469-21-9), Aroclor 1248 (CAS RN 12672-29-6), Aroclor 1254 (CAS RN 11097-69-1), and Aroclor 1260 (CAS RN 11096-82-5). The PQL shown is an average value for PCB congeners.

[10] Toxaphene: This entry includes congener chemicals contained in technical toxaphene (CAS RN 8001-35-2), i.e., chlorinated camphene.

[11] Xylene (total): This entry includes o-xylene (CAS RN 96-47-6), m-xylene (CAS RN 108-38-3), p-xylene (CAS RN 106-42-3), and unspecified xylenes (dimethylbenzenes) (CAS RN 1330-20-7). PQLs for method 8021 are 0.2 for o-xylene and 0.1 for m- or p-xylene. The PQL for m-xylene is 2.0 µg/L by method 8020 or 8260.


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