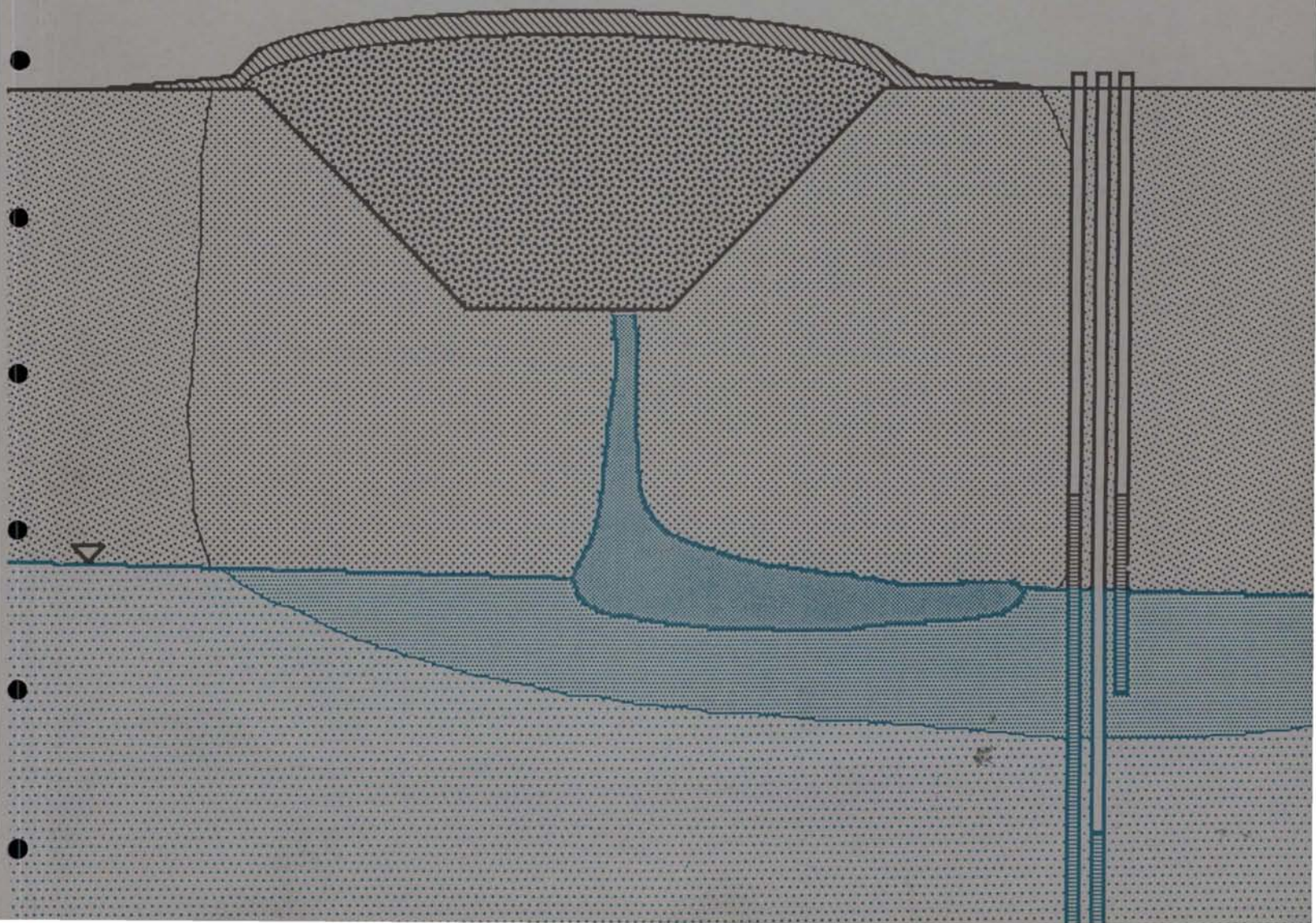
GROUND WATER EVALUATION AT A SOLID WASTE SITE

Idaho Water Resources Research Institute
University of Idaho
Moscow, Idaho

in cooperation with the

Department of Geology and Geological Engineering
University of Idaho
Moscow, Idaho



GROUND WATER EVALUATION AT A SOLID WASTE SITE

April 18-19, 1989
IDAHO FALLS CENTER
1776 SCIENCE CENTER DRIVE
IDAHO FALLS, IDAHO

April 20-21, 1989
MORRISON-KNUDSEN CENTRAL PLAZA
720 PARK BLVD
BOISE, IDAHO

May 4-5, 1989
STUDENT UNION BUILDING
UNIVERSITY OF IDAHO
MOSCOW, IDAHO

PURPOSE
To present an overview of ground water evaluation and monitoring at waste disposal sites. This course is nonmathematical in nature and will provide instruction in *Hydrogeologic Characterization of Solid Waste Disposal Sites, Monitoring Well Design and Construction and Impact of the Resource Conservation and Recovery Act of 1976 in Washington and Idaho.*

PARTICIPANTS
This short course is directed to professionals in the field, program managers, graduate students and interested public.

INSTRUCTORS
Dr. Dale Ralston is a Professor of Hydrogeology at the University of Idaho and Acting Director of the Idaho Water Resources Research Institute.

Dr. James Osiensky is an Associate Professor of Hydrogeology at the University of Idaho and is stationed in the Department of Geology and Geophysics at Boise State University.

Mr. Ching-Pi Wang, P.E. is a registered professional engineer in the State of Washington and is Senior Hydrogeologist with the State of Washington Department of Ecology. Mr. Wang is in charge of hydrogeologic investigations at landfills and hazardous waste sites.

GUEST SPEAKERS

Representatives from three of Idaho's Health Districts will be speaking during the short course. Their contributions will address the *Resource Conservation and Recovery Act of 1976.* In addition, Representative Deanna Vickers (D) of Lewiston will be participating. Ms. Vickers is actively involved in promoting legislation relating to waste management and sponsored **HB216** ***Solid Waste Management and Recycling Act of 1989.***

Mr. Darrus Martin
Idaho Health District 7
Idaho Falls Short Course

Mr. Jack Biddle
Idaho Health District 3
Boise Short Course

Representative Deanna Vickers
Legislative District 6
Moscow Short Course

Mr. James Guiffre
Director
Northcentral Health District
Moscow Short Course

Mr. Dale Geaudreau
Environmental Health Specialist
Northcentral Health District
Moscow Short Course

COURSE OUTLINE

DAY 1

Session Begins: 8:30 a.m.

I Introduction

II Hydrogeologic Characterization of Solid Waste Disposal Sites

Lunch

III Monitor Well Design and Construction

DAY 2

Session begins: 8:30 a.m.

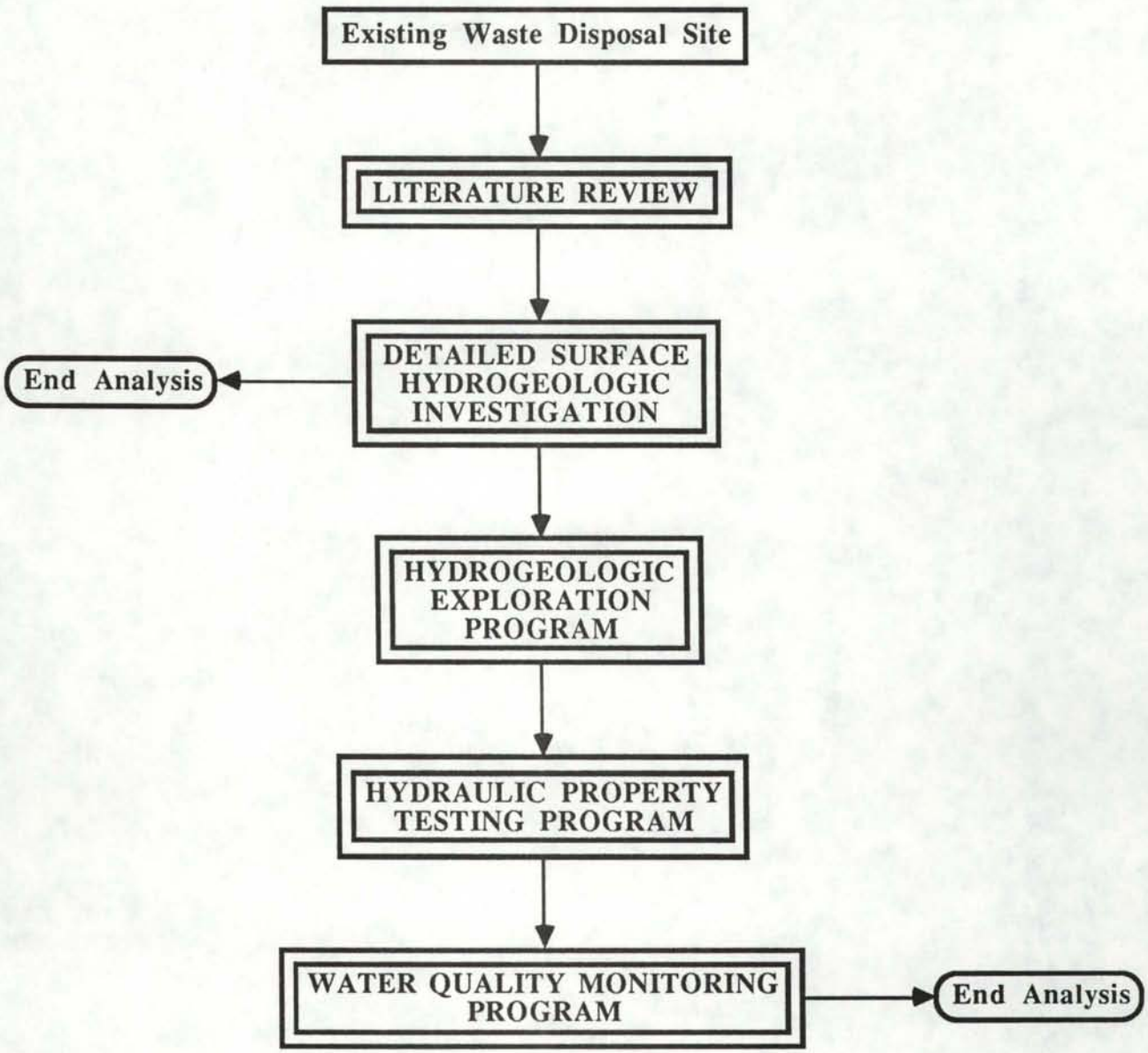
IV Impacts of the Resource and Conservation and Recovery Act of 1976 (RCRA) in Washington and Idaho

Lunch

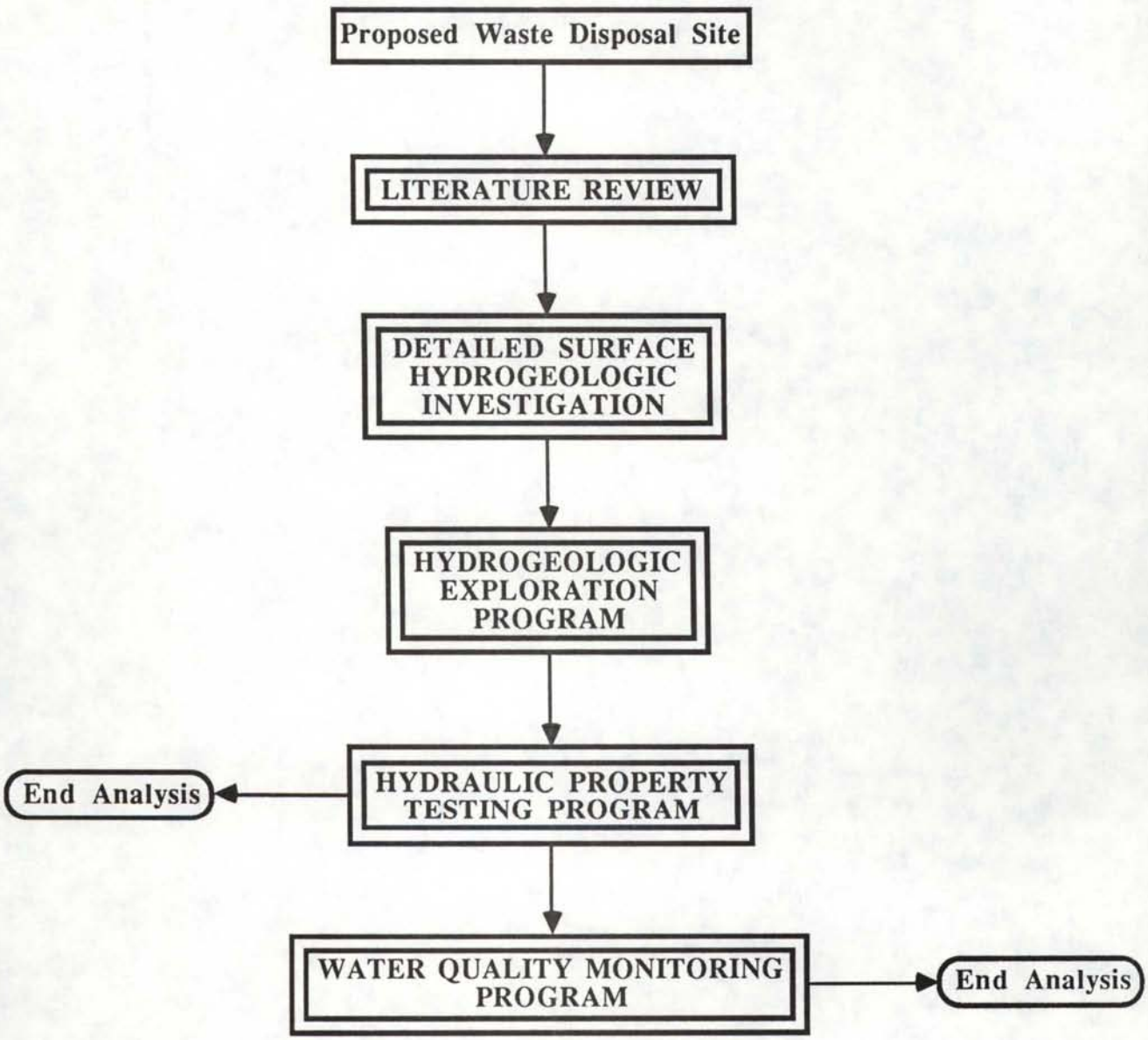
V Panel Discussion
Ground Water Evaluation at a Solid Waste Site

Breaks will be mid-morning and mid-afternoon of Day 1 with lunch scheduled for 12:00 p.m.
Break will be mid-morning of Day 2 with lunch scheduled for 12:00 p.m.
Day 1 will conclude at 4:30 p.m.
Day 2 will conclude at 3:00 p.m.

HYDROGEOLOGIC ANALYSIS OF SOLID WASTE DISPOSAL SITES: PART ONE



HYDROGEOLOGIC ANALYSIS OF SOLID WASTE DISPOSAL SITES: PART TWO

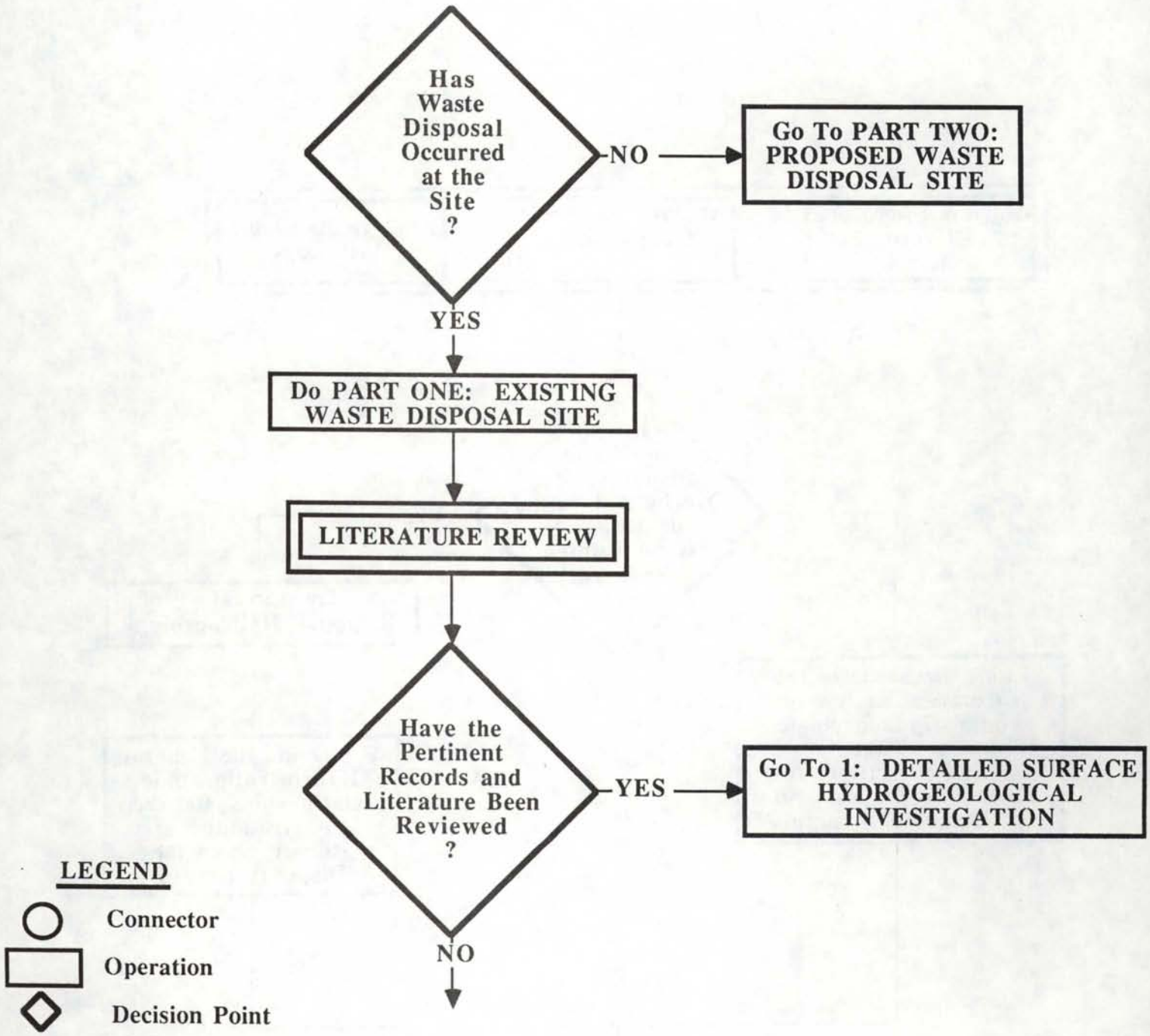


HYDROGEOLOGIC CHARACTERISTICS

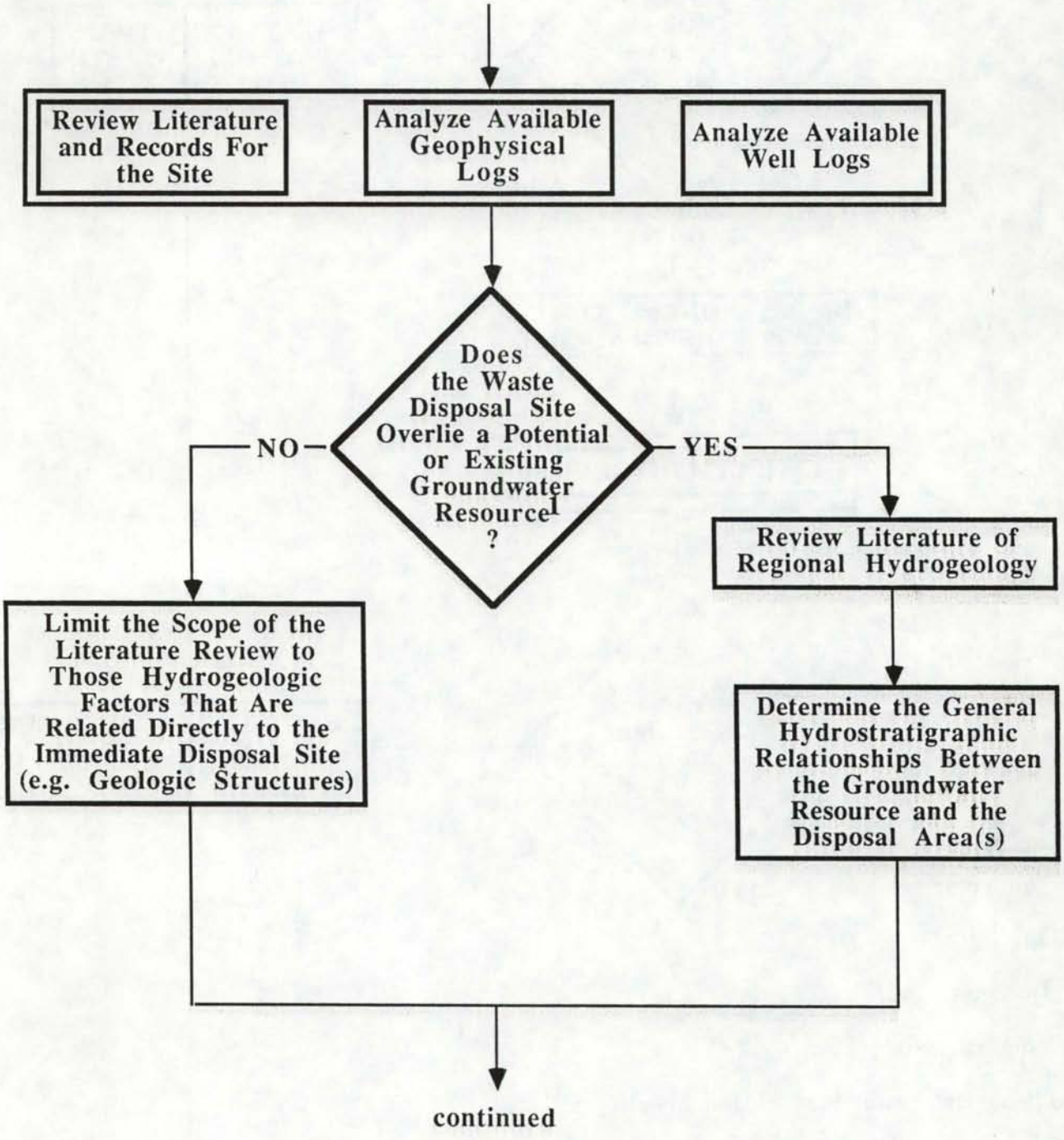
OF

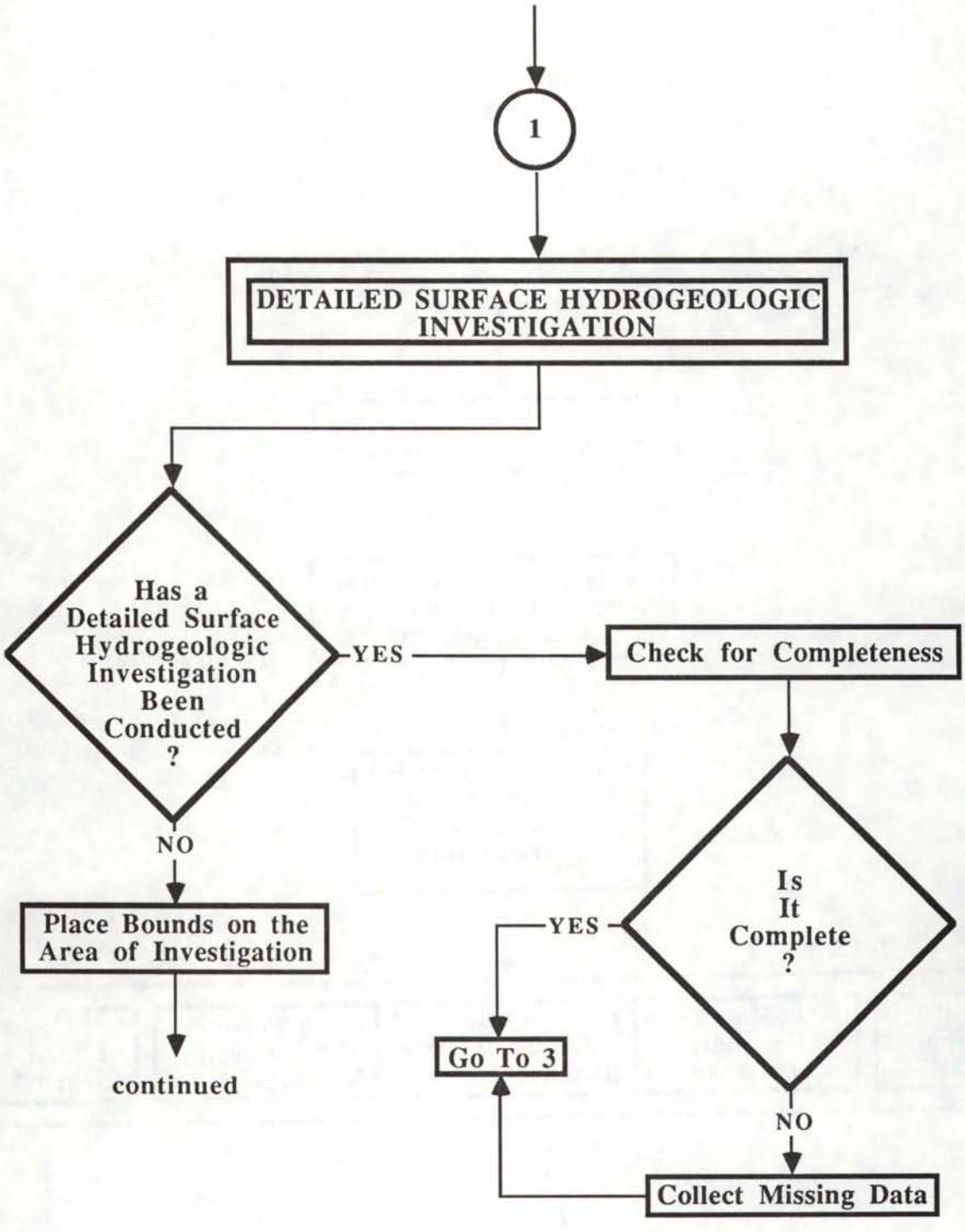
EXISTING WASTE SITES

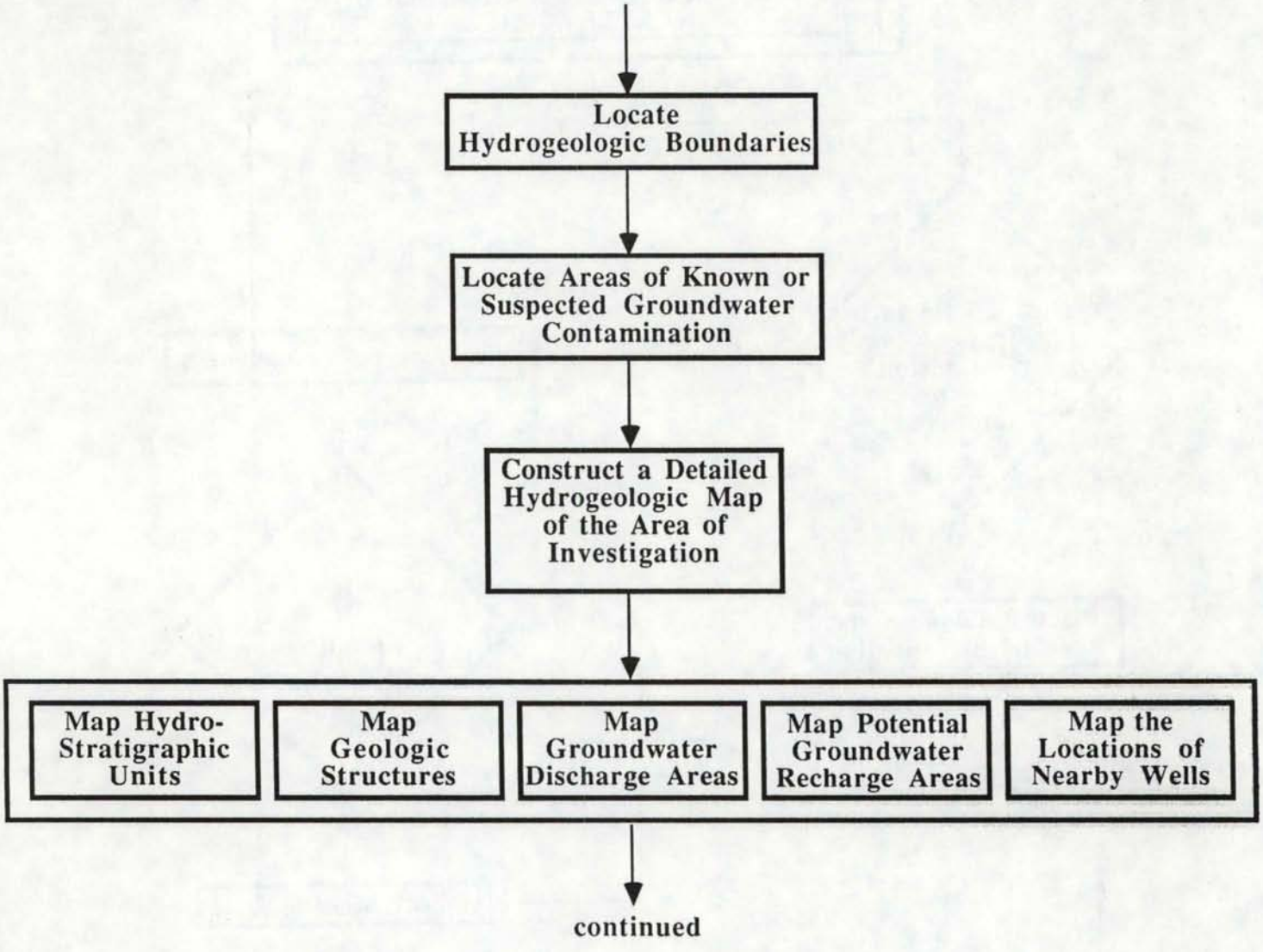
HYDROGEOLOGIC ANALYSIS OF SOLID WASTE DISPOSAL SITES: PART ONE



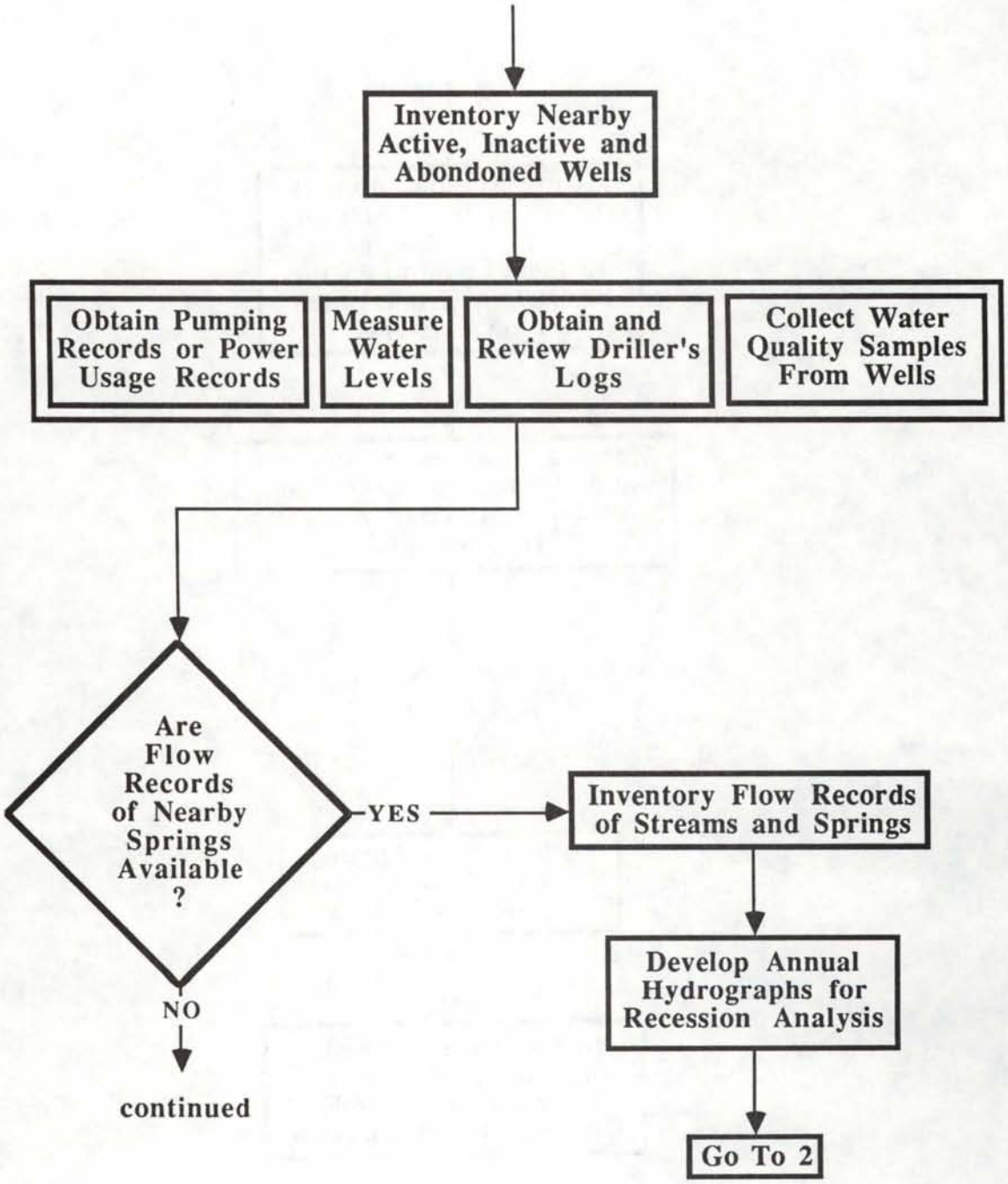
1. To be Determined by a Hydrogeologist
2. To be Determined by a Geophysist

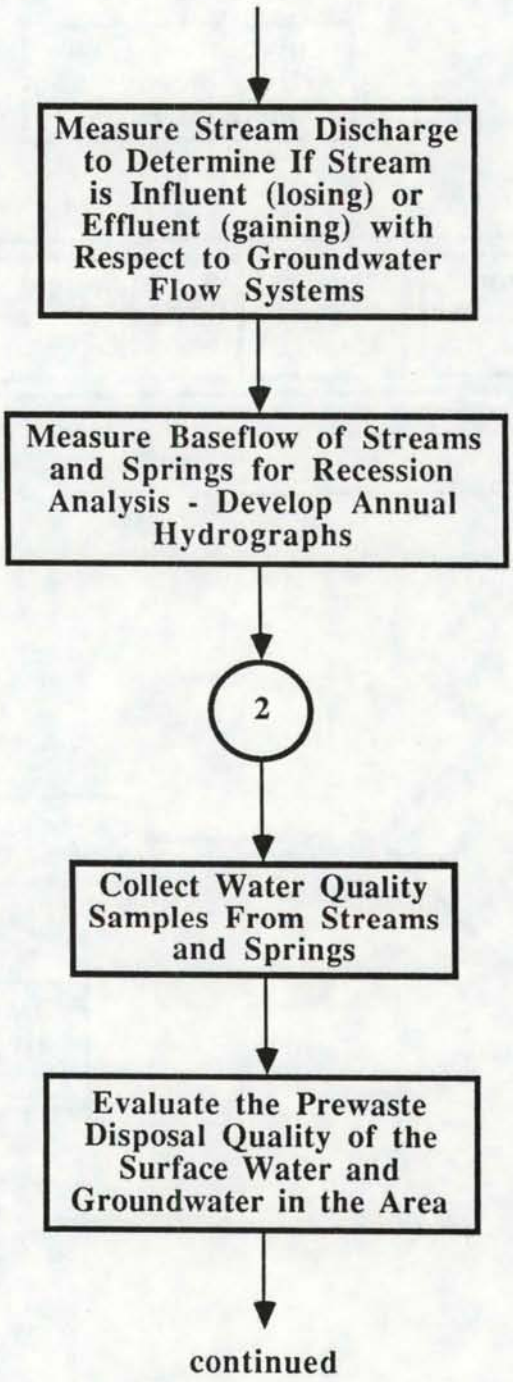

Review Literature and Records For the Site
Analyze Available Geophysical Logs
Analyze Available Well Logs
Does the Waste Disposal Site Overlie a Potential or Existing Groundwater Resource[1] ?
NO
YES
Limit the Scope of the Literature Review to Those Hydrogeologic Factors That Are Related Directly to the Immediate Disposal Site (e.g. Geologic Structures)
Review Literature of Regional Hydrogeology
Determine the General Hydrostratigraphic Relationships Between the Groundwater Resource and the Disposal Area(s)
continued


1
DETAILED SURFACE HYDROGEOLOGIC INVESTIGATION
Has a Detailed Surface Hydrogeologic Investigation Been Conducted ?
YES
Check for Completeness
NO
Place Bounds on the Area of Investigation
continued
Is It Complete ?
YES
Go To 3
NO
Collect Missing Data

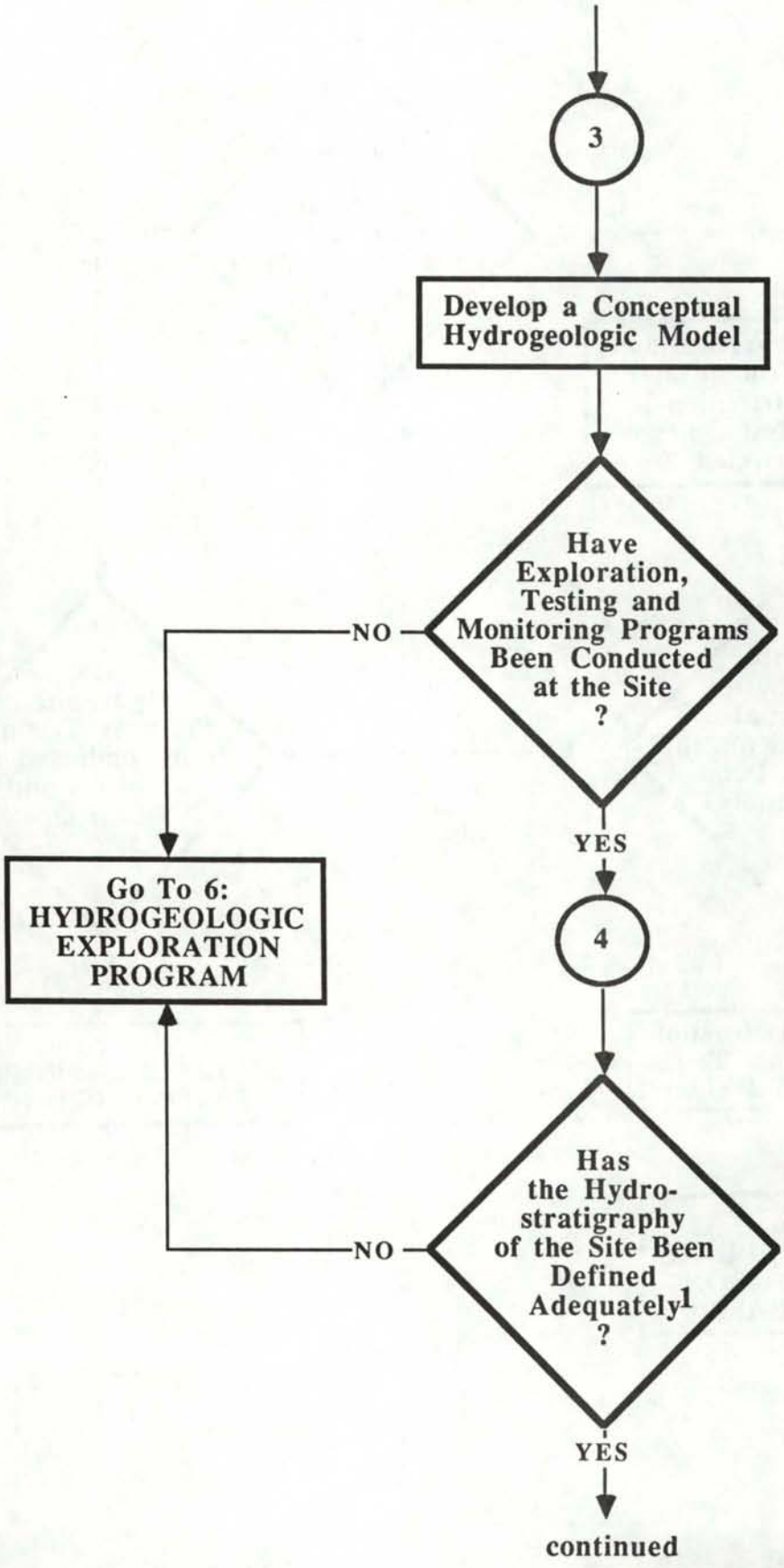

Locate Hydrogeologic Boundaries
Locate Areas of Known or Suspected Groundwater Contamination
Construct a Detailed Hydrogeologic Map of the Area of Investigation
Map Hydro-Stratigraphic Units
Map Geologic Structures
Map Groundwater Discharge Areas
Map Potential Groundwater Recharge Areas
Map the Locations of Nearby Wells

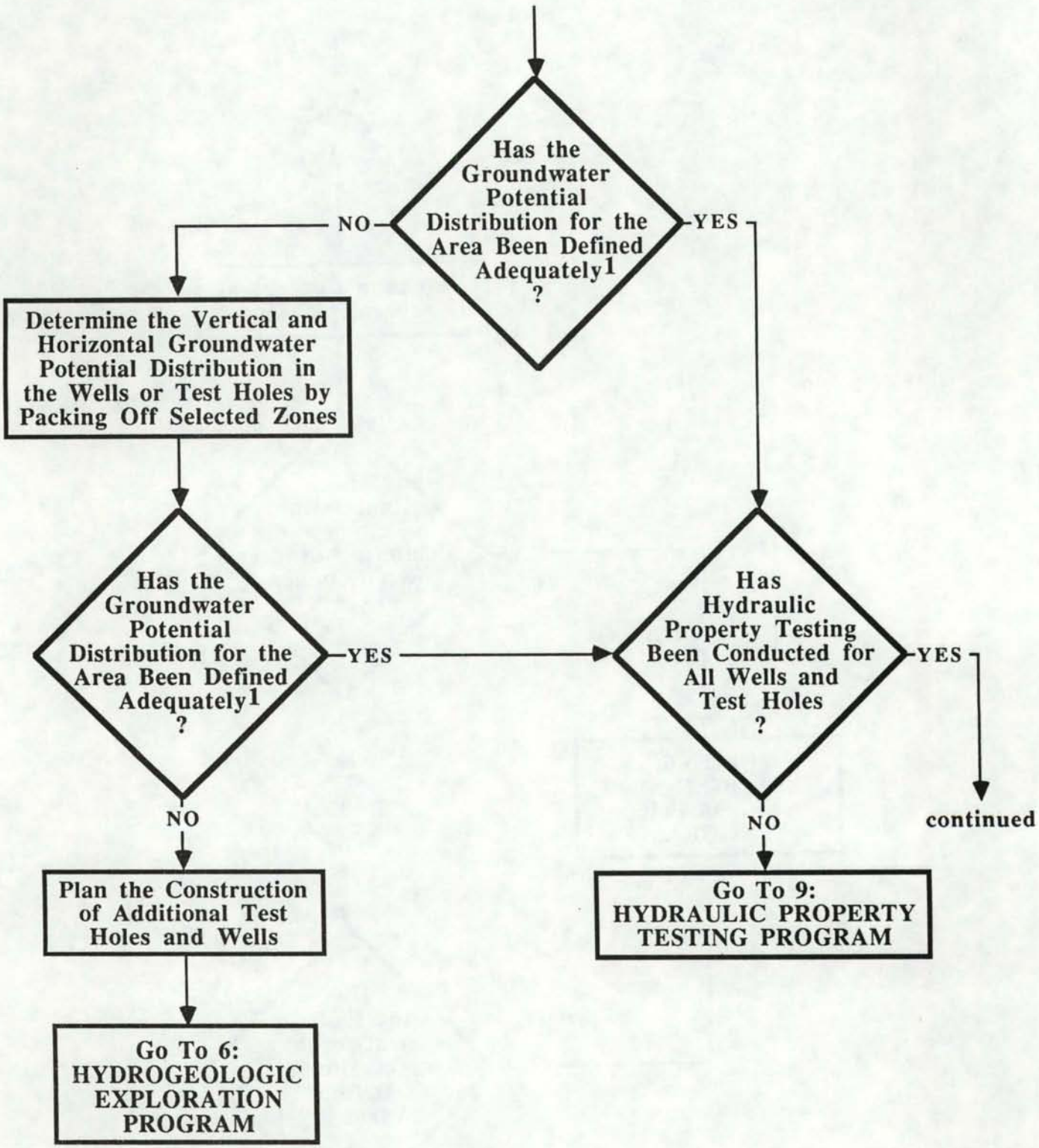
continued

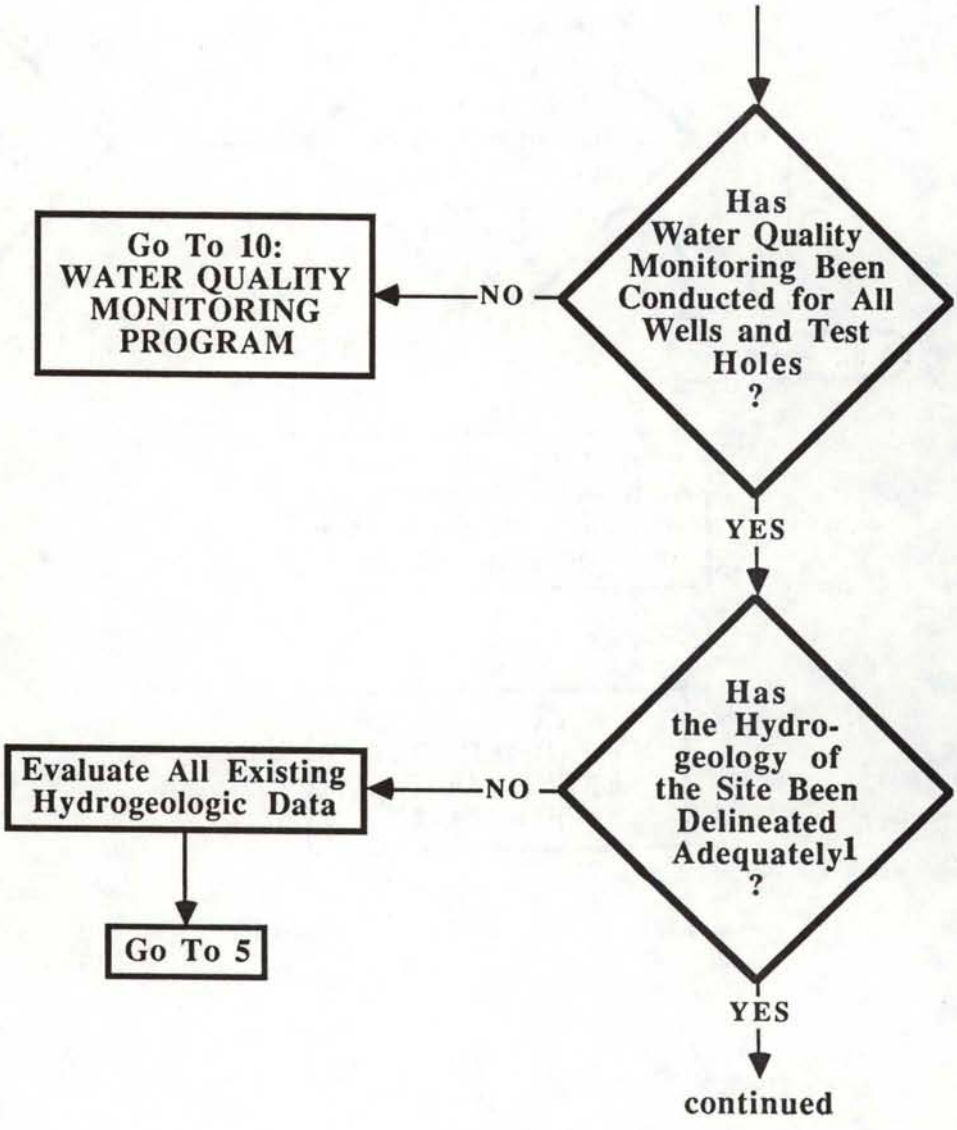

Inventory Nearby Active, Inactive and Abondoned Wells
Obtain Pumping Records or Power Usage Records
Measure Water Levels
Obtain and Review Driller's Logs
Collect Water Quality Samples From Wells
Are Flow Records of Nearby Springs Available ?
YES
Inventory Flow Records of Streams and Springs
Develop Annual Hydrographs for Recession Analysis
Go To 2
NO
continued

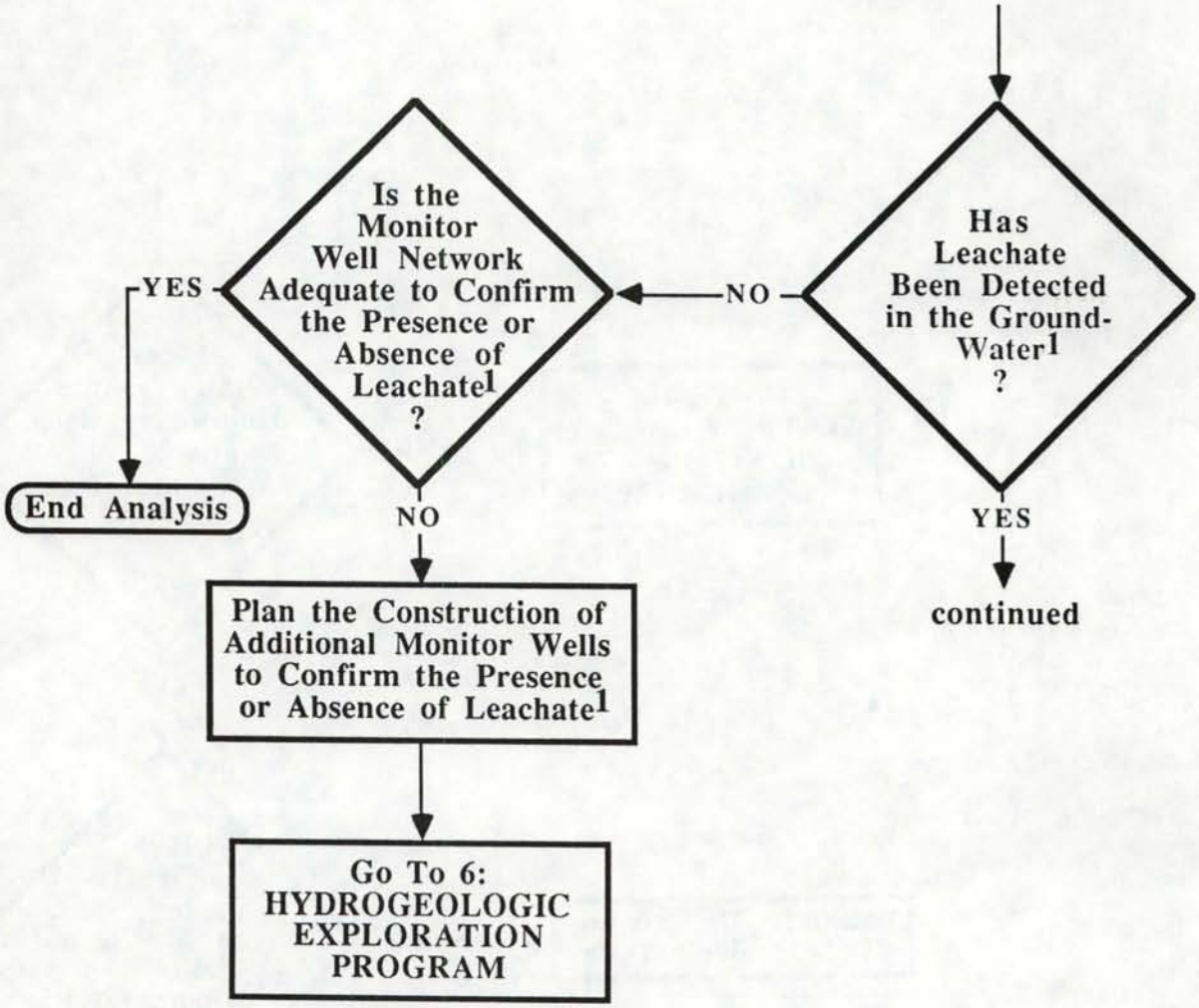

Measure Stream Discharge to Determine If Stream is Influent (losing) or Effluent (gaining) with Respect to Groundwater Flow Systems
Measure Baseflow of Streams and Springs for Recession Analysis - Develop Annual Hydrographs
2
Collect Water Quality Samples From Streams and Springs
Evaluate the Prewaste Disposal Quality of the Surface Water and Groundwater in the Area

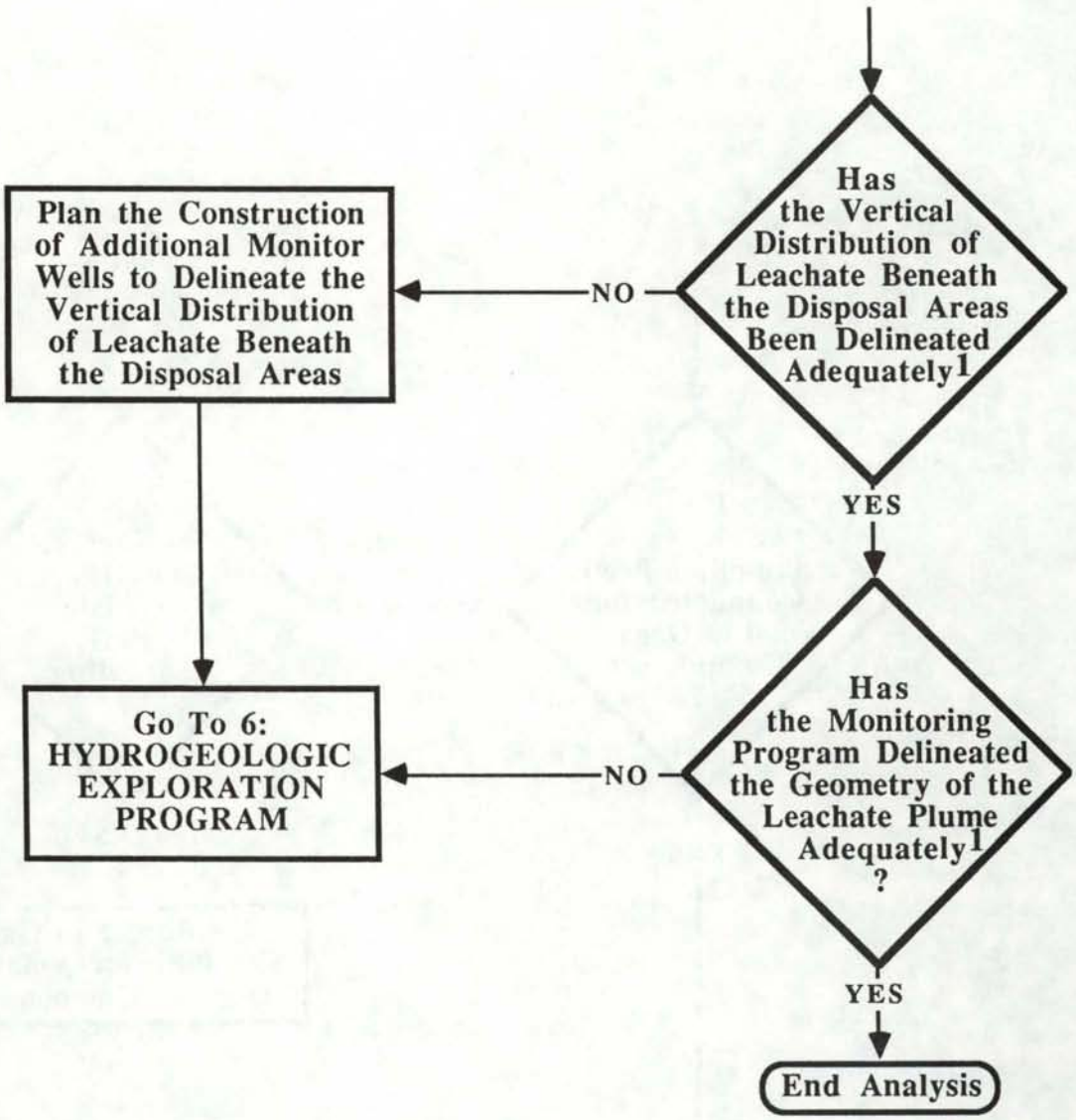
continued

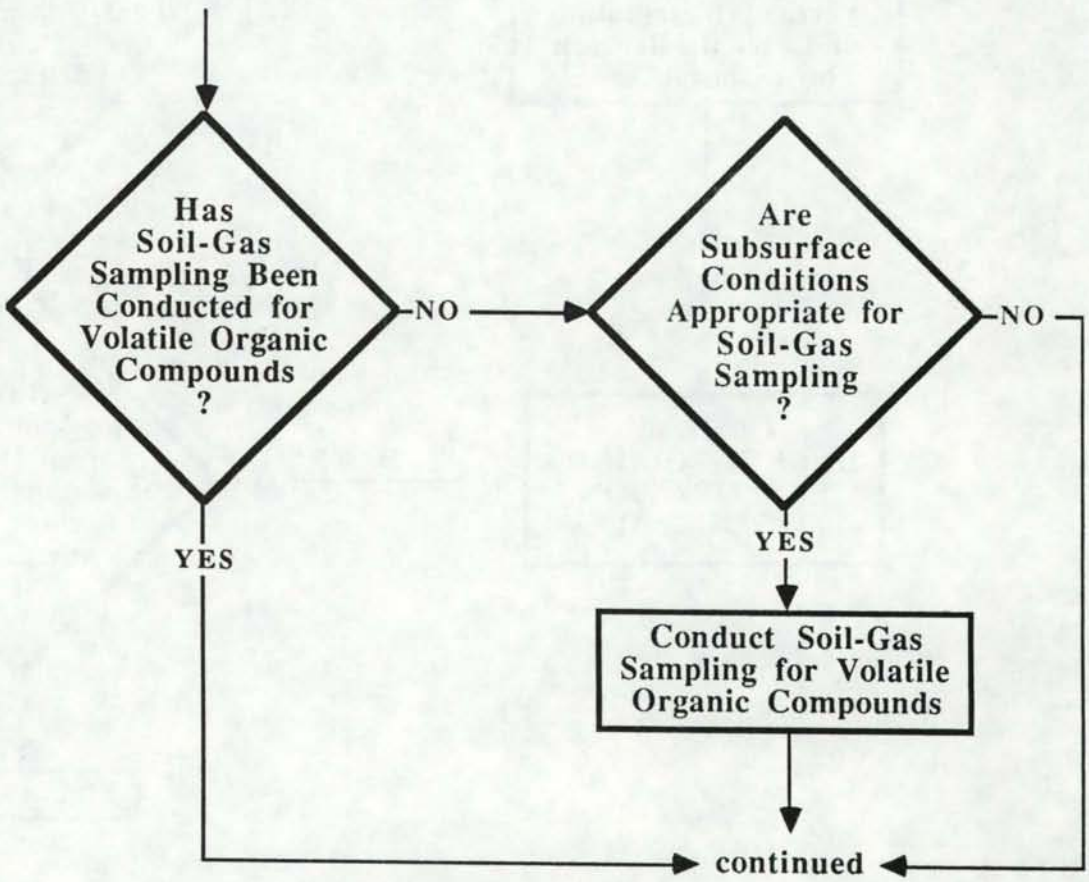

3
Develop a Conceptual Hydrogeologic Model
Have Exploration, Testing and Monitoring Programs Been Conducted at the Site ?
NO
YES
Go To 6: HYDROGEOLOGIC EXPLORATION PROGRAM
4
Has the Hydro-stratigraphy of the Site Been Defined Adequately[1] ?
NO
YES
continued

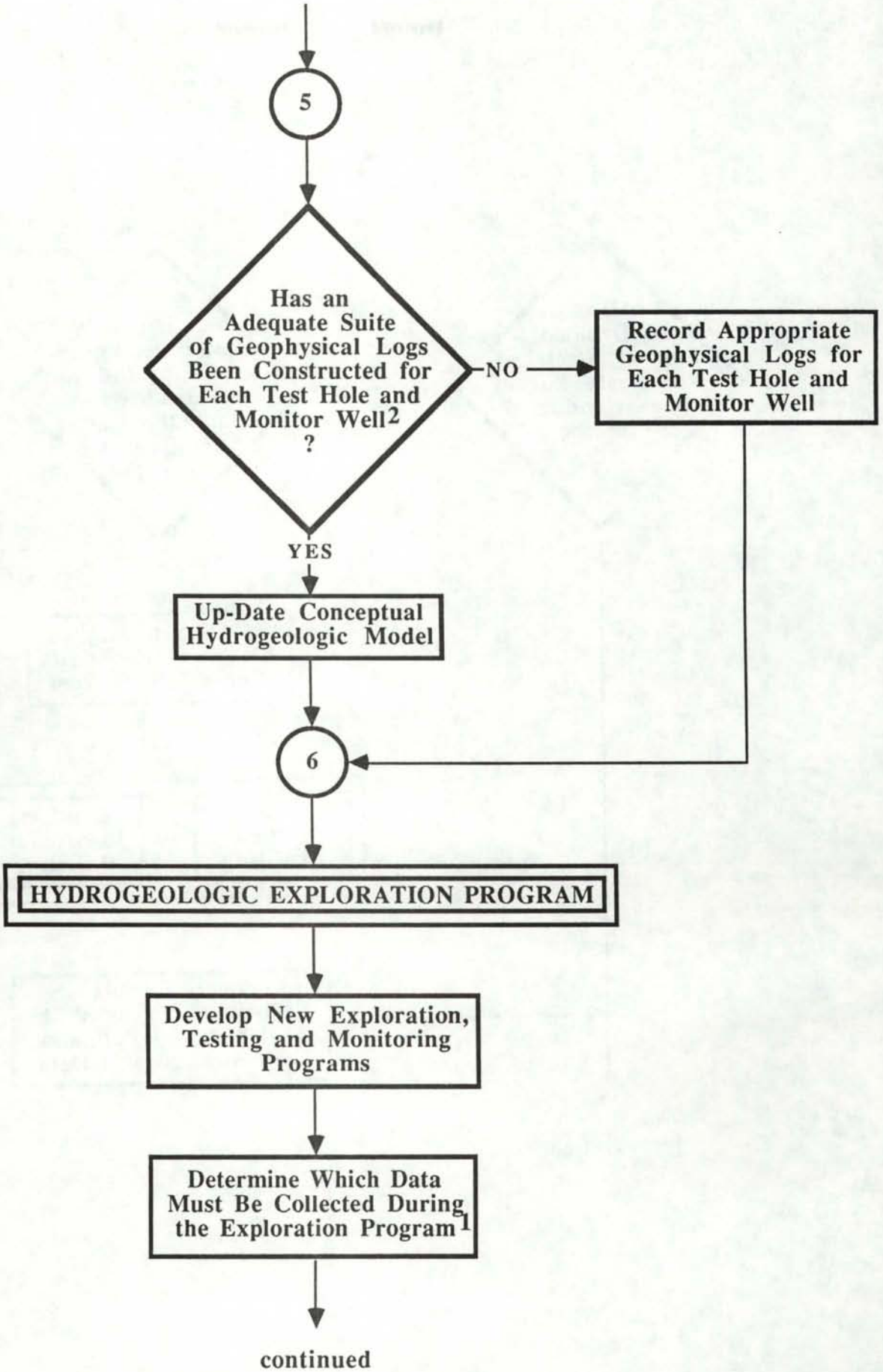

Has the Groundwater Potential Distribution for the Area Been Defined Adequately[1] ?
NO
YES
Determine the Vertical and Horizontal Groundwater Potential Distribution in the Wells or Test Holes by Packing Off Selected Zones
Has the Groundwater Potential Distribution for the Area Been Defined Adequately[1] ?
YES
NO
Plan the Construction of Additional Test Holes and Wells
Go To 6: HYDROGEOLOGIC EXPLORATION PROGRAM
Has Hydraulic Property Testing Been Conducted for All Wells and Test Holes ?
YES
NO
continued
Go To 9: HYDRAULIC PROPERTY TESTING PROGRAM


Has Water Quality Monitoring Been Conducted for All Wells and Test Holes ?
NO
Go To 10: WATER QUALITY MONITORING PROGRAM
YES
Has the Hydro-geology of the Site Been Delineated Adequately[1] ?
NO
Evaluate All Existing Hydrogeologic Data
Go To 5
YES
continued

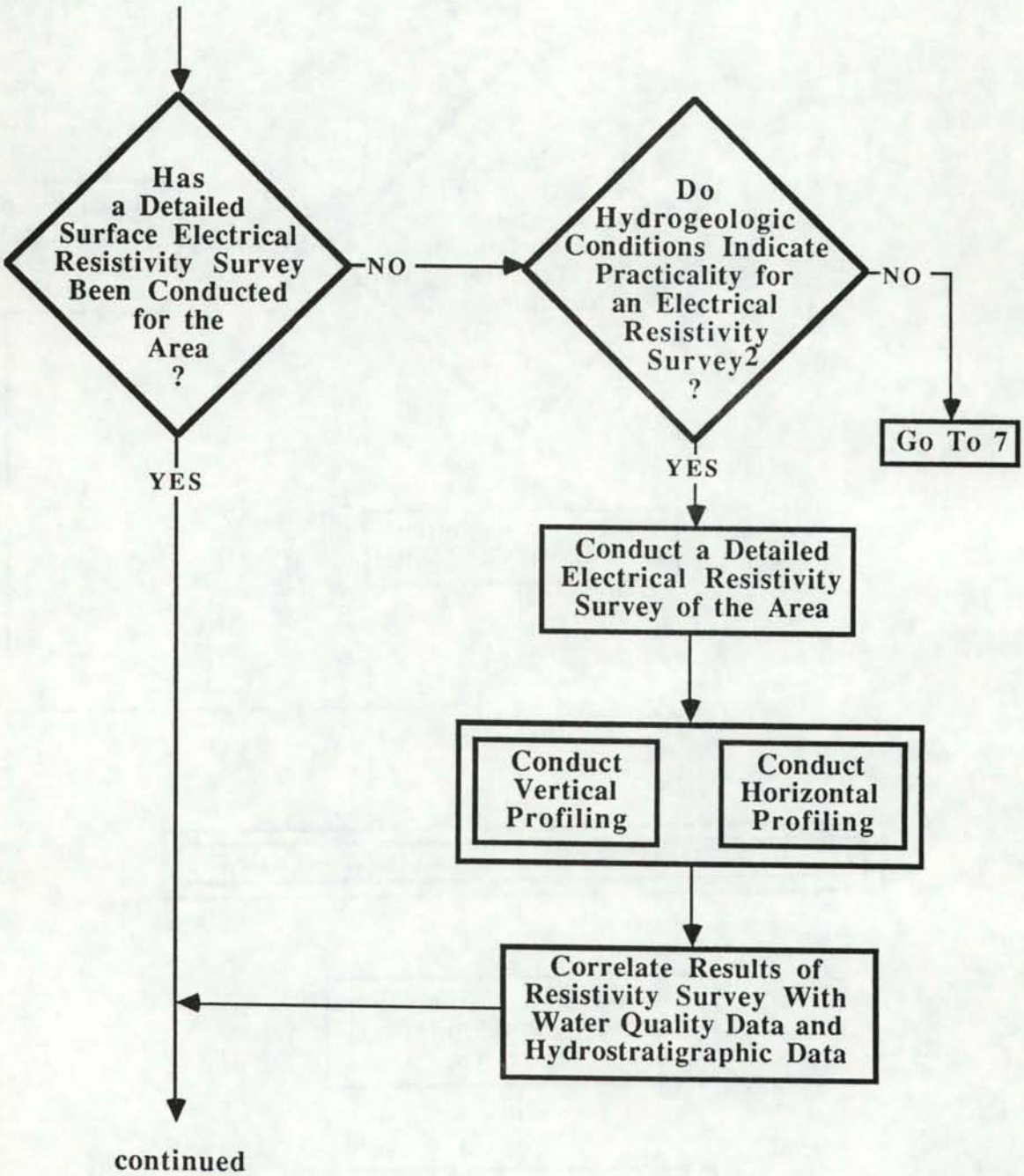

Has Leachate Been Detected in the Ground-Water[1] ?
NO
Is the Monitor Well Network Adequate to Confirm the Presence or Absence of Leachate[1] ?
YES
End Analysis
NO
Plan the Construction of Additional Monitor Wells to Confirm the Presence or Absence of Leachate[1]
Go To 6: HYDROGEOLOGIC EXPLORATION PROGRAM
YES
continued

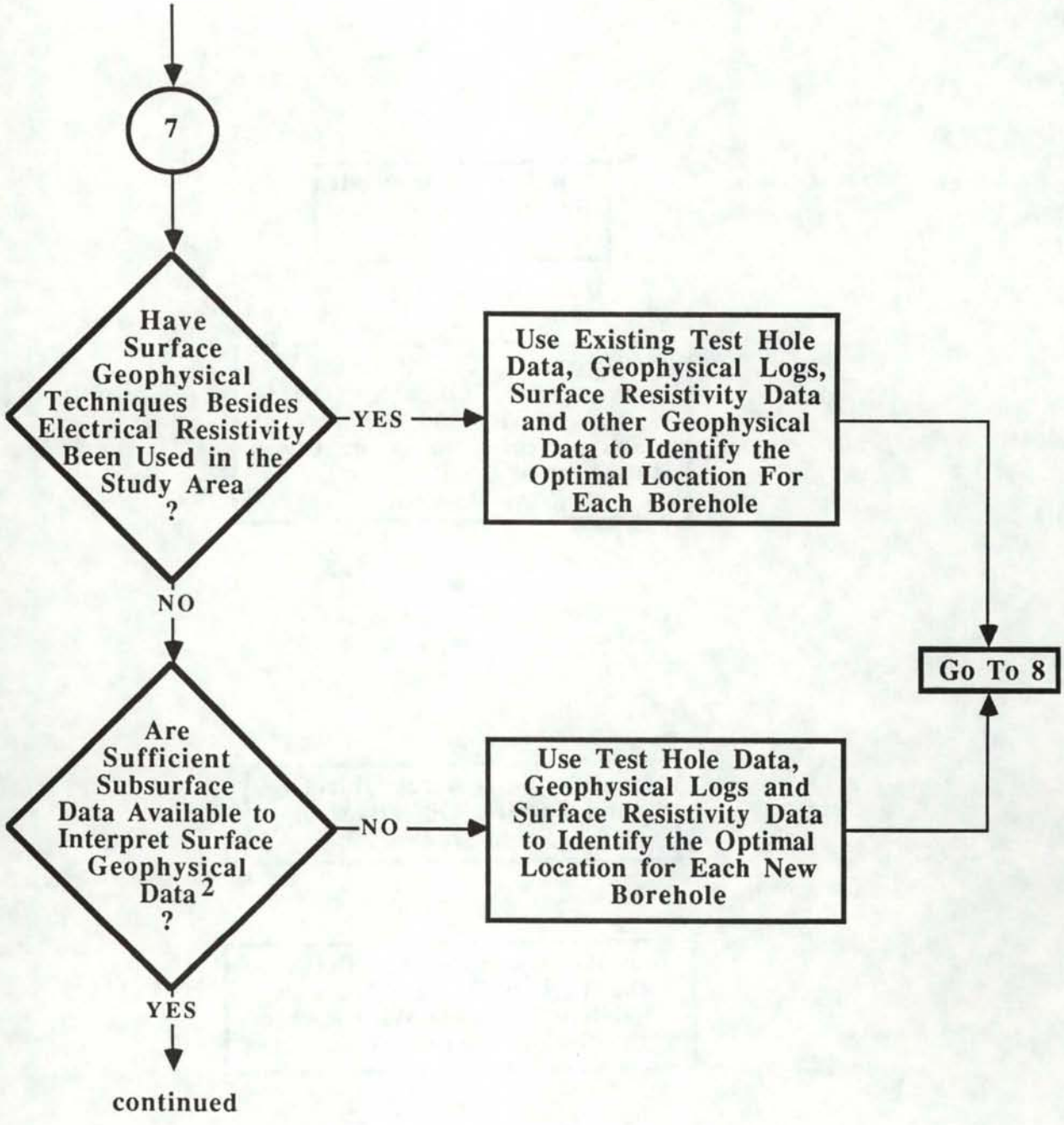

Has the Vertical Distribution of Leachate Beneath the Disposal Areas Been Delineated Adequately[1]
NO
Plan the Construction of Additional Monitor Wells to Delineate the Vertical Distribution of Leachate Beneath the Disposal Areas
YES
Has the Monitoring Program Delineated the Geometry of the Leachate Plume Adequately[1] ?
NO
Go To 6: HYDROGEOLOGIC EXPLORATION PROGRAM
YES
End Analysis

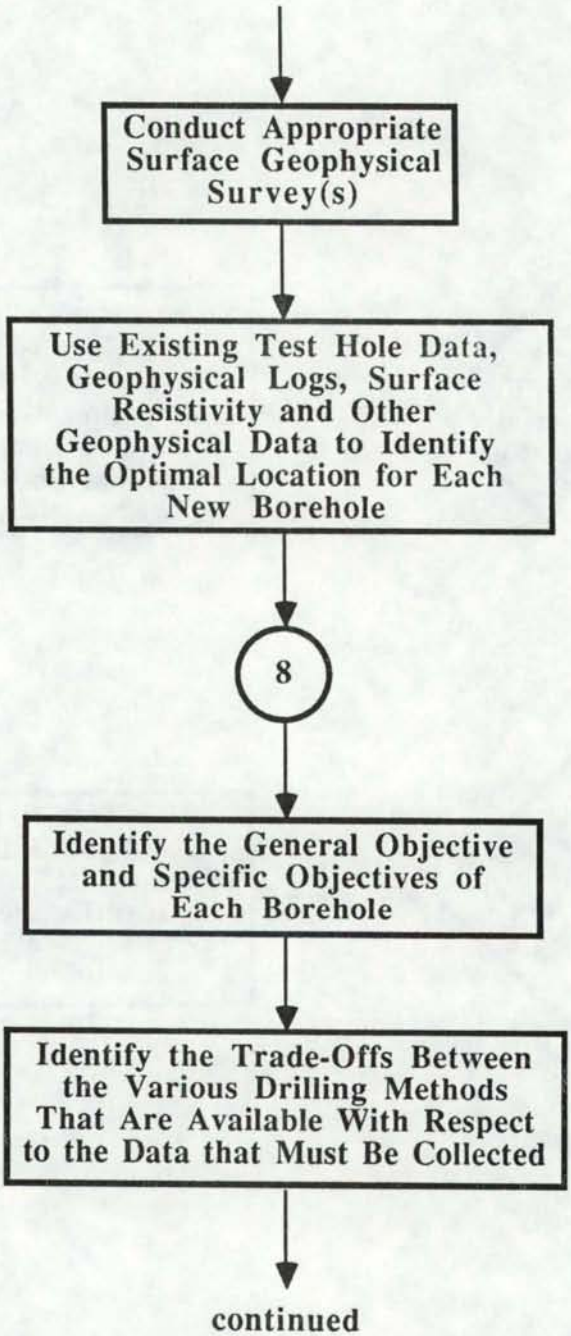

Has Soil-Gas Sampling Been Conducted for Volatile Organic Compounds ?
NO
Are Subsurface Conditions Appropriate for Soil-Gas Sampling ?
NO
YES
YES
Conduct Soil-Gas Sampling for Volatile Organic Compounds
continued

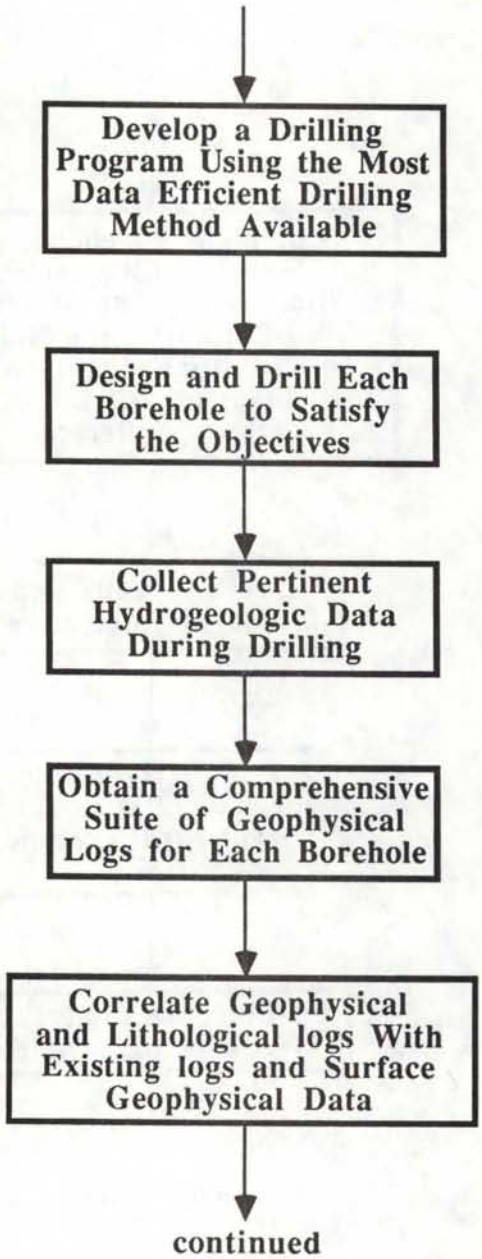

5
Has an Adequate Suite of Geophysical Logs Been Constructed for Each Test Hole and Monitor Well[2] ?
NO
Record Appropriate Geophysical Logs for Each Test Hole and Monitor Well
YES
Up-Date Conceptual Hydrogeologic Model
6
HYDROGEOLOGIC EXPLORATION PROGRAM
Develop New Exploration, Testing and Monitoring Programs
Determine Which Data Must Be Collected During the Exploration Program[1]

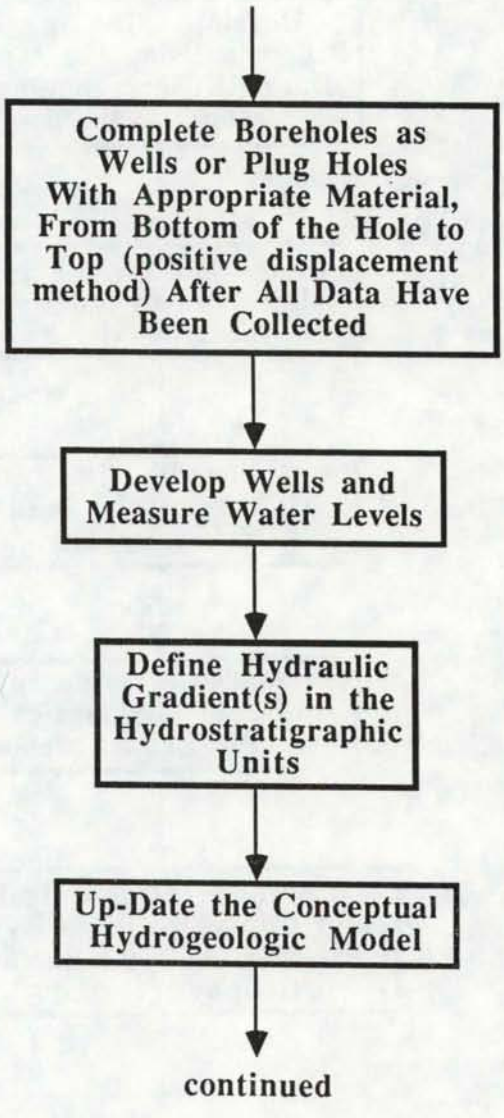
continued

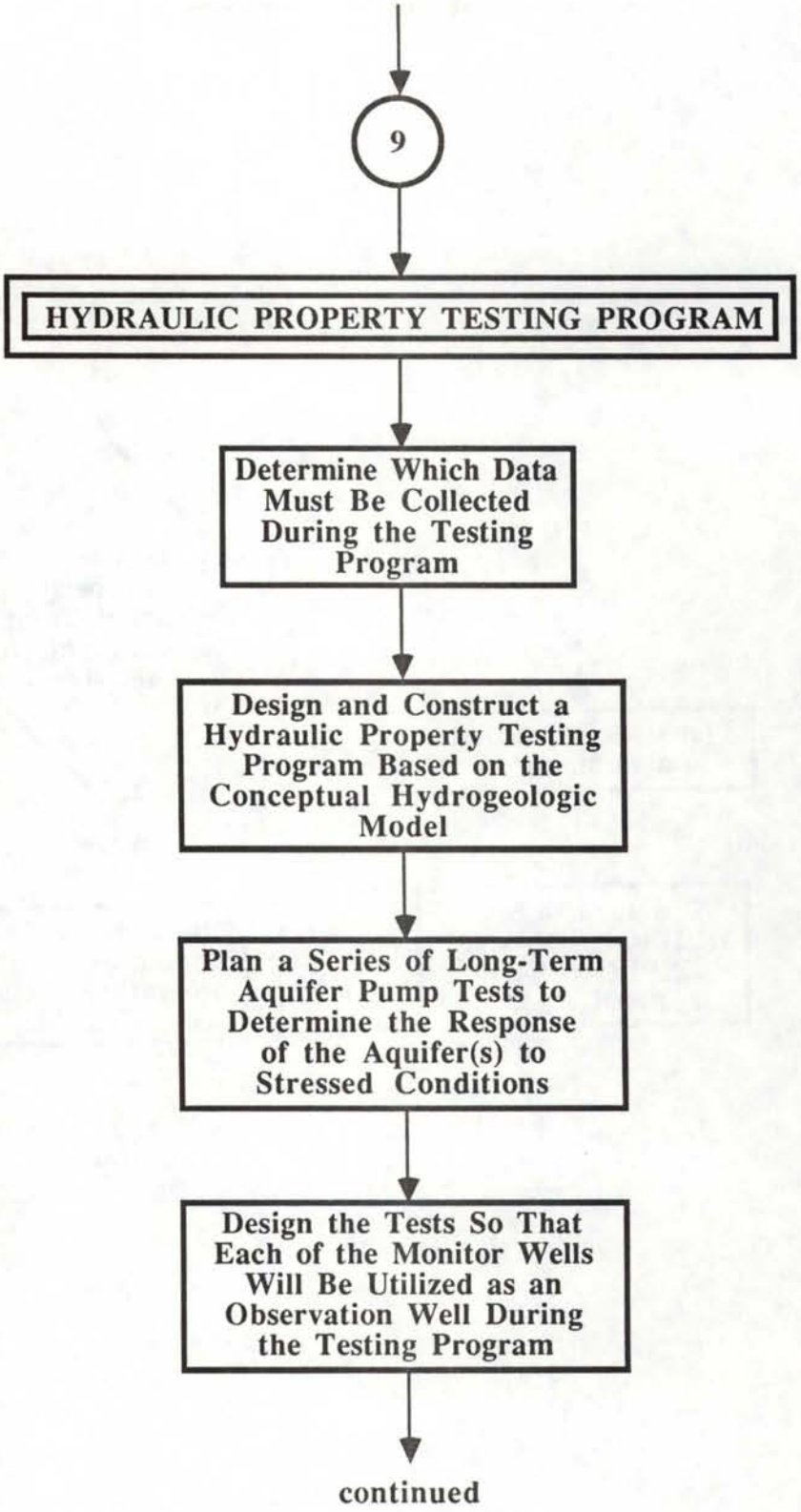

Has a Detailed Surface Electrical Resistivity Survey Been Conducted for the Area ?
NO
Do Hydrogeologic Conditions Indicate Practicality for an Electrical Resistivity Survey2 ?
NO
Go To 7
YES
YES
Conduct a Detailed Electrical Resistivity Survey of the Area
Conduct Vertical Profiling
Conduct Horizontal Profiling
Correlate Results of Resistivity Survey With Water Quality Data and Hydrostratigraphic Data
continued

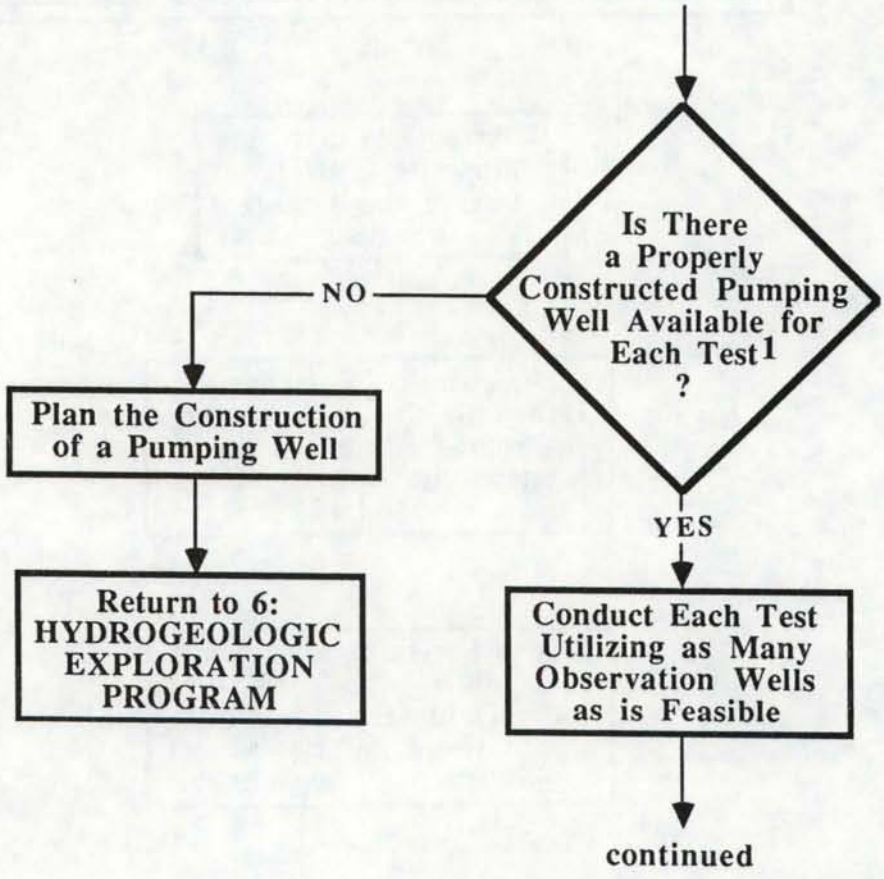

7
Have Surface Geophysical Techniques Besides Electrical Resistivity Been Used in the Study Area ?
YES
Use Existing Test Hole Data, Geophysical Logs, Surface Resistivity Data and other Geophysical Data to Identify the Optimal Location For Each Borehole
NO
Go To 8
Are Sufficient Subsurface Data Available to Interpret Surface Geophysical Data[2] ?
NO
Use Test Hole Data, Geophysical Logs and Surface Resistivity Data to Identify the Optimal Location for Each New Borehole
YES
continued

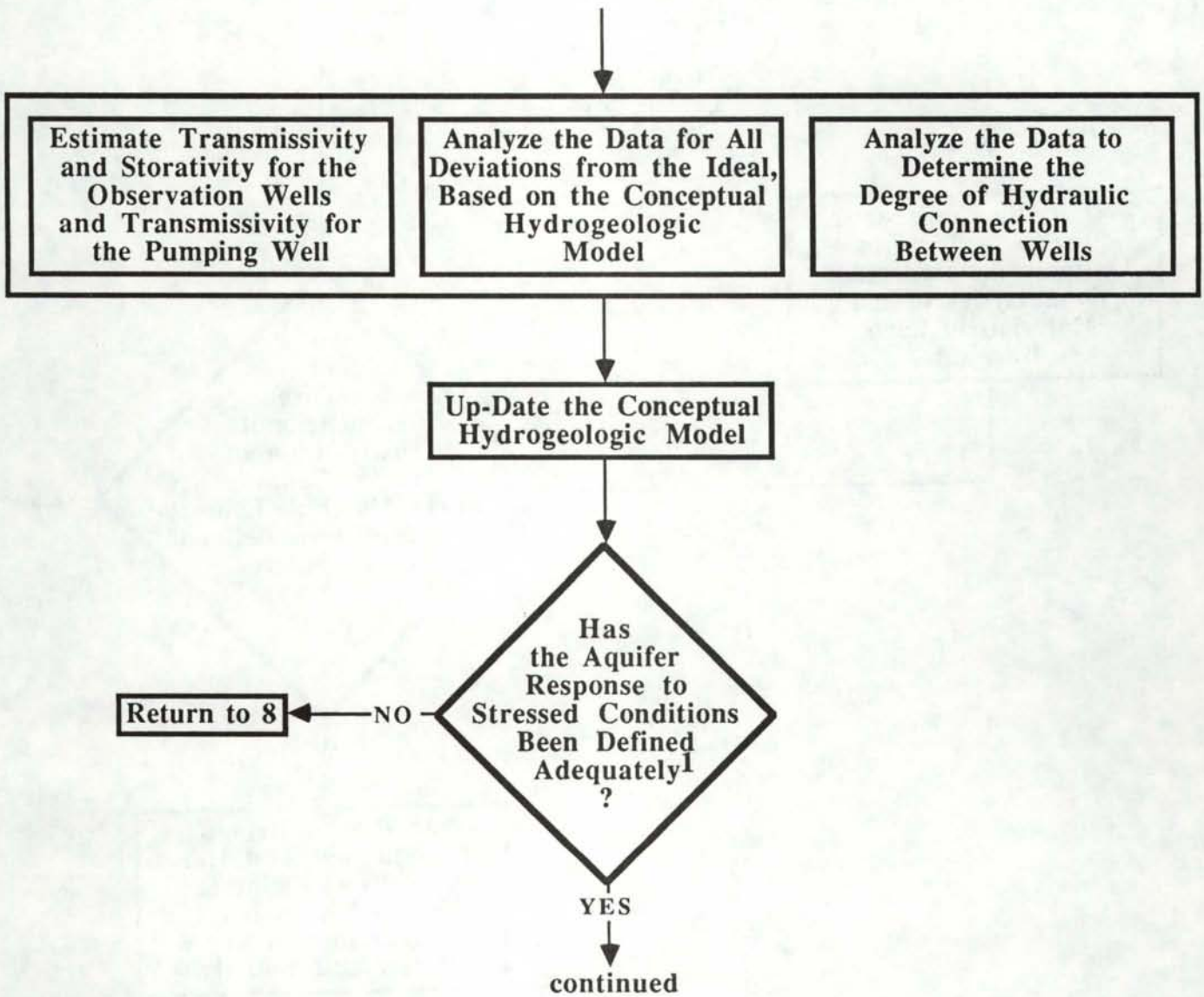

Conduct Appropriate Surface Geophysical Survey(s)
Use Existing Test Hole Data, Geophysical Logs, Surface Resistivity and Other Geophysical Data to Identify the Optimal Location for Each New Borehole
8
Identify the General Objective and Specific Objectives of Each Borehole
Identify the Trade-Offs Between the Various Drilling Methods That Are Available With Respect to the Data that Must Be Collected
continued

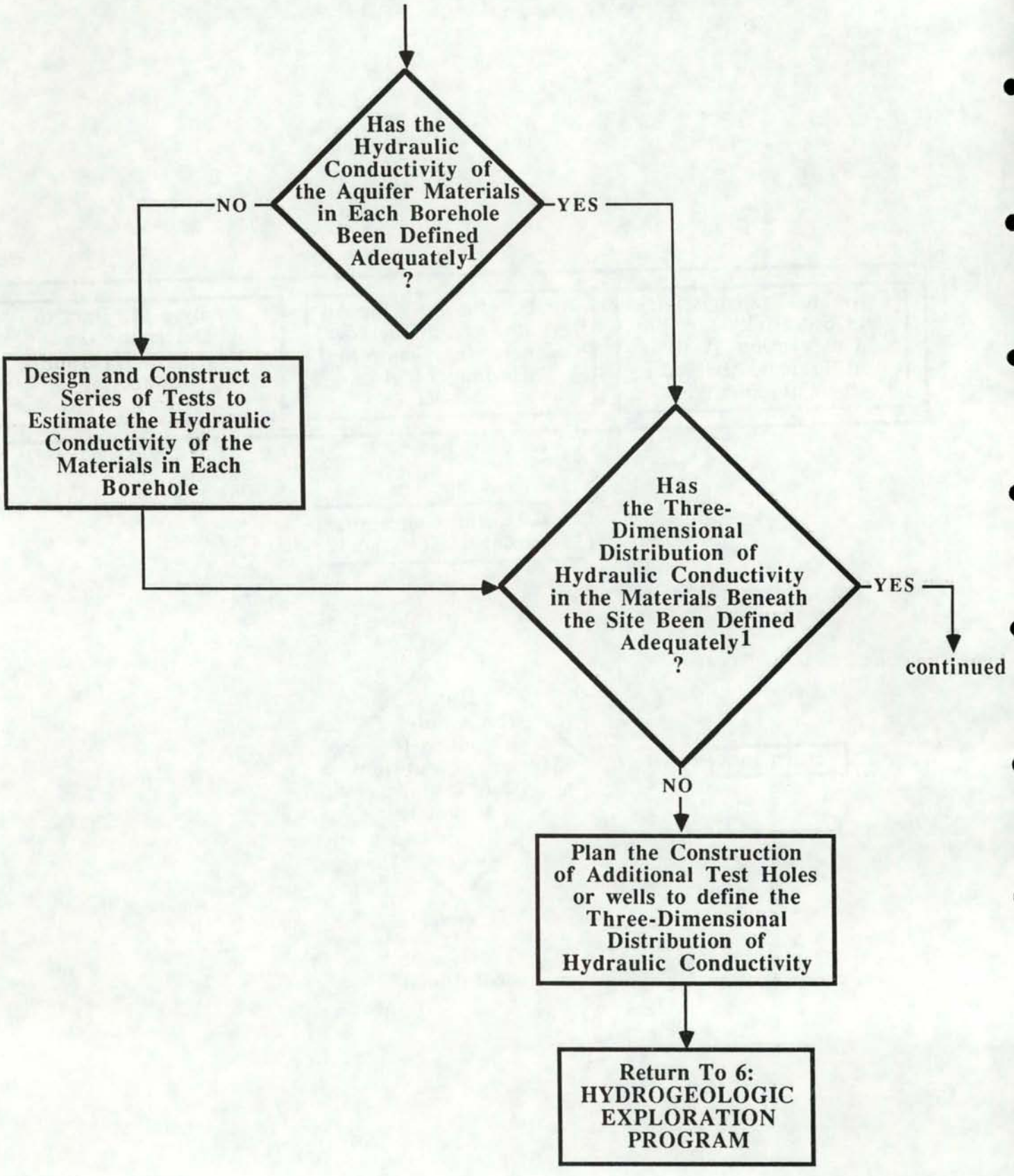

Develop a Drilling Program Using the Most Data Efficient Drilling Method Available
Design and Drill Each Borehole to Satisfy the Objectives
Collect Pertinent Hydrogeologic Data During Drilling
Obtain a Comprehensive Suite of Geophysical Logs for Each Borehole
Correlate Geophysical and Lithological logs With Existing logs and Surface Geophysical Data
continued

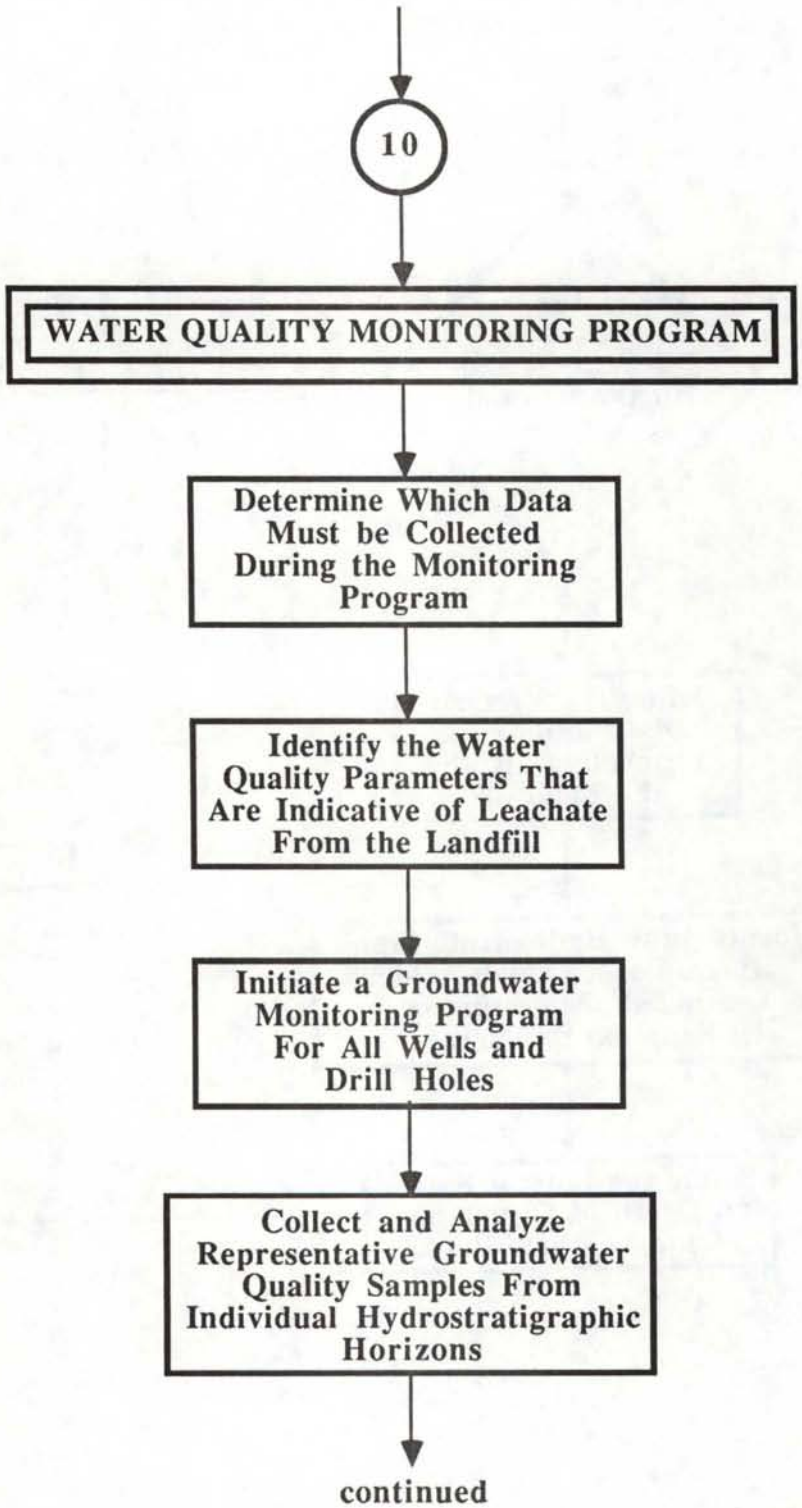

Complete Boreholes as Wells or Plug Holes With Appropriate Material, From Bottom of the Hole to Top (positive displacement method) After All Data Have Been Collected
Develop Wells and Measure Water Levels
Define Hydraulic Gradient(s) in the Hydrostratigraphic Units
Up-Date the Conceptual Hydrogeologic Model
continued

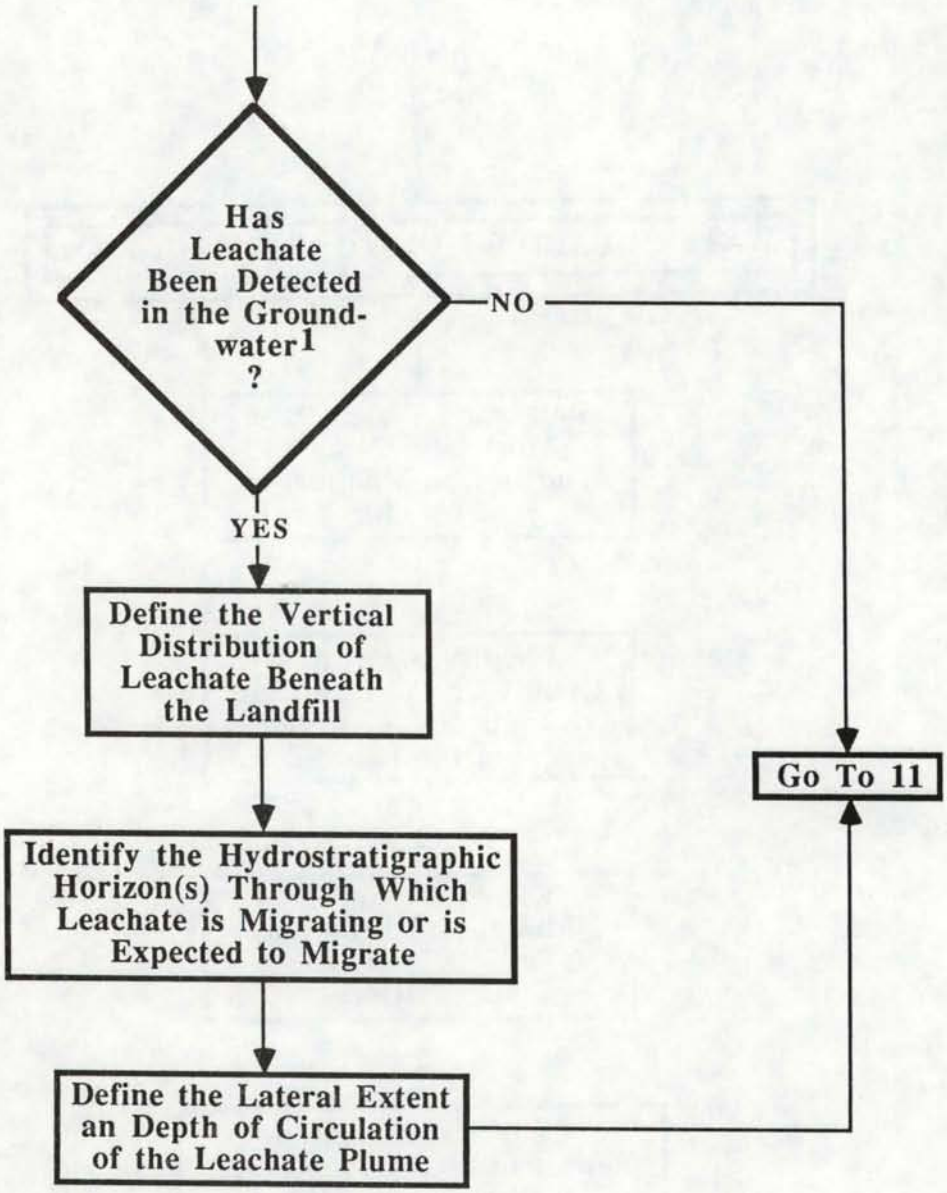

9
HYDRAULIC PROPERTY TESTING PROGRAM
Determine Which Data Must Be Collected During the Testing Program
Design and Construct a Hydraulic Property Testing Program Based on the Conceptual Hydrogeologic Model
Plan a Series of Long-Term Aquifer Pump Tests to Determine the Response of the Aquifer(s) to Stressed Conditions
Design the Tests So That Each of the Monitor Wells Will Be Utilized as an Observation Well During the Testing Program
continued

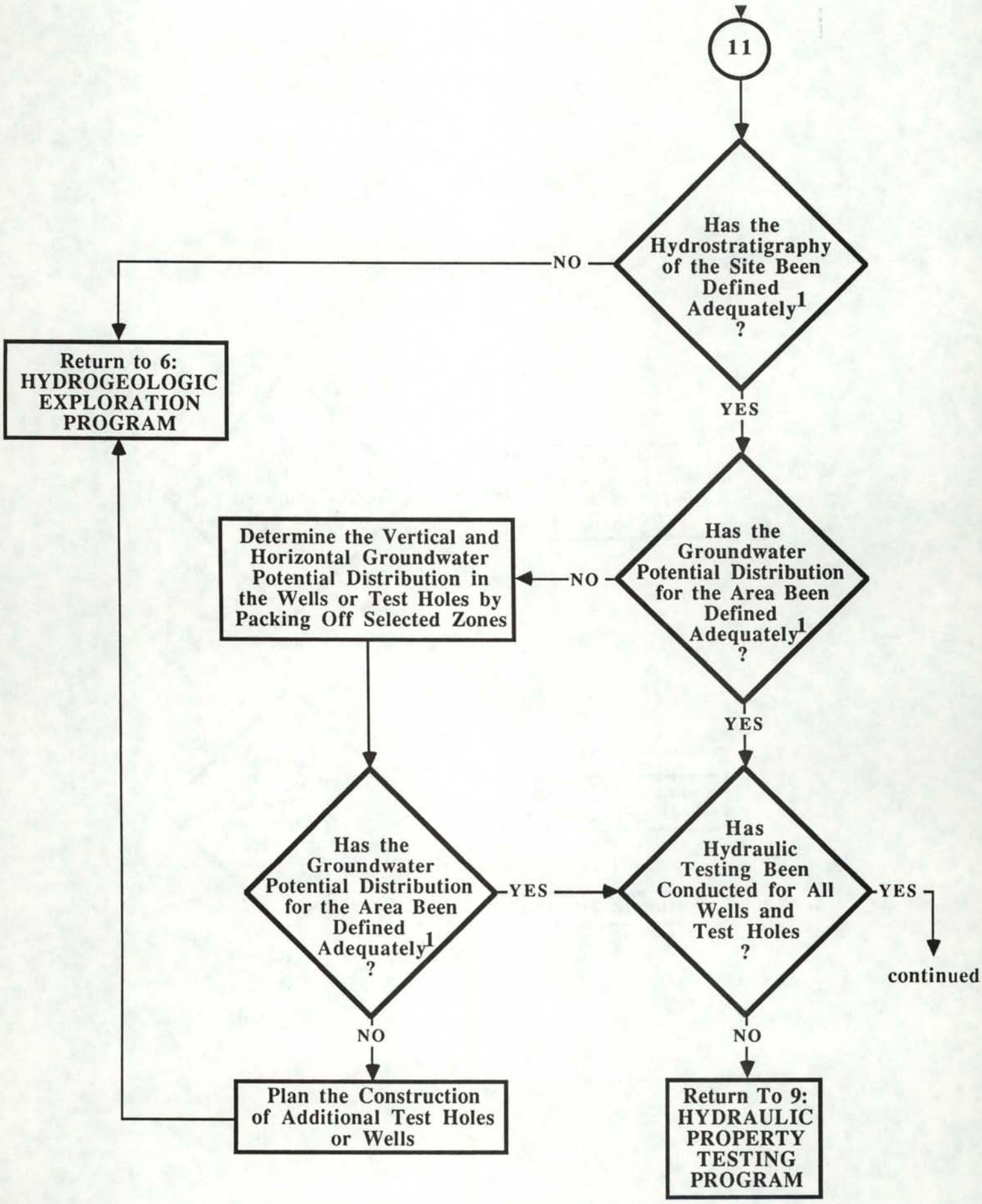

Is There a Properly Constructed Pumping Well Available for Each Test[1] ?
NO
YES
Plan the Construction of a Pumping Well
Return to 6: HYDROGEOLOGIC EXPLORATION PROGRAM
Conduct Each Test Utilizing as Many Observation Wells as is Feasible
continued

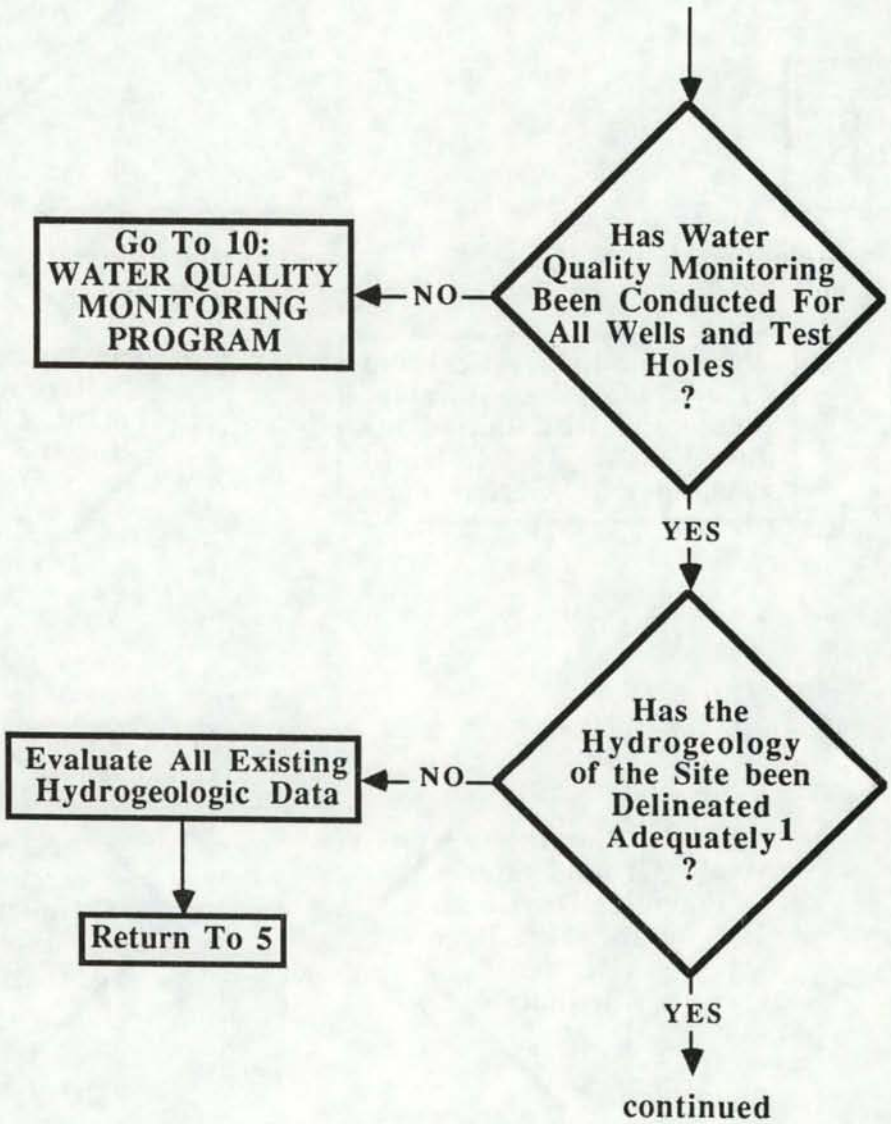

Estimate Transmissivity and Storativity for the Observation Wells and Transmissivity for the Pumping Well
Analyze the Data for All Deviations from the Ideal, Based on the Conceptual Hydrogeologic Model
Analyze the Data to Determine the Degree of Hydraulic Connection Between Wells
Up-Date the Conceptual Hydrogeologic Model
Has the Aquifer Response to Stressed Conditions Been Defined Adequately[1] ?
NO
Return to 8
YES
continued

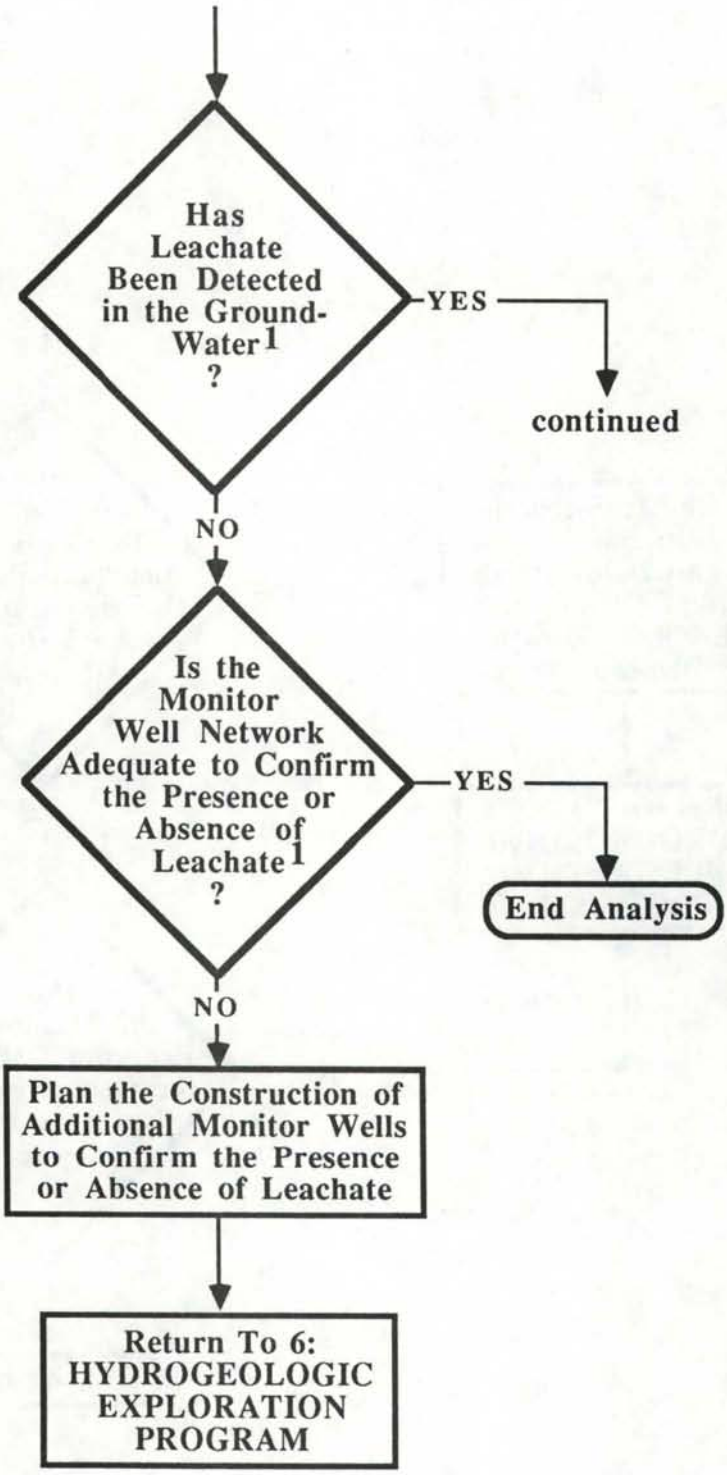

Has the Hydraulic Conductivity of the Aquifer Materials in Each Borehole Been Defined Adequately[1] ?
NO
YES
Design and Construct a Series of Tests to Estimate the Hydraulic Conductivity of the Materials in Each Borehole
Has the Three-Dimensional Distribution of Hydraulic Conductivity in the Materials Beneath the Site Been Defined Adequately[1] ?
YES
continued
NO
Plan the Construction of Additional Test Holes or wells to define the Three-Dimensional Distribution of Hydraulic Conductivity
Return To 6: HYDROGEOLOGIC EXPLORATION PROGRAM

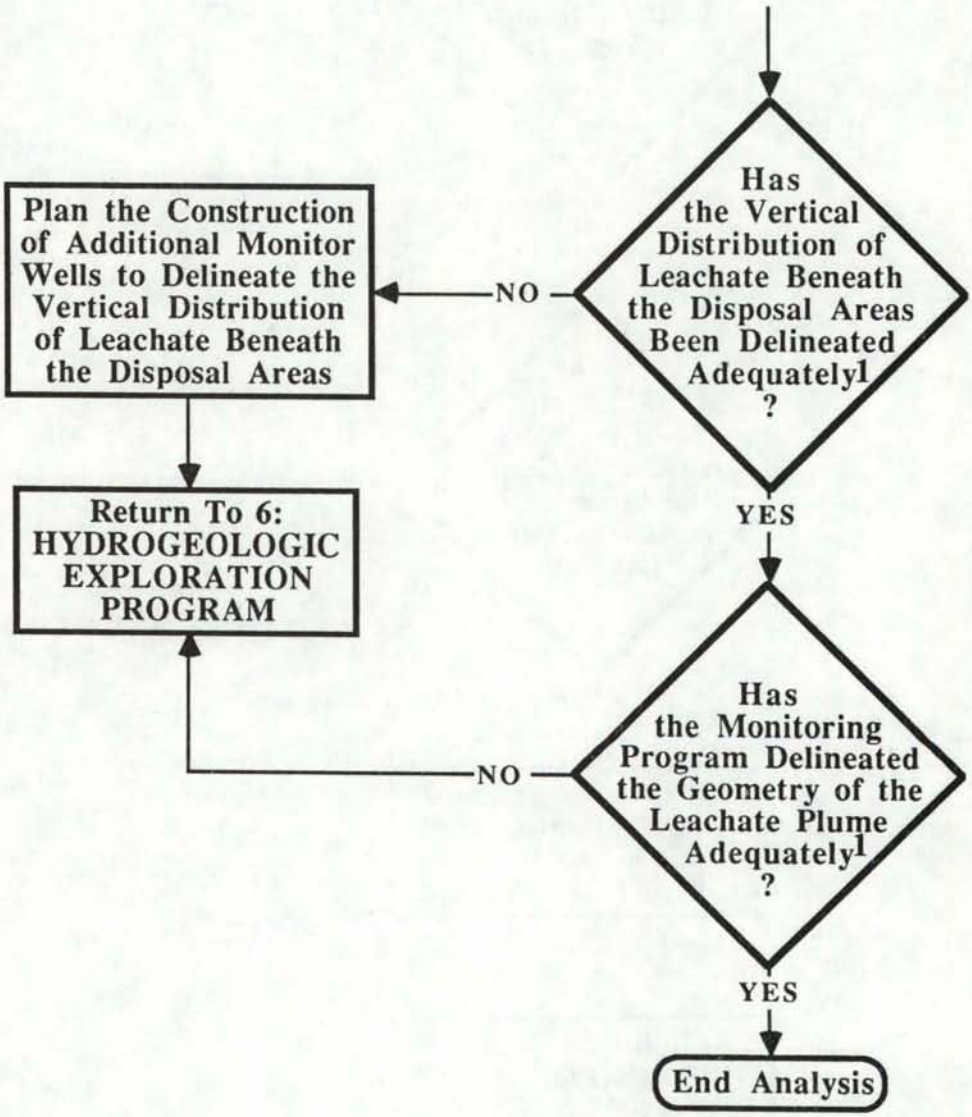

10
WATER QUALITY MONITORING PROGRAM
Determine Which Data Must be Collected During the Monitoring Program
Identify the Water Quality Parameters That Are Indicative of Leachate From the Landfill
Initiate a Groundwater Monitoring Program For All Wells and Drill Holes
Collect and Analyze Representative Groundwater Quality Samples From Individual Hydrostratigraphic Horizons
continued

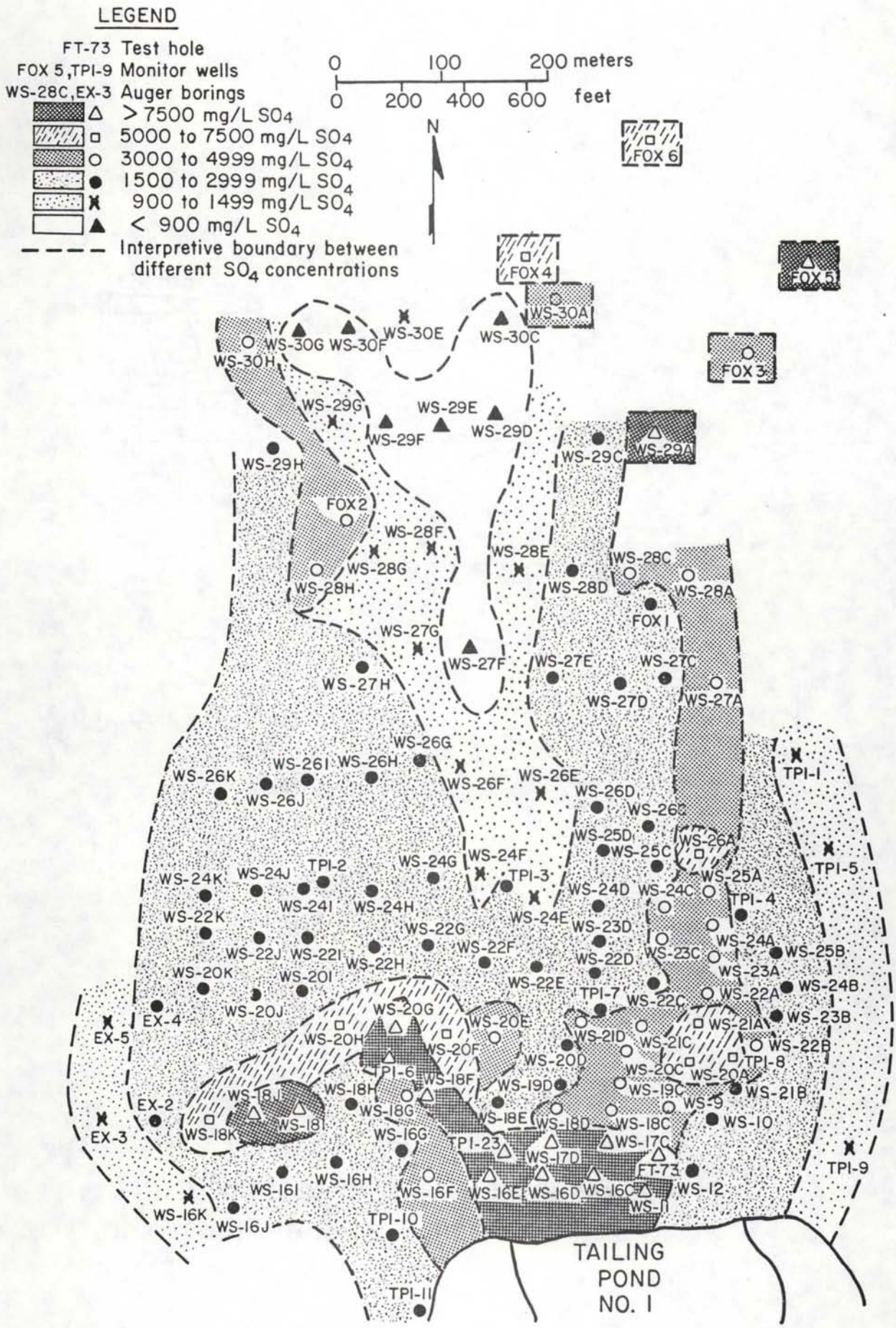

Has Leachate Been Detected in the Ground-water[1] ?
NO
YES
Define the Vertical Distribution of Leachate Beneath the Landfill
Identify the Hydrostratigraphic Horizon(s) Through Which Leachate is Migrating or is Expected to Migrate
Define the Lateral Extent an Depth of Circulation of the Leachate Plume
Go To 11


11
Has the Hydrostratigraphy of the Site Been Defined Adequately[1] ?
NO
YES
Return to 6: HYDROGEOLOGIC EXPLORATION PROGRAM
Has the Groundwater Potential Distribution for the Area Been Defined Adequately[1] ?
NO
YES
Determine the Vertical and Horizontal Groundwater Potential Distribution in the Wells or Test Holes by Packing Off Selected Zones
Has the Groundwater Potential Distribution for the Area Been Defined Adequately[1] ?
YES
NO
Has Hydraulic Testing Been Conducted for All Wells and Test Holes ?
YES
continued
NO
Plan the Construction of Additional Test Holes or Wells
Return To 9: HYDRAULIC PROPERTY TESTING PROGRAM

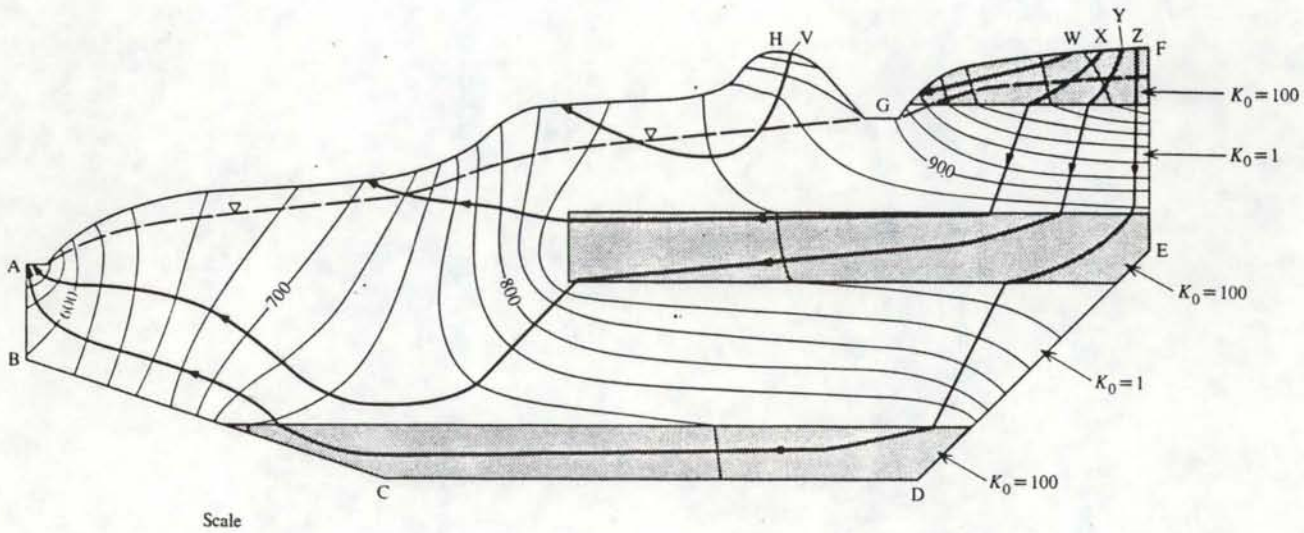

Has Water Quality Monitoring Been Conducted For All Wells and Test Holes ?
NO
Go To 10: WATER QUALITY MONITORING PROGRAM
YES
Has the Hydrogeology of the Site been Delineated Adequately[1] ?
NO
Evaluate All Existing Hydrogeologic Data
Return To 5
YES
continued


Has Leachate Been Detected in the Ground-Water[1] ?
YES
continued
NO
Is the Monitor Well Network Adequate to Confirm the Presence or Absence of Leachate[1] ?
YES
End Analysis
NO
Plan the Construction of Additional Monitor Wells to Confirm the Presence or Absence of Leachate
Return To 6: HYDROGEOLOGIC EXPLORATION PROGRAM

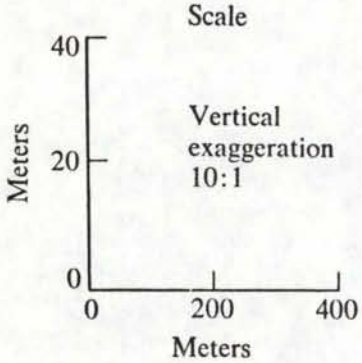

Has the Vertical Distribution of Leachate Beneath the Disposal Areas Been Delineated Adequately[1] ?
NO
Plan the Construction of Additional Monitor Wells to Delineate the Vertical Distribution of Leachate Beneath the Disposal Areas
YES
Has the Monitoring Program Delineated the Geometry of the Leachate Plume Adequately[1] ?
NO
Return To 6: HYDROGEOLOGIC EXPLORATION PROGRAM
YES
End Analysis



Interpretive representation of the seepage plume in plan view at the Federal American Partners mill site, Fremont County, Wyoming



Scale



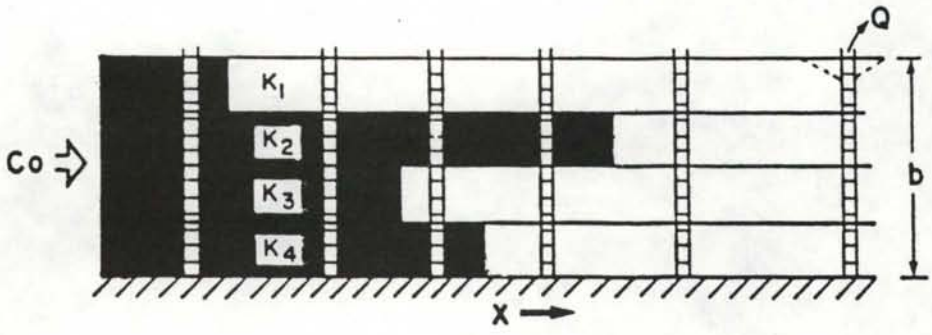
Equipotential line (ϕ in cm H_2O)

Flow direction

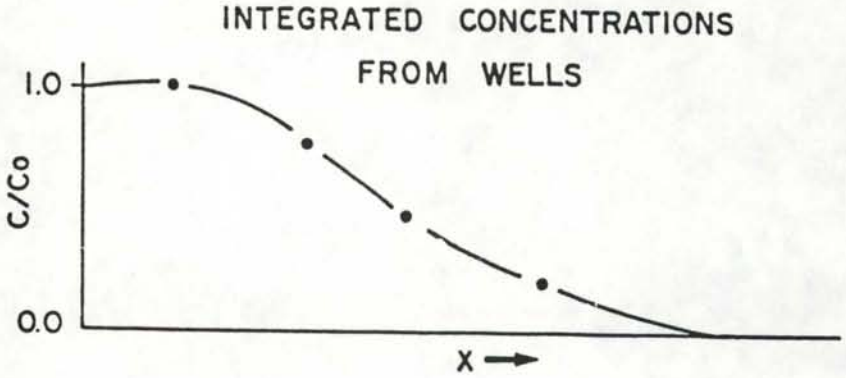
Water table

$K_{xx}/K_{zz} = 100$ in all formations

Steady state regional flow in a vertical cross section through a groundwater basin



Macroscopic concentration distribution



Corresponding megascopic concentration distribution

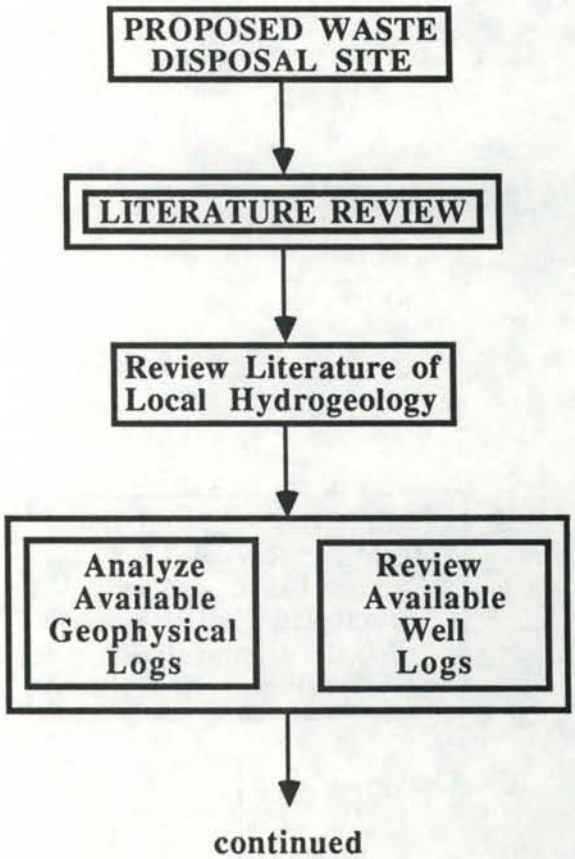
Continuous injection of contaminants into horizontally stratified aquifer

HYDROGEOLOGIC CHARACTERISTICS

OF

PROPOSED WASTE SITES

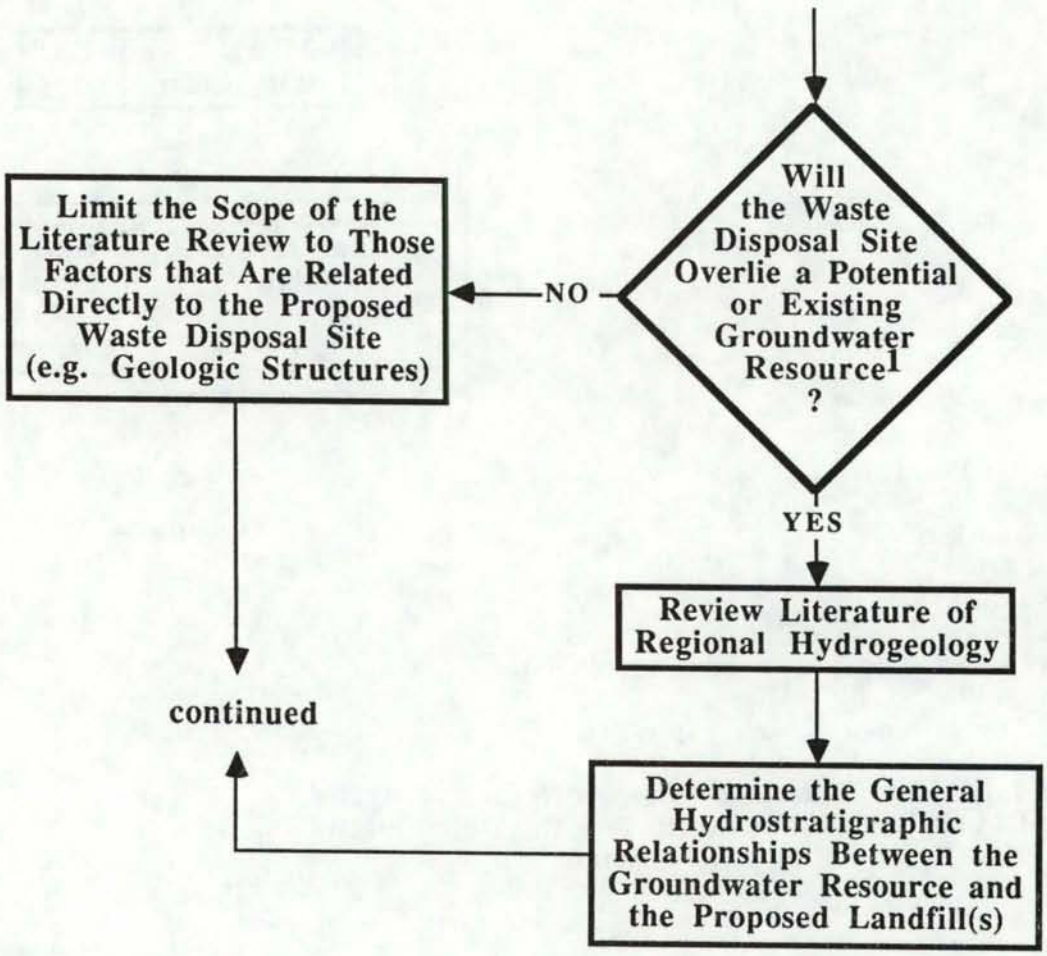
HYDROGEOLOGIC ANALYSIS OF SOLID WASTE DISPOSAL SITES: PART TWO

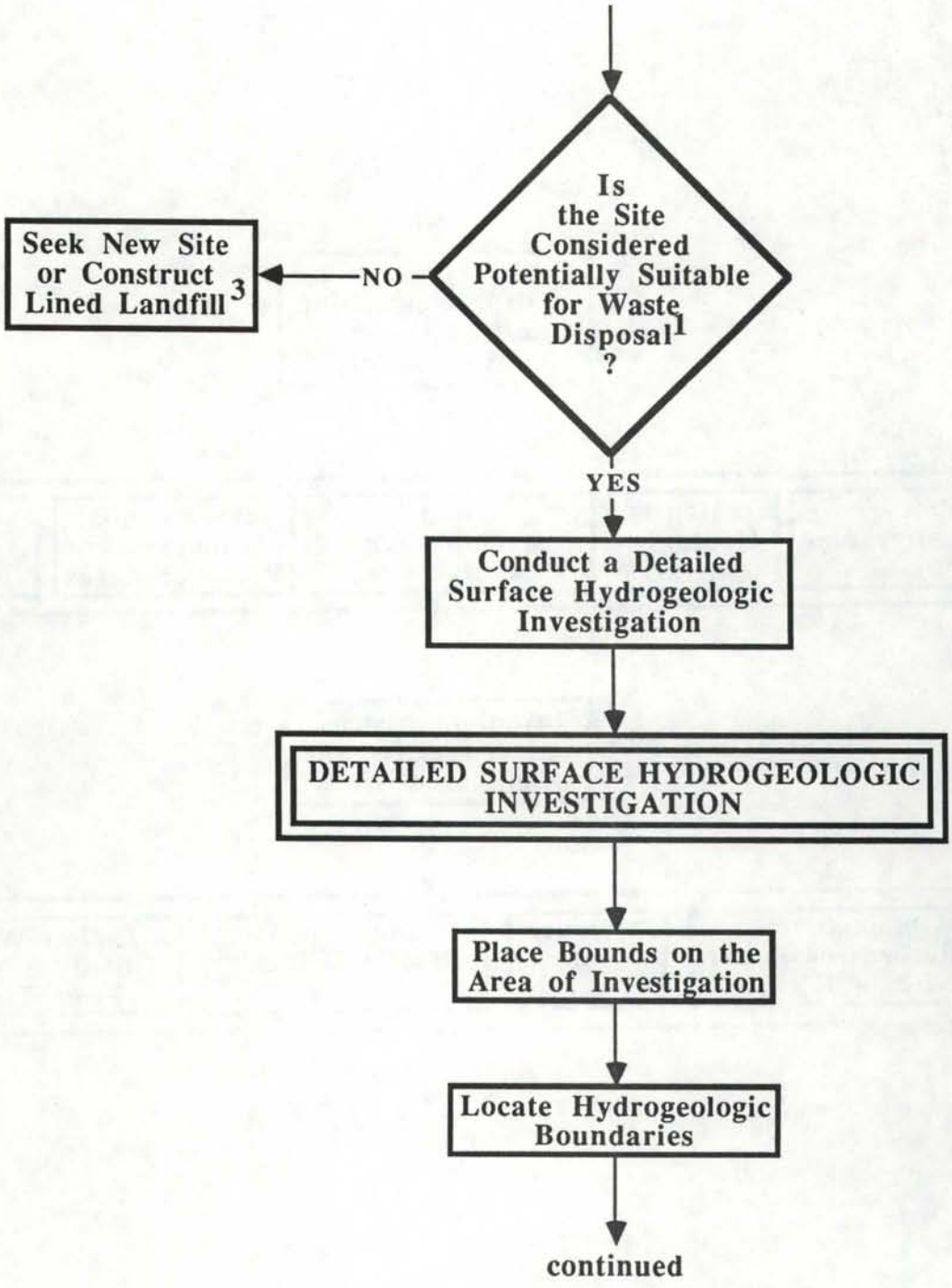


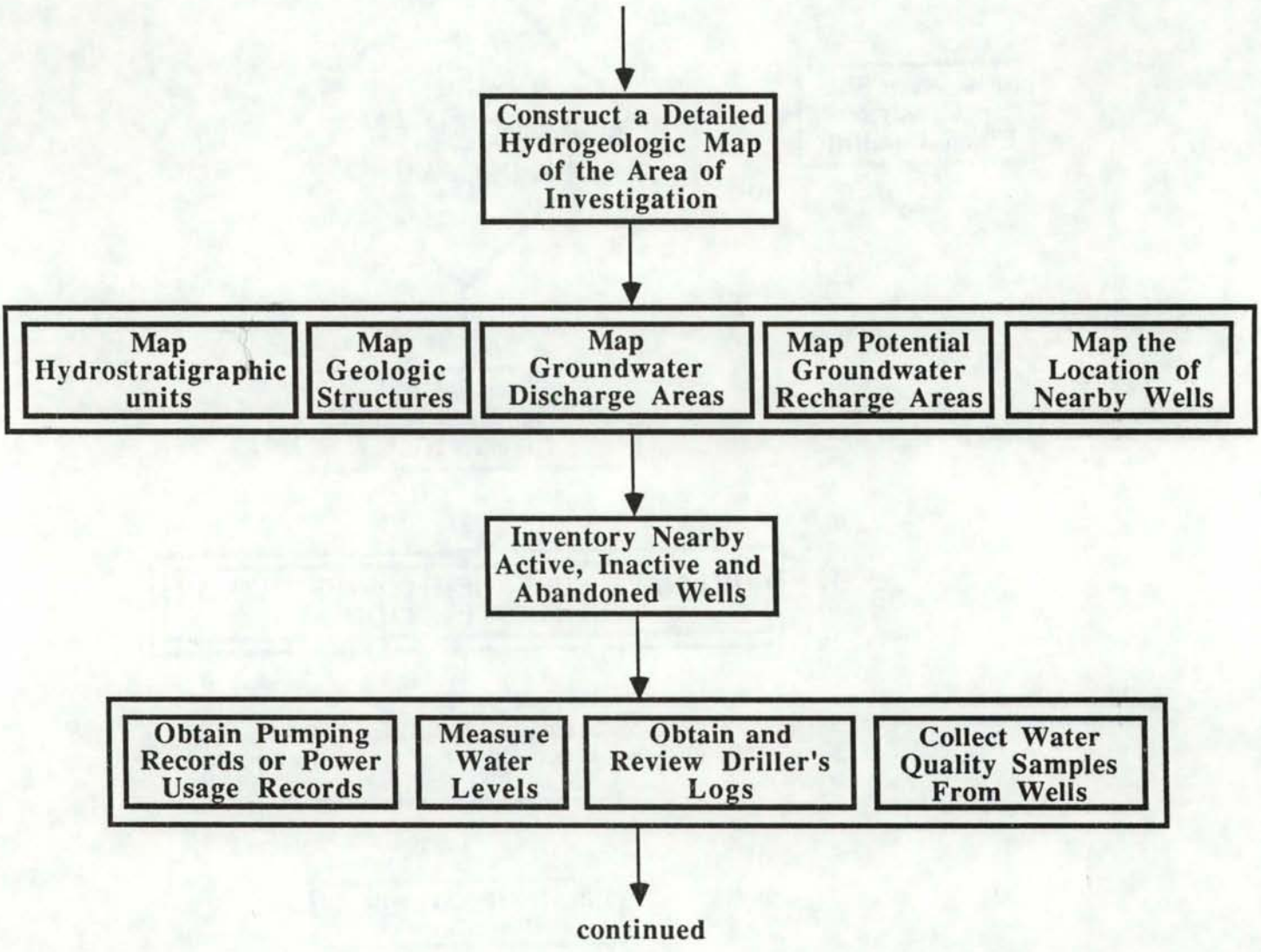
LEGEND

- Connector
- Operation
- Decision Point
- End Analysis
- Subroutine

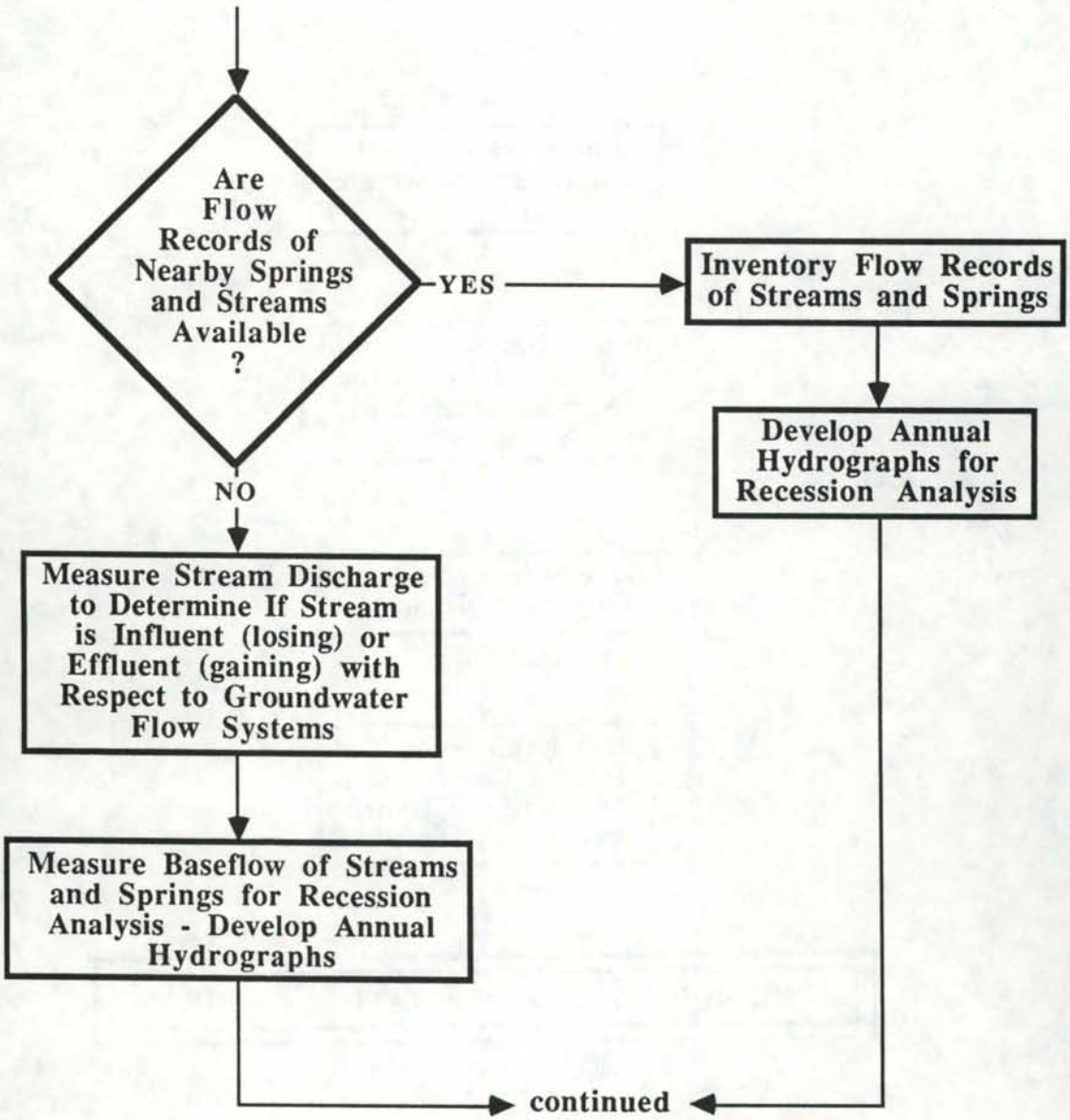
1. To be Determined by a Hydrogeologist.
2. To be Determined by a Geophysist.
3. If a Lined Landfill is to be Constructed, Investigative Detail Must be Sufficient to Ensure the Design of an Effective Leachate Detection System.

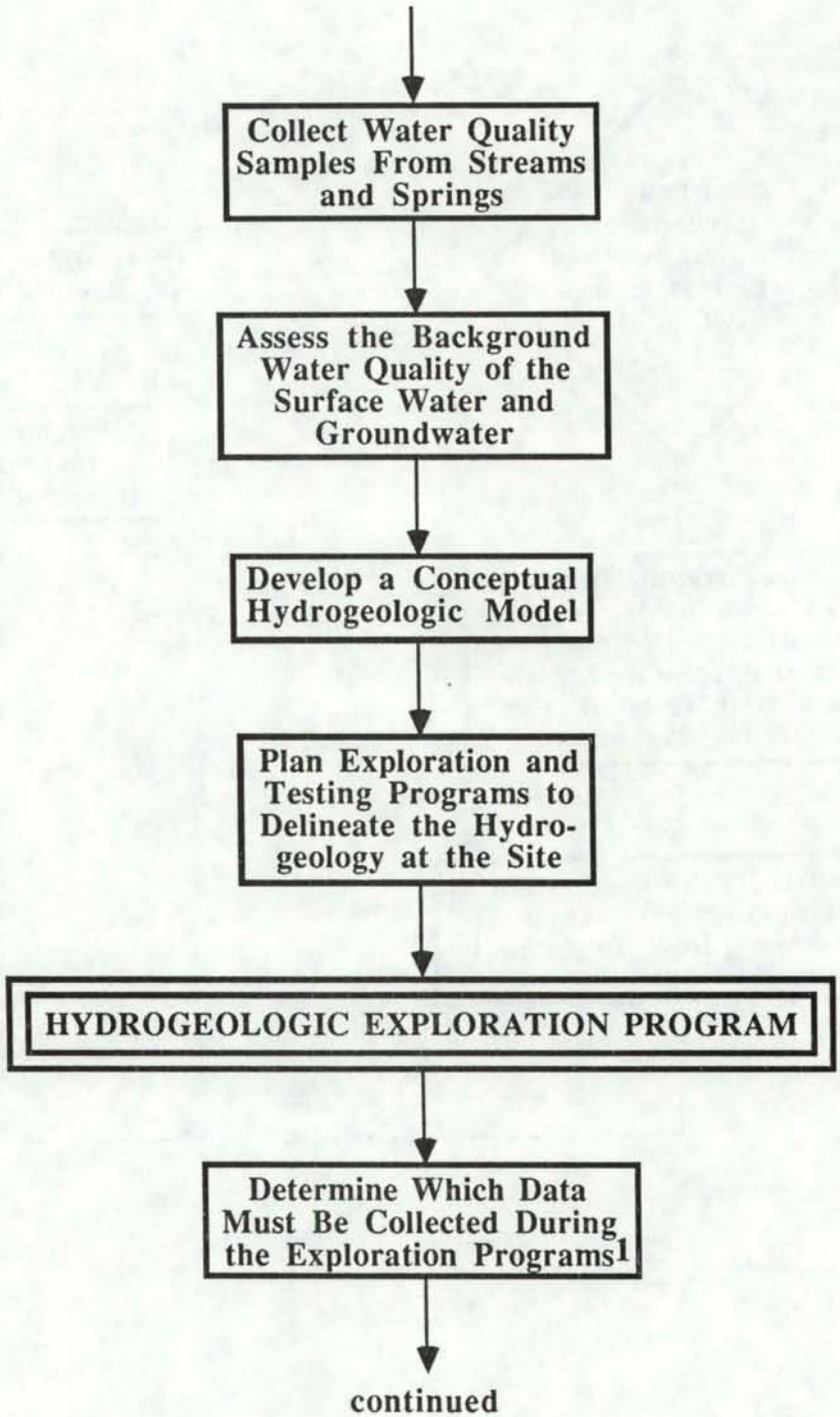

Will the Waste Disposal Site Overlie a Potential or Existing Groundwater Resource[1] ?
NO
Limit the Scope of the Literature Review to Those Factors that Are Related Directly to the Proposed Waste Disposal Site (e.g. Geologic Structures)
YES
Review Literature of Regional Hydrogeology
Determine the General Hydrostratigraphic Relationships Between the Groundwater Resource and the Proposed Landfill(s)
continued

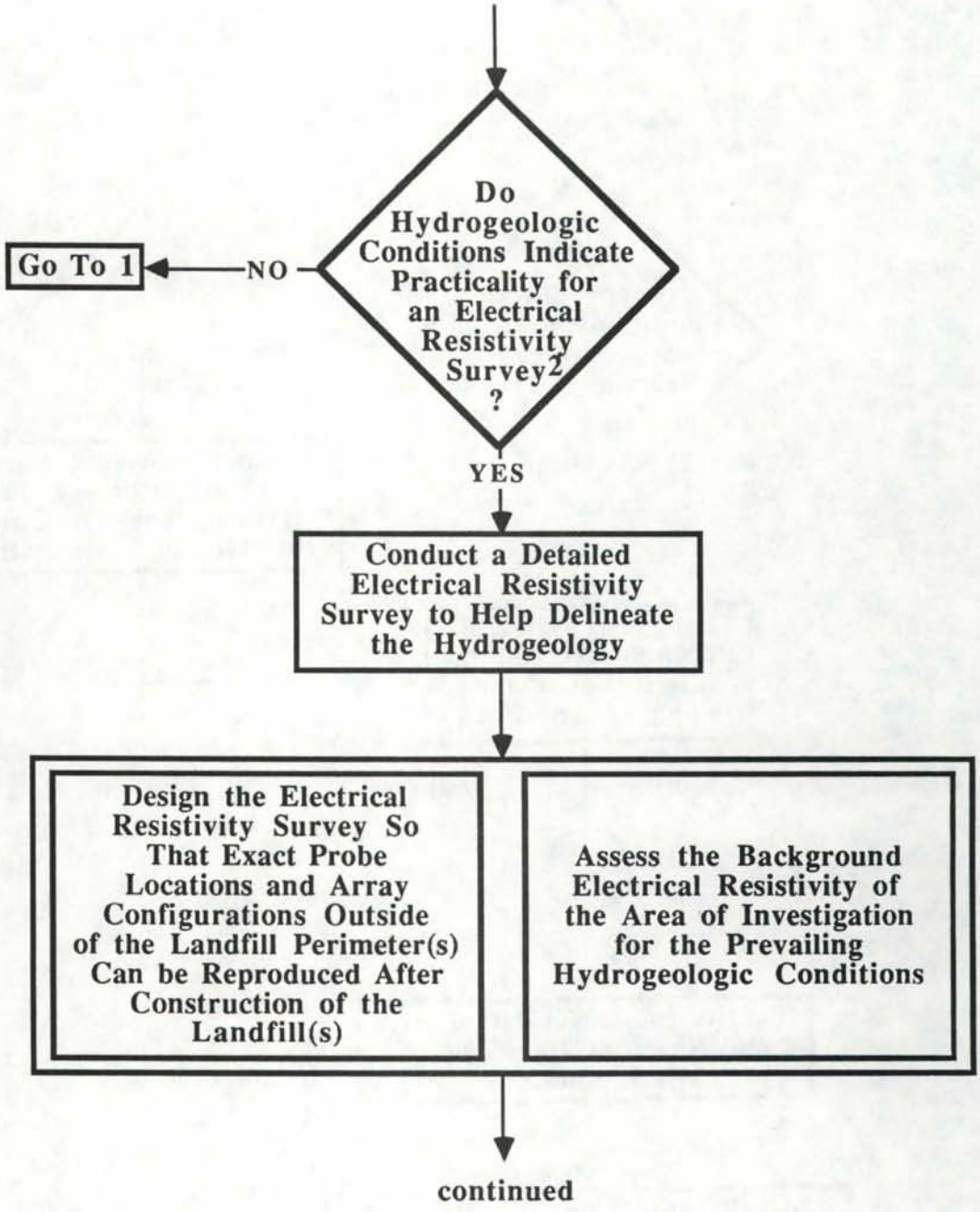

Is the Site Considered Potentially Suitable for Waste Disposal[1] ?
NO
Seek New Site or Construct Lined Landfill[3]
YES
Conduct a Detailed Surface Hydrogeologic Investigation
DETAILED SURFACE HYDROGEOLOGIC INVESTIGATION
Place Bounds on the Area of Investigation
Locate Hydrogeologic Boundaries
continued


Construct a Detailed Hydrogeologic Map of the Area of Investigation
Map Hydrostratigraphic units
Map Geologic Structures
Map Groundwater Discharge Areas
Map Potential Groundwater Recharge Areas
Map the Location of Nearby Wells
Inventory Nearby Active, Inactive and Abandoned Wells
Obtain Pumping Records or Power Usage Records
Measure Water Levels
Obtain and Review Driller's Logs
Collect Water Quality Samples From Wells

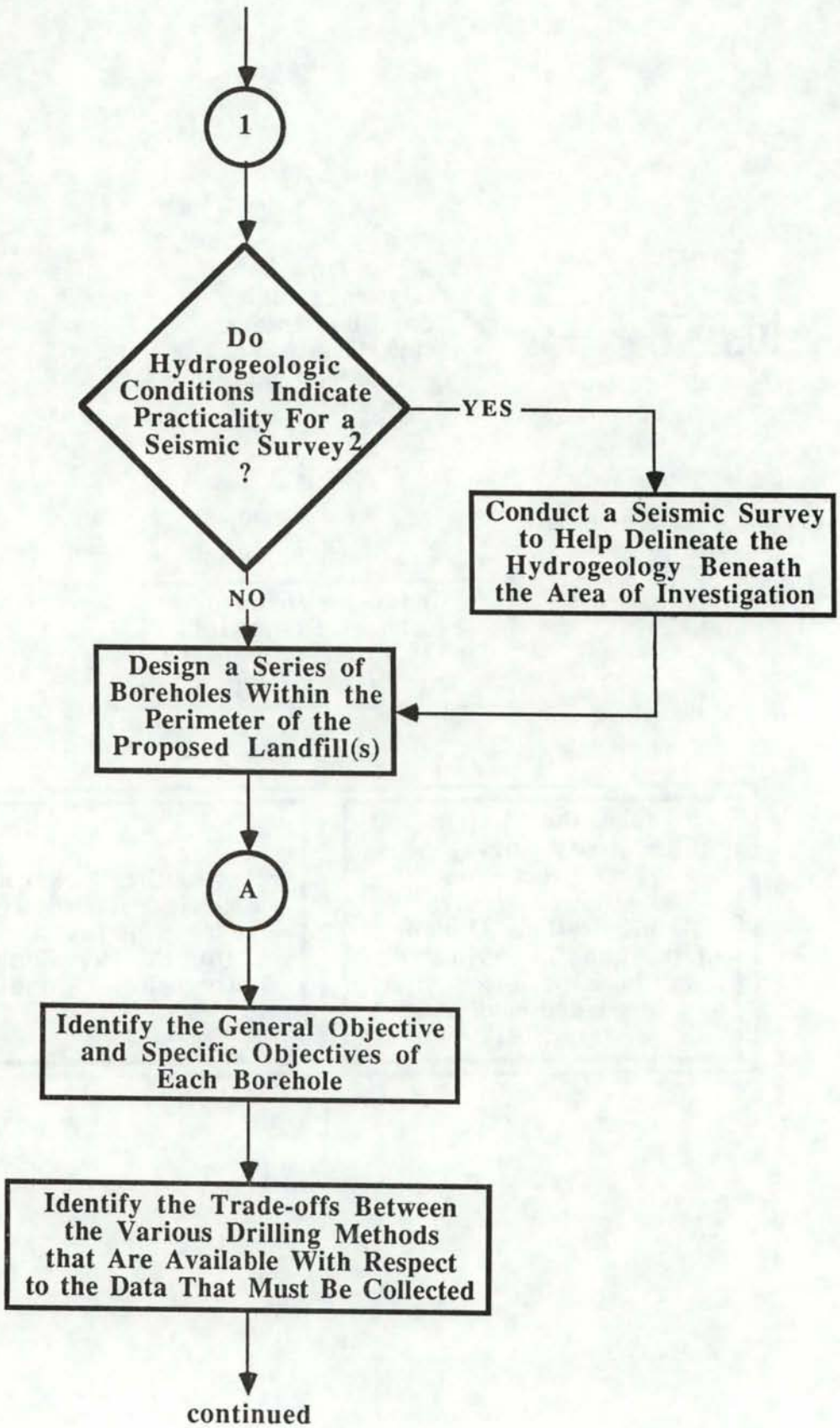
continued

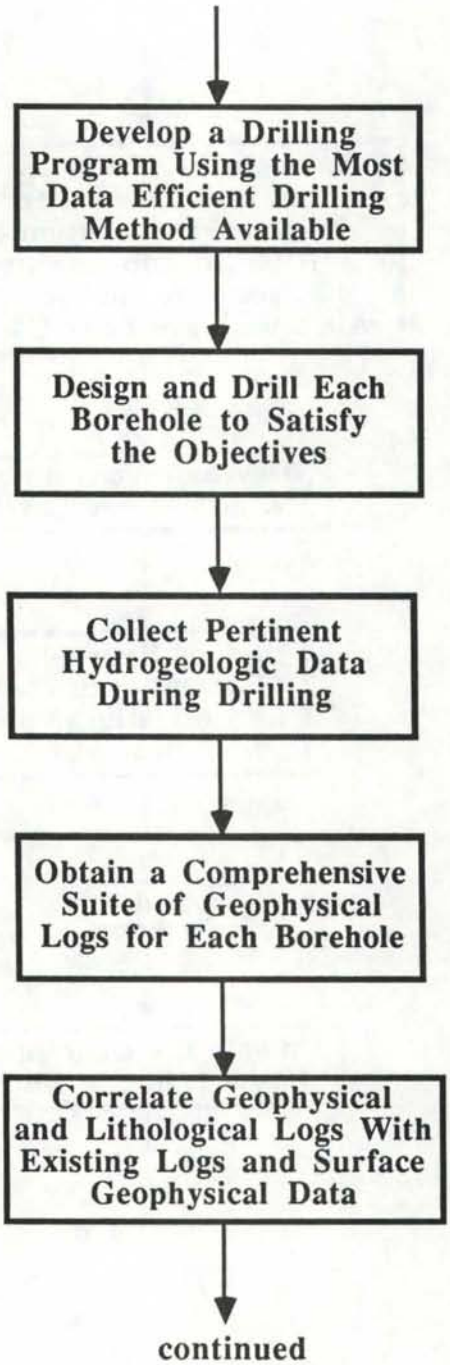

Are Flow Records of Nearby Springs and Streams Available ?
YES
Inventory Flow Records of Streams and Springs
Develop Annual Hydrographs for Recession Analysis
NO
Measure Stream Discharge to Determine If Stream is Influent (losing) or Effluent (gaining) with Respect to Groundwater Flow Systems
Measure Baseflow of Streams and Springs for Recession Analysis - Develop Annual Hydrographs
continued

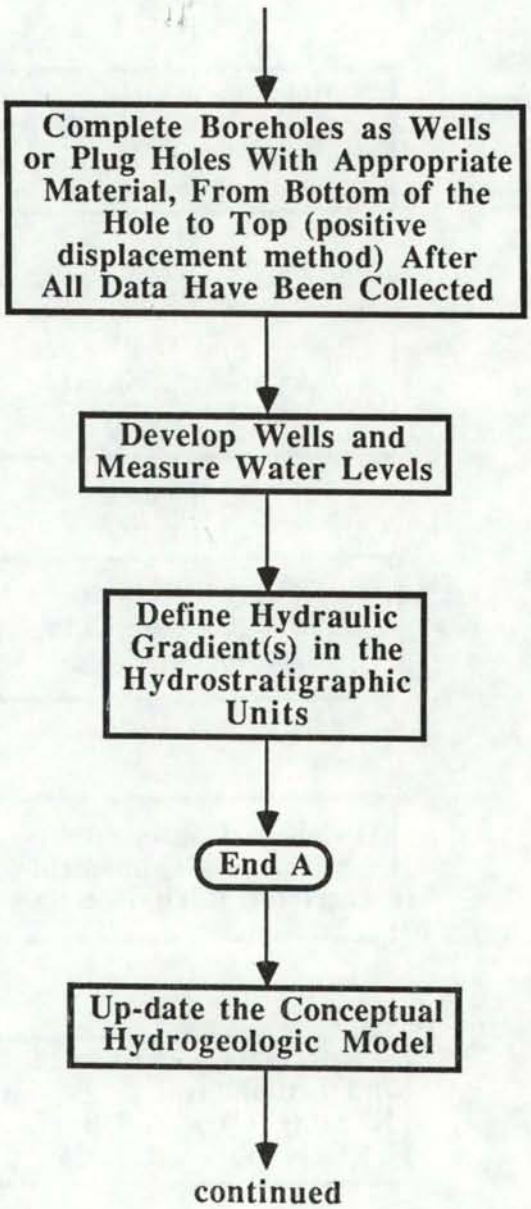

Collect Water Quality Samples From Streams and Springs
Assess the Background Water Quality of the Surface Water and Groundwater
Develop a Conceptual Hydrogeologic Model
Plan Exploration and Testing Programs to Delineate the Hydrogeology at the Site
HYDROGEOLOGIC EXPLORATION PROGRAM
Determine Which Data Must Be Collected During the Exploration Programs[1]
continued

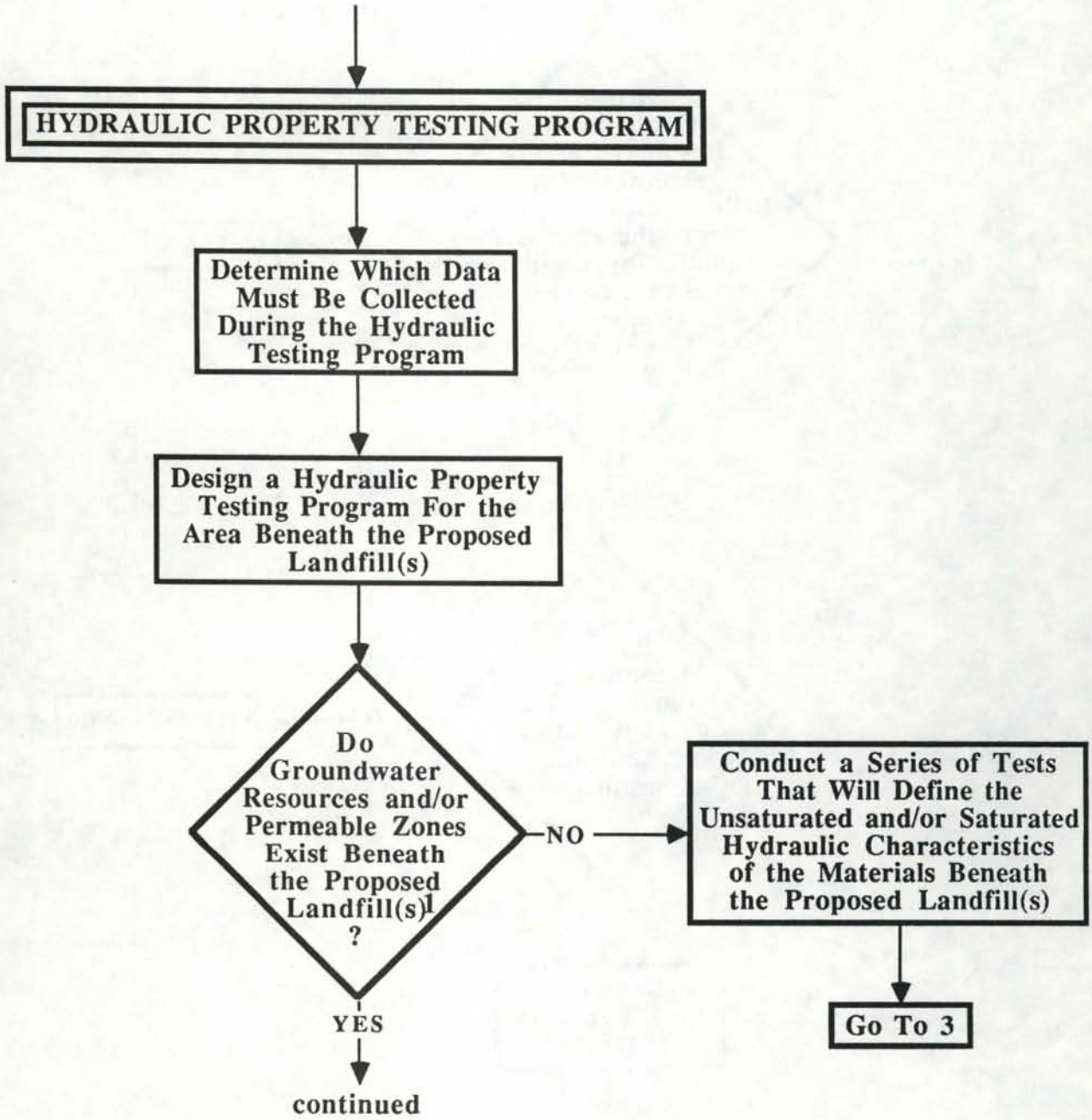

Do Hydrogeologic Conditions Indicate Practicality for an Electrical Resistivity Survey[2] ?
NO
Go To 1
YES
Conduct a Detailed Electrical Resistivity Survey to Help Delineate the Hydrogeology
Design the Electrical Resistivity Survey So That Exact Probe Locations and Array Configurations Outside of the Landfill Perimeter(s) Can be Reproduced After Construction of the Landfill(s)
Assess the Background Electrical Resistivity of the Area of Investigation for the Prevailing Hydrogeologic Conditions

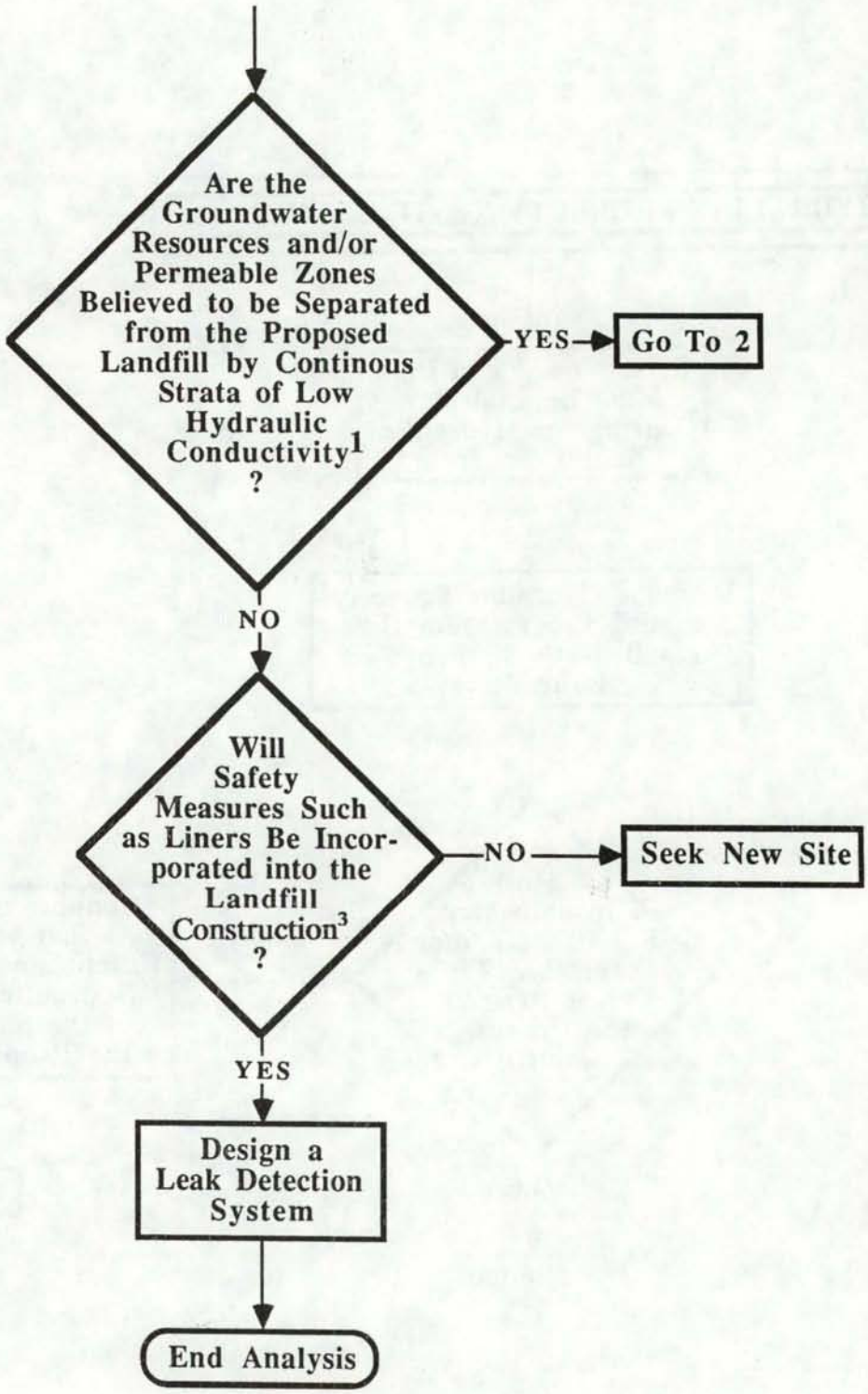
continued

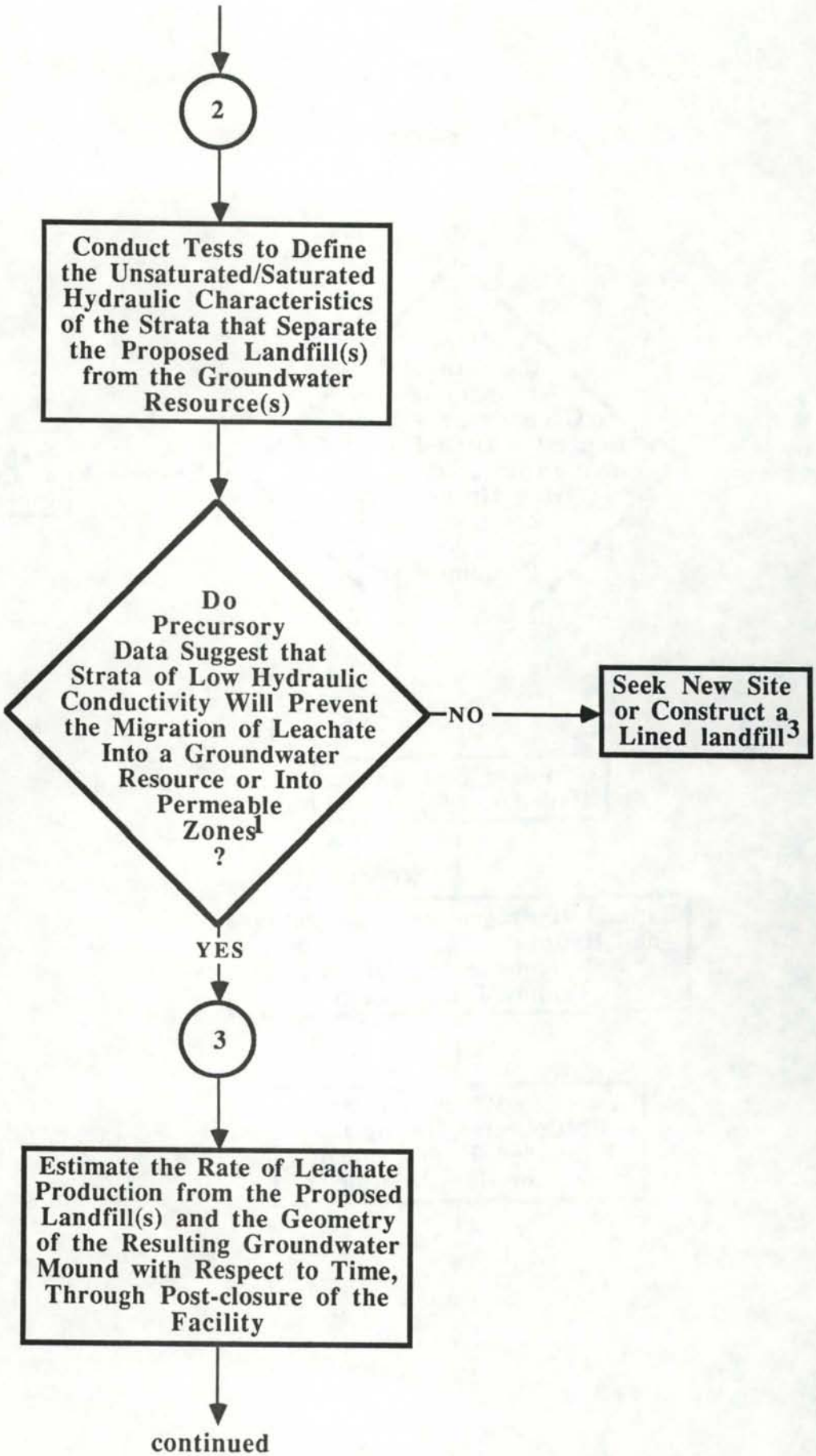

1
Do Hydrogeologic Conditions Indicate Practicality For a Seismic Survey ?
2
YES
Conduct a Seismic Survey to Help Delineate the Hydrogeology Beneath the Area of Investigation
NO
Design a Series of Boreholes Within the Perimeter of the Proposed Landfill(s)
A
Identify the General Objective and Specific Objectives of Each Borehole
Identify the Trade-offs Between the Various Drilling Methods that Are Available With Respect to the Data That Must Be Collected
continued

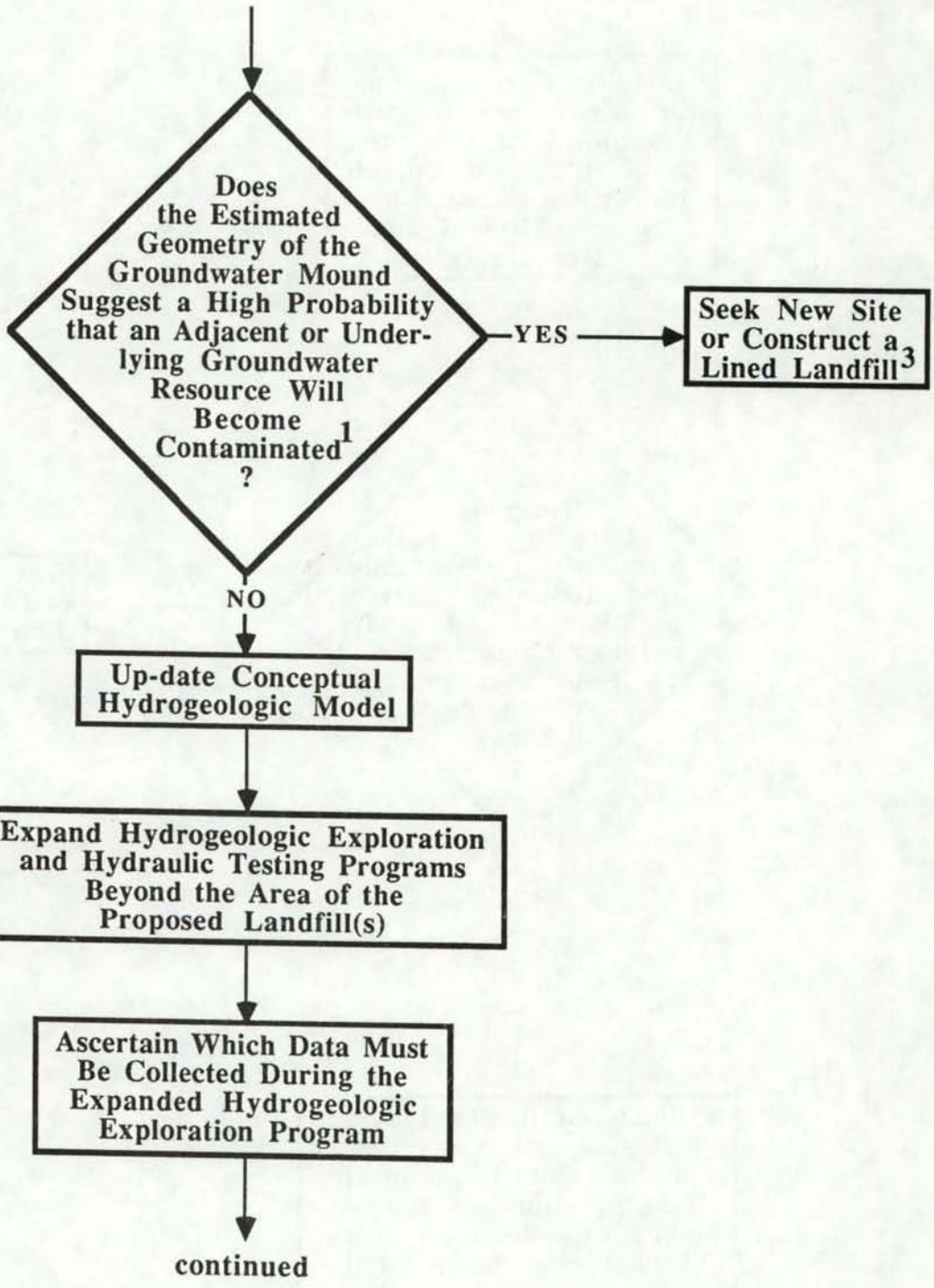

Develop a Drilling Program Using the Most Data Efficient Drilling Method Available
Design and Drill Each Borehole to Satisfy the Objectives
Collect Pertinent Hydrogeologic Data During Drilling
Obtain a Comprehensive Suite of Geophysical Logs for Each Borehole
Correlate Geophysical and Lithological Logs With Existing Logs and Surface Geophysical Data
continued

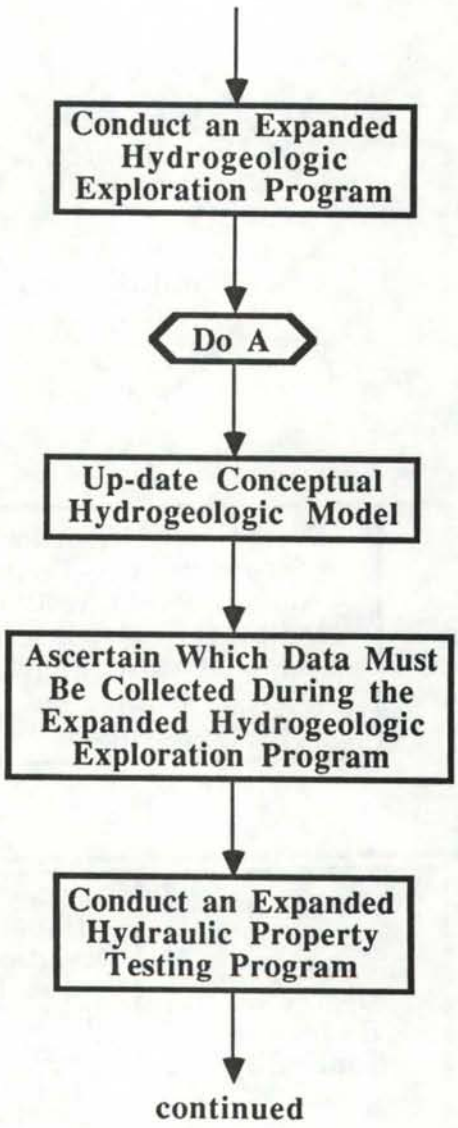

Complete Boreholes as Wells or Plug Holes With Appropriate Material, From Bottom of the Hole to Top (positive displacement method) After All Data Have Been Collected
Develop Wells and Measure Water Levels
Define Hydraulic Gradient(s) in the Hydrostratigraphic Units
End A
Up-date the Conceptual Hydrogeologic Model
continued

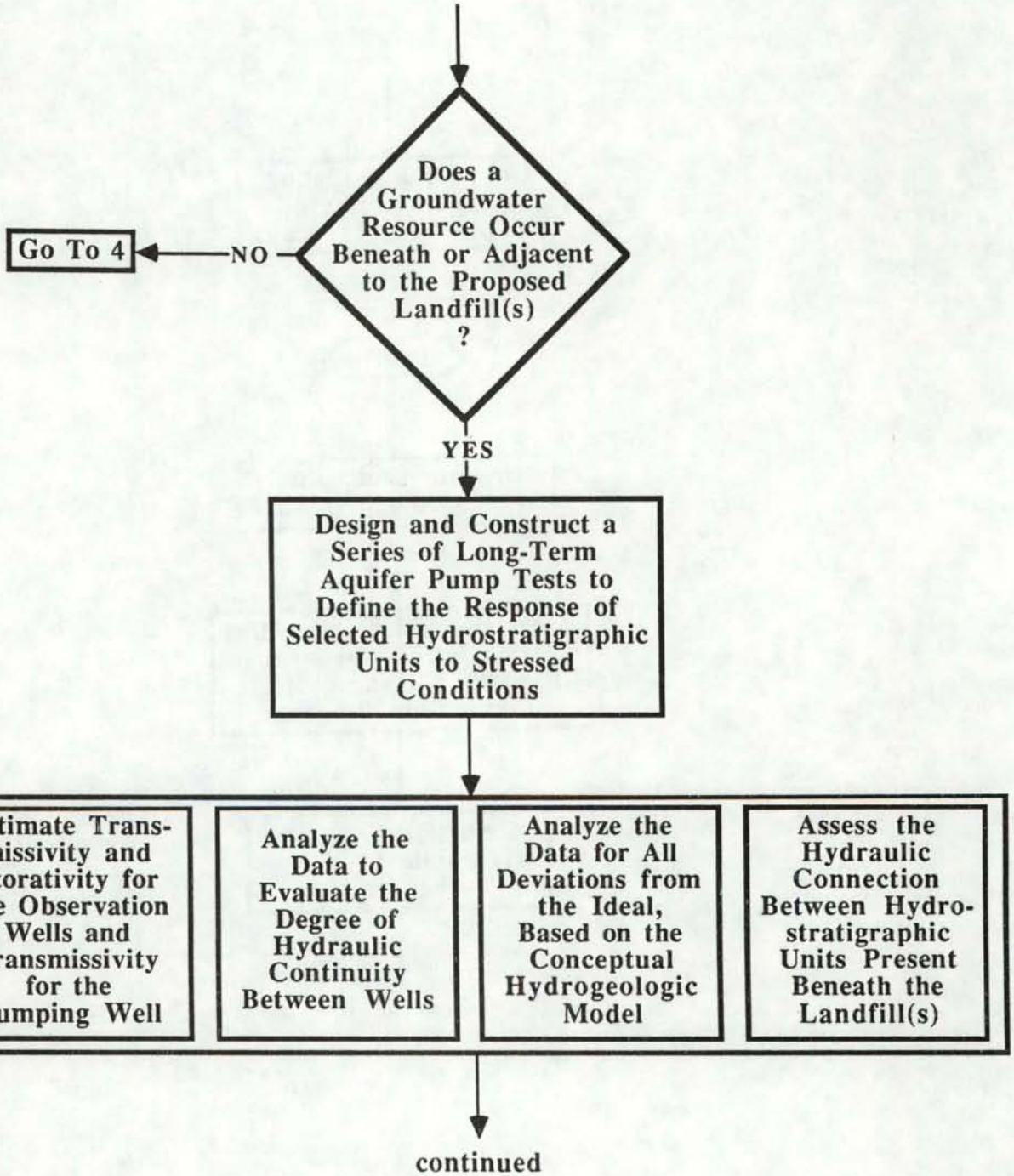

HYDRAULIC PROPERTY TESTING PROGRAM
Determine Which Data Must Be Collected During the Hydraulic Testing Program
Design a Hydraulic Property Testing Program For the Area Beneath the Proposed Landfill(s)
Do Groundwater Resources and/or Permeable Zones Exist Beneath the Proposed Landfill(s) ?
NO
Conduct a Series of Tests That Will Define the Unsaturated and/or Saturated Hydraulic Characteristics of the Materials Beneath the Proposed Landfill(s)
Go To 3
YES
continued


Are the Groundwater Resources and/or Permeable Zones Believed to be Separated from the Proposed Landfill by Continous Strata of Low Hydraulic Conductivity[1] ?
YES
Go To 2
NO
Will Safety Measures Such as Liners Be Incorporated into the Landfill Construction[3] ?
NO
Seek New Site
YES
Design a Leak Detection System
End Analysis

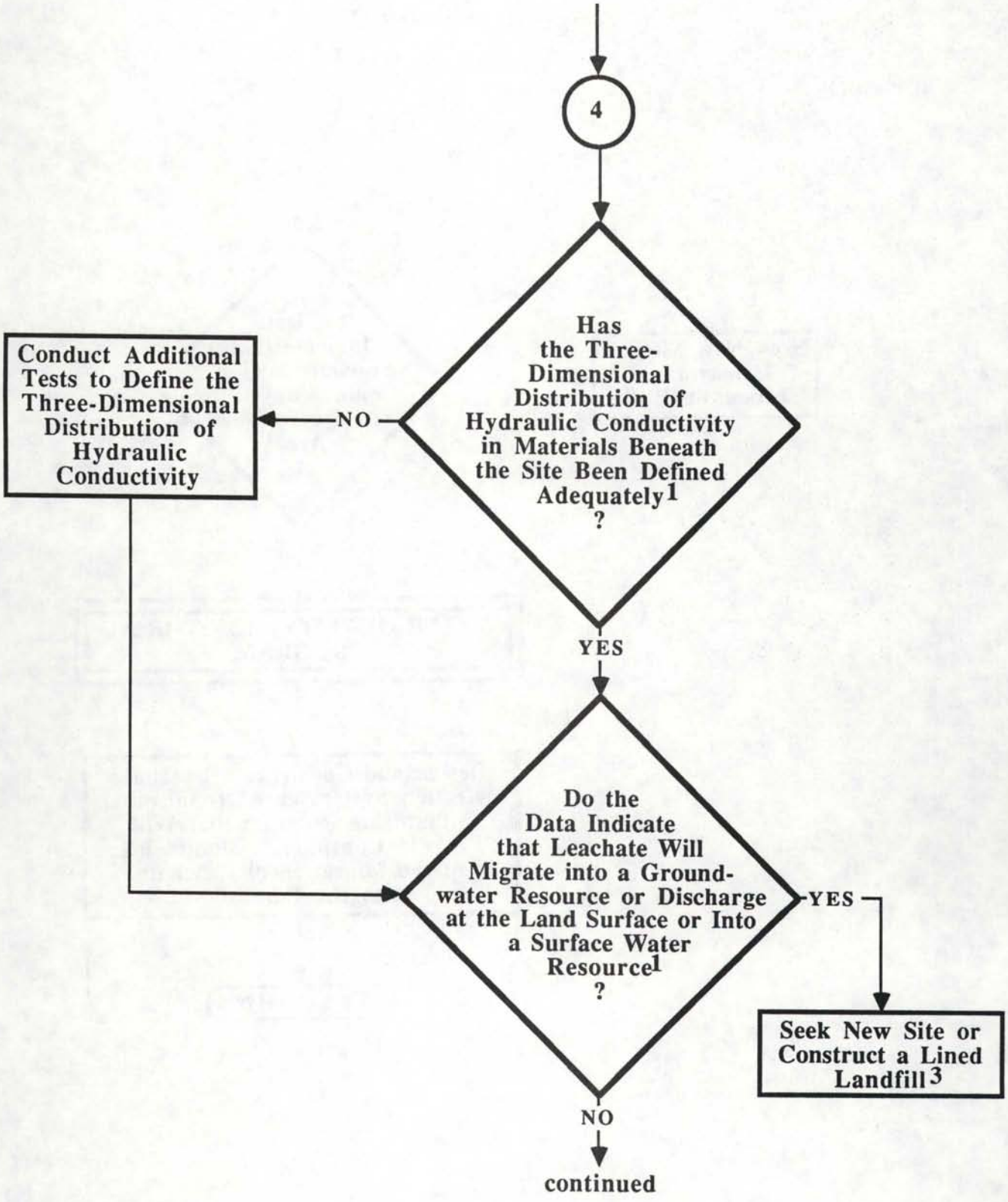

2
Conduct Tests to Define the Unsaturated/Saturated Hydraulic Characteristics of the Strata that Separate the Proposed Landfill(s) from the Groundwater Resource(s)
Do Precursory Data Suggest that Strata of Low Hydraulic Conductivity Will Prevent the Migration of Leachate Into a Groundwater Resource or Into Permeable Zones[1] ?
NO
Seek New Site or Construct a Lined landfill[3]
YES
3
Estimate the Rate of Leachate Production from the Proposed Landfill(s) and the Geometry of the Resulting Groundwater Mound with Respect to Time, Through Post-closure of the Facility
continued

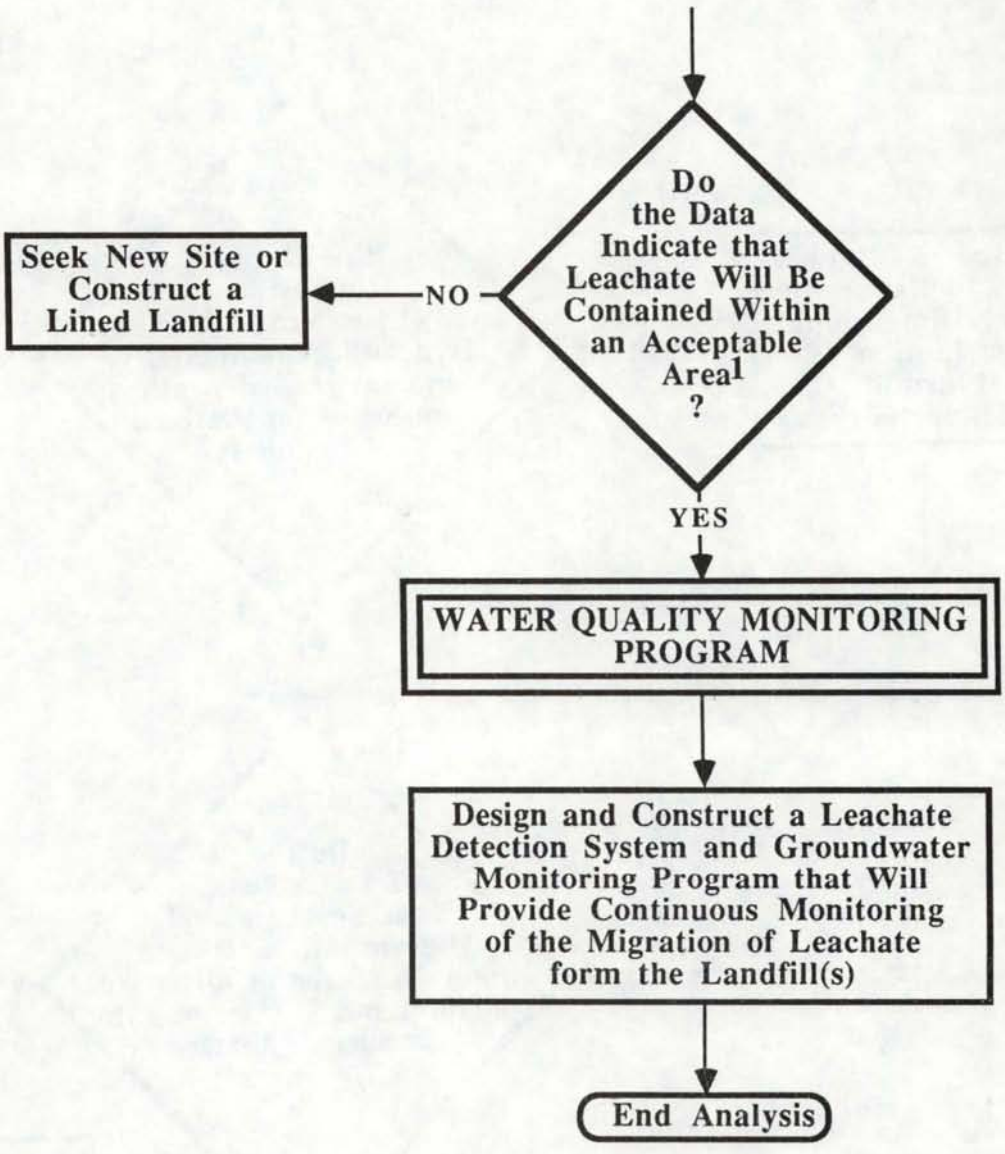

Does the Estimated Geometry of the Groundwater Mound Suggest a High Probability that an Adjacent or Underlying Groundwater Resource Will Become Contaminated[1] ?
YES
Seek New Site or Construct a Lined Landfill[3]
NO
Up-date Conceptual Hydrogeologic Model
Expand Hydrogeologic Exploration and Hydraulic Testing Programs Beyond the Area of the Proposed Landfill(s)
Ascertain Which Data Must Be Collected During the Expanded Hydrogeologic Exploration Program
continued


Conduct an Expanded Hydrogeologic Exploration Program
Do A
Up-date Conceptual Hydrogeologic Model
Ascertain Which Data Must Be Collected During the Expanded Hydrogeologic Exploration Program
Conduct an Expanded Hydraulic Property Testing Program
continued


Does a Groundwater Resource Occur Beneath or Adjacent to the Proposed Landfill(s) ?
NO
Go To 4
YES
Design and Construct a Series of Long-Term Aquifer Pump Tests to Define the Response of Selected Hydrostratigraphic Units to Stressed Conditions
Estimate Transmissivity and Storativity for the Observation Wells and Transmissivity for the Pumping Well
Analyze the Data to Evaluate the Degree of Hydraulic Continuity Between Wells
Analyze the Data for All Deviations from the Ideal, Based on the Conceptual Hydrogeologic Model
Assess the Hydraulic Connection Between Hydrostratigraphic Units Present Beneath the Landfill(s)

continued


4
Has the Three-Dimensional Distribution of Hydraulic Conductivity in Materials Beneath the Site Been Defined Adequately[1] ?
NO
Conduct Additional Tests to Define the Three-Dimensional Distribution of Hydraulic Conductivity
YES
Do the Data Indicate that Leachate Will Migrate into a Ground-water Resource or Discharge at the Land Surface or Into a Surface Water Resource[1] ?
YES
Seek New Site or Construct a Lined Landfill[3]
NO
continued


Do the Data Indicate that Leachate Will Be Contained Within an Acceptable Area[1] ?
NO
Seek New Site or Construct a Lined Landfill
YES
WATER QUALITY MONITORING PROGRAM
Design and Construct a Leachate Detection System and Groundwater Monitoring Program that Will Provide Continuous Monitoring of the Migration of Leachate form the Landfill(s)
End Analysis

REVIEW OF DRILLING TECHNIQUES FROM MONITOR WELL CONSTRUCTION

FACTORS TO CONSIDER WHEN SELECTING A DRILLING METHOD FOR MONITORING WELL CONSTRUCTION

1. Hydrologic environment
    a. Type(s) of formation(s)
    b. Depth of drilling
2. Types of pollutants expected
3. Location of drilling site
4. Design of monitoring well
5. Availability of drilling equipment
6. Cost

CABLE TOOL METHOD
Advantages

1. Good sample recovery
2. Good delineation of water bearing zones during drilling
3. Good mobility characteristics
4. Good drilling in most formations
5. Inexpensive

CABLE TOOL METHOD
Disadvantages

1. Slow
2. Requires driving casing in unconsolidated formations
3. May be necessary to double case hold for good seal or gravel pack

MUD ROTARY
Advantages

1. Availability
2. Capable of satisfactory drilling in most formations
3. Depth capability
4. Permits wide variety of formation logging
5. Modest cost
6. Good gravel packing and casing seal

MUD ROTARY
Disadvantages

1. Requires drilling fluid
   a. Difficult to remove
   b. May affect sample integrity
2. Circulates contaminants
3. Mobility may be limited
4. Poor rock or soil sample recovery

AIR ROTARY
Advantages

1. No drilling fluid required
2. Excellent drilling in hard rock
3. Fast
4. Good depth capability
5. Easy grout and gravel pack installation

AIR ROTARY
Disadvantages

1. Casing may be required during drilling
2. Cross contamination of different formations
3. Limited equipment availability
4. Limited equipment mobility
5. Difficult formation sampling
6. High cost of drilling

DOUBLE WALL REVERSE CIRCULATION
Advantages

1. Formation water is not contaminated by the drilling water
2. Good sample recovery
3. No caving in unconsolidated formations

DOUBLE WALL REVERSE CIRCULATION
Disadvantages

1. Not readily available
2. Expensive
3. Sealing of wells, placement of grout, etc. may be difficult

HOLLOW STEM CONTINUOUS-FLIGHT AUGER
Advantages

1. Good mobility of equipment
2. No drilling fluid required
3. Problems of hold caving minimized
4. Soil sampling relatively easy

HOLLOW STEM CONTINUOUS-FLIGHT AUGER
Disadvantages

1. Cannot be used in hard rock
2. Limited depth capability
3. Cross contamination of permeable zones is possible
4. Limited casing diameter
5. Difficult to obtain good well seals

SOLID-STEM CONTINUOUS FLIGHT AUGER
Advantages

1. Fast in shallow unconsolidated formations
2. Inexpensive to operate
3. Highly mobile
4. Requires no drilling fluid

SOLID-STEM CONTINUOUS FLIGHT AUGER
Disadvantages

1. Cannot be used in consolidated formations
2. Limited depth capability
3. Possible borehole collapse after the auger is removed
4. Difficult sampling

BUCKET AUGER
Advantages

1. No drilling fluid required above the zone of saturation
2. Sealing of wells easy
3. Formation sampling is excellent

BUCKET AUGER
Disadvantages

1. Limited depths
2. Water or drilling mud necessary for caving formations
3. Rigs are not readily available

DRIVING
Advantages

1. Inexpensive and fast
2. Highly mobile

DRIVING
Disadvantages

1. Limited to using metal casing
2. Limited depth
3. Limited to unconsolidated formations
4. Inability to get good casing seals
5. Limited casing diameter
6. No sample recovery

JETTING
Advantages

1. Fast
2. Highly mobile
3. Inexpensive

JETTING
Disadvantages

1. Requires large quantities of water
2. Difficult to get good casing seals
3. Limited casing diameter
4. Limited depth
5. Poor sample acquisition

Examples of hydrogeologic data that can be collected during drilling.

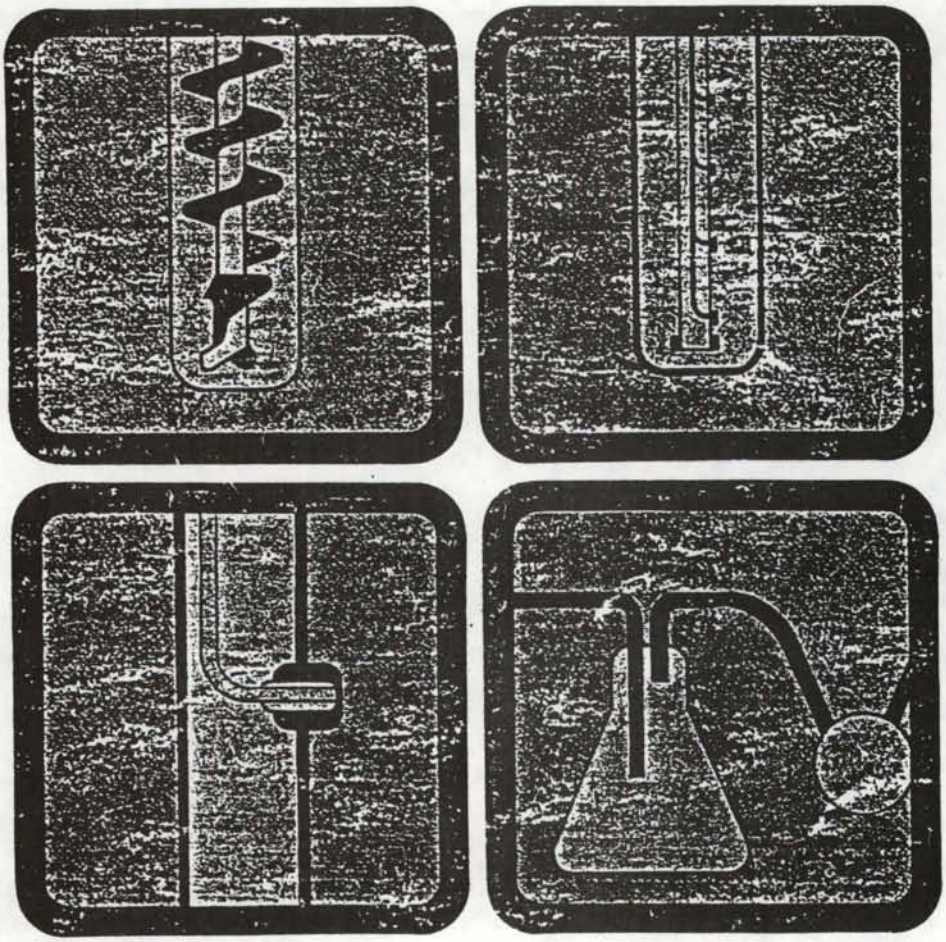
	HYDROGEOLOGIC DATA							
Drilling Method	Formation samples (lithology)	Formation samples (water)	Specific electrical conductance	Field analysis of water samples	Groundwater potential	Water table depth	Estimated hydraulic conductivity	Geophysical Logs-(depending on borehole diameter)
Mud Rotary	Samples by core drilling or drive coring. Water samples by pore-water extraction techniques. Potential for contamination of core.	Drill to sampling depth, pull drill string; set and gravel pack temporary well screen (Fig. 4.4).	No	No	No	No	Set temporary well screen and gravel pack, test, pull screen, drill to next horizon. Can be done in conjunction with formation water sampling.	Yes (uncased hole) Nuclear logs only in cased hole.
Air Rotary	Samples by core drilling or drive coring. Water samples by pore-water extraction techniques.	Drive casing to sampling depth, bail or pump sample; set riser pipe and packer and pump sample for each horizon in uncased boreholes (Fig. 4.5)	Conductance of mixed water during drilling.	Mixed samples during drilling.	Relative measurement only during pause in drilling.	Yes	Packing off intervals - pump test or falling head test (or same as mud rotary).	Yes (Uncased hole) Nuclear logs only in cased hole.
Air Drilling with Casing Hammer	Same as Air Rotary.	Drive casing to sampling depth, bail or pump sample.	Yes, at selected depths (mixing minimized).	Yes, at selected depths (mixing minimized).	Measurement during pause in drilling if casing is driven.	Yes	Falling head test.	Nuclear logs only.
Cable Tool	Formation samples from sand pump-bailer. Core samples same as for Air Rotary.	Samples collected if casing bailed dry without sand heaves or if temporary well screen set.	Yes, at different depths (mixing minimized in cased holes).	Yes, for certain parameters (mixing minimized in cased holes).	Measurement during pause in drilling if casing is driven.	Yes	Same as Air Rotary.	Nuclear logs only for cased holes.
Double-Wall, Reverse Circulation	Formation samples; core samples same as for Air Rotary.	Same as Mud or Air Rotary.	Conductance of mixed water during air drilling.	Mixed samples during air drilling.	Relative measurement only during pause in air drilling.	Yes, air drilling only.	Same as Mud or Air Rotary.	Yes (uncased hole) Nuclear logs only in cased hole.

Examples of hydrogeologic data that can be collected during drilling (continued).

	HYDROGEOLOGIC DATA							
Drilling Method	Formation samples (lithology)	Formation samples (water)	Specific electrical conductance	Field Analysis of water samples	Groundwater potential	Water table depth	Estimated hydraulic conductivity	Geophysical Logs (depending on borehole diameter)
Solid-Stem Continuous Flight Auger	No	No	No	No	No	Difficult at depth.	Yes, if hole is screened and cased.	Nuclear logs only.
Hollow-Stem Continuous Flight Auger	Core samples analyzed for adsorbed ions or precipitates. Water quality samples obtained by pore-water extrabtion techniques.	No	No	No	No	Difficult at depth.	Yes, if hole is screened and cased.	Nuclear logs only.
Keck Screened Hollow-Stem Continuous Flight Auger	Same as hollow-stem continuous flight auger.	Yes, at any depth (mixing may occur).	Yes, at any depth (mixing may occur).	Yes, at any depth (mixing may occur).	Yes, at any depth.	Yes	Yes, at any depth.	Nuclear logs only.
Jetting	Core samples analyzed the same as for hollow-stem continuous flight auger.	Yes, if drive point is used.	Yes, only when samples are obtained.	Yes, only when samples are obtained.	No	Yes, shallow depth only.	Yes, after casing installation.	Nuclear logs only.
Drive Points	No	Yes, at any depth.	Yes, at any depth.	Yes, at any depth.	Yes, at shallow depth.	Yes, shallow depth only.	Yes, at any depth.	Nuclear logs only.

MONITOR WELL DESIGN CONSTRUCTION

Manual of Ground-Water Sampling Procedures



by Marion R. Scalf, James F. McNabb, William J. Dunlap,
Roger L. Cosby, John Fryberger

NWWA/EPA Series

SECTION 5

CONSTRUCTION OF MONITORING WELLS

The success of a ground-water monitoring program depends on numerous factors; however, the location, design, and construction of the monitoring wells is usually the most costly and non-repeatable factor. Hence, it is extremely important that the well construction be accomplished properly at the outset.

The primary objectives of monitoring wells are:

(a) to provide access to ground water
(b) to determine which pollutants are present in the ground water and the concentrations.
(c) to determine the areal and vertical distribution of pollutants.

In order to accomplish these objectives in the most competent and cost-effective manner, consideration must be given the proper well design and construction method that will best fit the specific objectives and the hydrogeologic conditions.

GENERAL REQUIREMENTS

Location

The general criteria for locating monitoring wells are discussed in the preceding section. Occasionally a location which is highly desired from groundwater flow criteria presents unusual problems in design and construction of the monitoring well. The effect that the location may have on well design and construction can best be appreciated following the detailed discussions on drilling methods and design criteria.

Diameter

The diameter of the casing for monitoring wells should be just sufficient to allow the sampling tool (bailer or pump) to be lowered into the well to the desired depth. The diameter of the hole into which the casing is placed must be at least sufficiently large for the casing to fit and in many cases must be at least 2 inches larger to permit placement of a grout seal around the outside of the casing.

Casings and/or holes drilled much larger than the necessary minimum can, in fact, have undesired effects on the data. For example, in formations of very low permeability the excessive storage in an unnecessarily large boring can cause the water level inside the boring to be erroneously low for days or

even weeks. Also, because it is usually necessary to remove water standing in the well before taking a sample of the formation water, excessive storage can complicate the water sampling procedure.

Depth

The intake part of a monitoring well should be depth-discrete. That part of the well, the screen or other openings, through which water enters the well or casing should be limited to a specific depth range.

Water supply wells that may exist in an area to be monitored are often used as sampling points. Substantial care must be exercised when this is done and the results are often questionable. Water-supply wells are constructed to produce a given quantity of water, hence, they may be screened throughout a thick aquifer, through several permeable layers of an aquifer, or sometimes through two or more aquifers or discrete water-bearing layers. When this situation exists, it is probable that the hydrostatic heads are different between different layers. Under non-pumping conditions this interconnection permits water from the layer with the higher head to flow through the well and into the formation with the lower head. This can occur between layers of different permeability separated by only a few feet of low permeability material. This condition can, of course, have substantial effect on the concentration of a pollutant obtained by pumping for a short time before sampling.

Therefore, it is important that monitoring wells be constructed to be depth-discrete and to sample only from one specific layer without interconnection to other layers. In order to assure that this depth-discrete requirement is met, provisions for placing cement grout above and, if necessary, below the well screen on the outside of the casing must be made in the design of the wells.

Commonly (especially when sampling for contaminants lighter than water) it is desirable to sample at the water table, or top of the saturated zone in an unconfined aquifer. The screen or intake part of the well should then extend from a few feet above to a few feet below the anticipated position of the water table to allow for future water-table fluctuations. Often, under semi-confined aquifer conditions, the water will rise in the well above the top of the more permeable layer and above the top of an improperly positioned screen. Care must be exercised in these cases to extend the screen high enough to be above the water level in the formation; otherwise, light organics or other contaminants could be undetected or at least not properly quantified.

On the other hand, a contaminant can migrate along fairly restricted pathways and go undetected by depth discrete wells which are not completed at the proper depth. This danger is particularly present in a geologic environment of highly stratified formations, and in fractured rock formations.

Intake Portion of Monitoring Wells

That part of the well through which water enters the casing must be properly constructed and developed to avoid subsequent sampling problems. Commercially made well screens used in water-supply wells are recommended for

most monitoring wells even though well efficiency is not a primary concern. Other choices are sawed or torchcut slots in the well casing to let the water flow in.

Design criteria for the intake part of the well are:

(a) The screen or intake part should have sufficient open area to permit the easy inflow of water from the formation.
(b) The slot openings should be just small enough to keep most of the natural formation out, but as large as possible to allow easy flow of water.
(c) The well should be developed.

Well Casings

As noted earlier, sampling equipment, including well casings, should be constructed of materials that have the least potential for affecting the quality parameters of the sample. The usual dilemma for the field investigator is the relation between cost and accuracy. Obviously, PVC is far less costly than Teflon, a major consideration when contemplating well construction for a major ground water monitoring effort. On the other hand, bleeding of organic constituents from PVC cements, as well as adsorption, poses a significant potential for affecting the quality of samples where the contaminants under consideration may be in the parts per billion range.

In many situations, it may be realistic to compromise some accuracy with cost, particularly in regard to casing materials used in well construction. For example, if the major contaminants are already defined and they do not include substances which might bleed from PVC or cemented joints, it might be reasonable to use wells cased with the less expensive and readily obtainable PVC. Or, wells constructed of less than optimum materials might be used with a reasonable level of confidence for sampling if at least one identically-constructed well was available in a nearby, uncontaminated part of the aquifer to provide ground water samples for use as "blanks". Obviously, such a "blank" will not address the problems of adsorption on the casing material nor leaching of casing material induced by contaminants in the ground water. Careful consideration is required in each individual case, and the analytical laboratory should be fully aware of construction materials used.

Care must be given to preparation of the casing and well screens prior to installation. As a minimum, both should be washed with a detergent and rinsed thoroughly with clean water. Care should also be taken that these and other sampling materials are protected from contamination by using some type of ground cover such as plastic sheeting for temporary storage in the work area.

DRILLING METHODS

Selection of the drilling method best suited for a particular job is based on the following factors in order of importance:

(1) Hydrogeologic Environment
    (a) Type(s) of formation(s)
    (b) Depth of drilling
    (c) Depth of desired screen setting below water table

(2) Types of pollutants expected
(3) Location of drilling site - dry land, or inside a lagoon
(4) Design of monitoring well desired
(5) Availability of drilling equipment

The principles of operation, advantages and disadvantages of the more common types of drilling techniques suitable for constructing ground-water monitoring wells are discussed as follows.

Mud Rotary

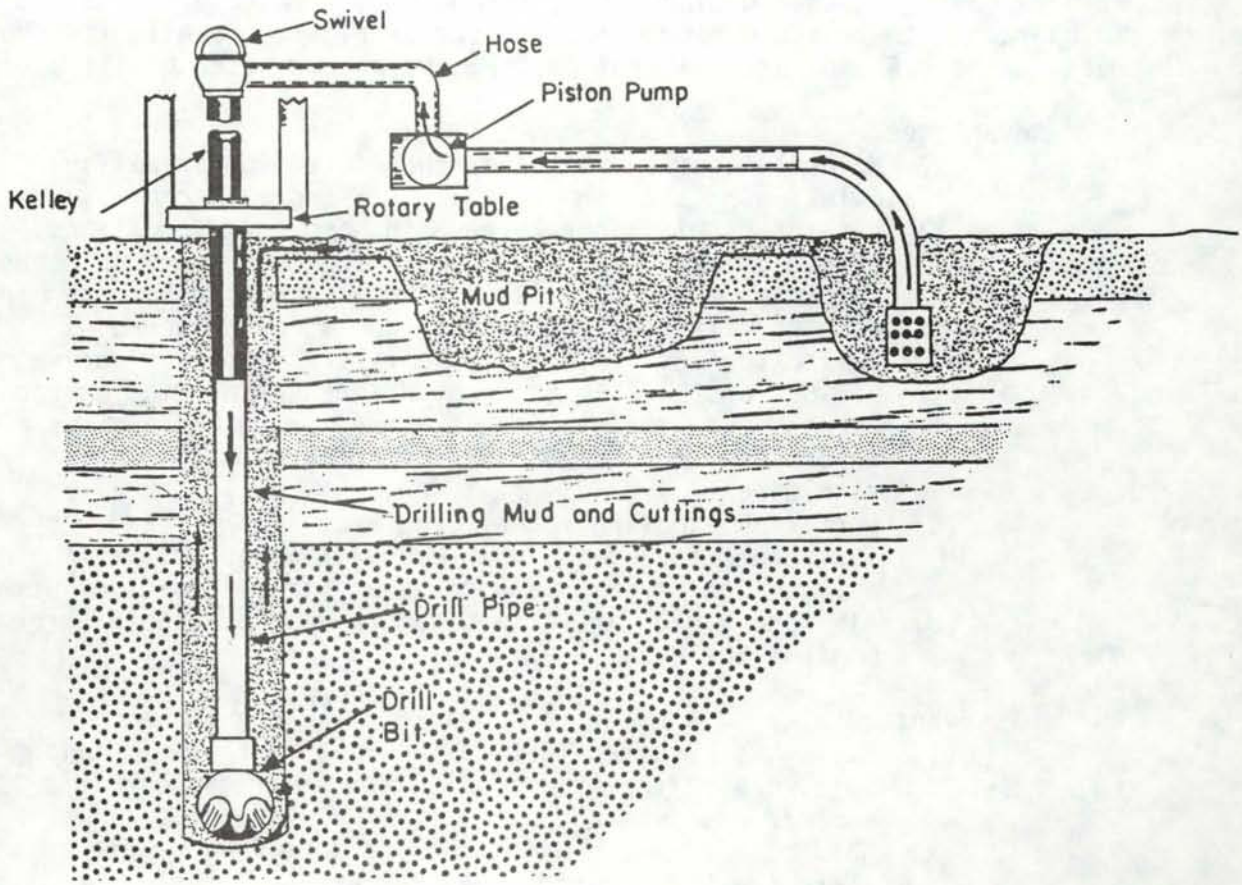
Principles of Operation: A drilling fluid is pumped down the inside of the drill pipe, and then returns to the surface through the annulus between the drill pipe and the borehole wall (Figure 8). This fluid cools the drill bit, carries the cuttings to the surface, prevents excessive fluid loss into the formation, and prevents the formation from caving. The rotating drill pipe turns the bit which cuts the formation allowing the cuttings to be flushed out.

The drilling fluid may be clear water, water mixed with bentonite or water mixed with a biodegradable organic "mud".

Mud rotary rigs are the most common rig available. Other types of drilling rigs are, however, better suited for certain geologic environments and for many water-quality sampling programs.

Advantages:
(1) Available throughout the U.S.
(2) Capable of drilling all formations, hard or soft.
(3) Capable of drilling to any depth desired for monitoring.
(4) Casing not required during drilling.
(5) Formation logging (sampling) is fairly reliable in most formations.
(6) Relatively inexpensive.

Disadvantages:
(1) Drilling fluid mixes with formation fluid and is often difficult to completely remove.
(2) Bentonite (if used to minimize fluid loss) will adsorb metals and may interfere with some other parameters, thereby making this drilling method (at least the use of bentonite drilling mud) undesirable where metals are being sampled.
(3) Organic/biodegradable additives mixed with the water to minimize fluid loss will interfere with bacterial analyses and organic-related parameters.
(4) No information on the position of the water table, and only limited information on water-producing zones is directly available during drilling. Electric logging of rotary drilled wells can substantially add to the accuracy of the driller's log and to water-related information.
(5) Circulates contaminants.



The drilling fluid (or water) is pumped through the swivel and down through the kelley which is turned by the rotary table. The mud then flows down through the drill pipe, out through the bit and back up the hole carrying cuttings which settle out of the mud in the first section(s) of the mud pit.

Figure 8. Mud Rotary Drilling

Air Rotary

Principles of Operation: An air-rotary rig operates in the same manner as a mud-rotary rig except that air is circulated down the drill pipe and returns (bringing the cuttings) up the annulus. Some rotary rigs are equipped to operate either with mud or air. Air rotary rigs are available throughout much of the U.S. and are well suited for many ground-water quality programs.

Advantages:

(1) No drilling fluid is used, therefore, contamination or dilution of the formation water is not a factor.
(2) Air-rotary rigs operate best in hard rock formations.
(3) Formation water is blown out of the hole along with the cuttings, therefore, it is possible to readily determine when the first water-bearing zone is encountered.
(4) Collection and field analysis (after filtering) of water blown from the hole can provide enough information regarding changes in water quality for some parameters such as chlorides for which only large changes in concentration are significant.
(5) Formation sampling ranges from excellent in hard, dry formations to nothing when circulation is lost as in formations such as some limestones or other formations with cavities.
(6) Air rotary rigs are common and readily available throughout most of the U.S.

Disadvantages:

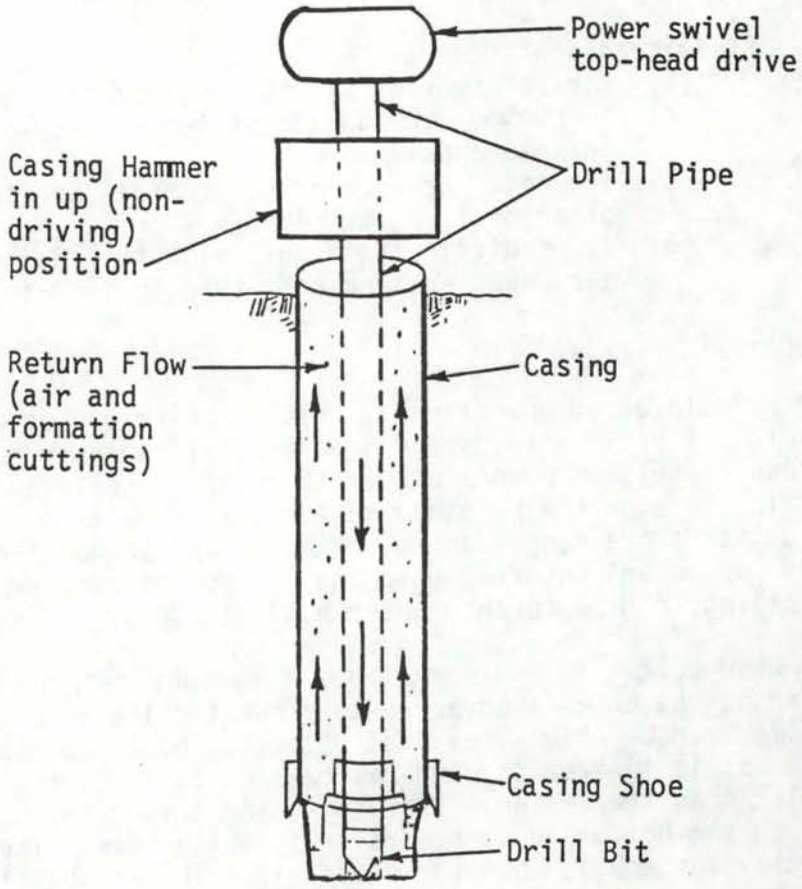
(1) Casing is required to keep the hole open when drilling in soft, caving formations below the water table. This is often a major disadvantage.
(2) When more than one water-bearing zone is encountered and where the hydrostatic pressures are different, then flow between the zones will occur between the time when the drilling is done and the hole can be properly cased and one zone grouted off.

Air Drilling with Casing Hammer

Principles of Operation: A top-head drive rotary rig can be modified to accept a casing hammer. The method of drilling is the same as with air rotary except that when caving formations are encountered the casing hammer drives the casing down to prevent the hole from caving (Figure 9). The casing can be driven without withdrawing the drill pipe. This drilling method is generally excellent for constructing monitoring wells in unconsolidated formations.

Advantages:

(1) Same advantages as with standard air rotary drilling except that soft, caving formations can be drilled.
(2) The use of casing minimizes flow into the hole from upper water-bearing layers, therefore multiple layers can be penetrated and sampled for rough field determinations of some water quality parameters.



An air drill with casing hammer operates like an air rotary drill except that in caving formations the casing can be driven to hold the hole open. The casing hammer is slipped down over the drill pipe and attached to the top of the casing and by a hammering motion, drives the casing. Usually the drill bit has drilled below the casing somewhat, but the casing shoe cuts a larger hole than the drill bit and therefore has to be driven.

Figure 9. Air Drill with Casing Hammer

Disadvantages:

(1) Air-rotary rigs with casing hammers are not in common use throughout the United States and may be difficult to locate in some areas.
(2) The cost per hour or per foot is substantially higher than other drilling methods.
(3) It is difficult to pull back the casing if it has been driven very deep - say deeper than 50 feet in many formations.

Cable Tool

Principles of Operation: A cable tool rig uses a heavy, solid-steel, chisel-type drill bit suspended on a steel cable, which when raised and dropped chisels or pounds a hole through the soils and rock (Figure 10). When drilling through the unsaturated zone, some water must be added to the hole. The cuttings are suspended in the water and then bailed out periodically. After sufficient water is entering the borehole to replace the water removed by bailing then no further water need be added.

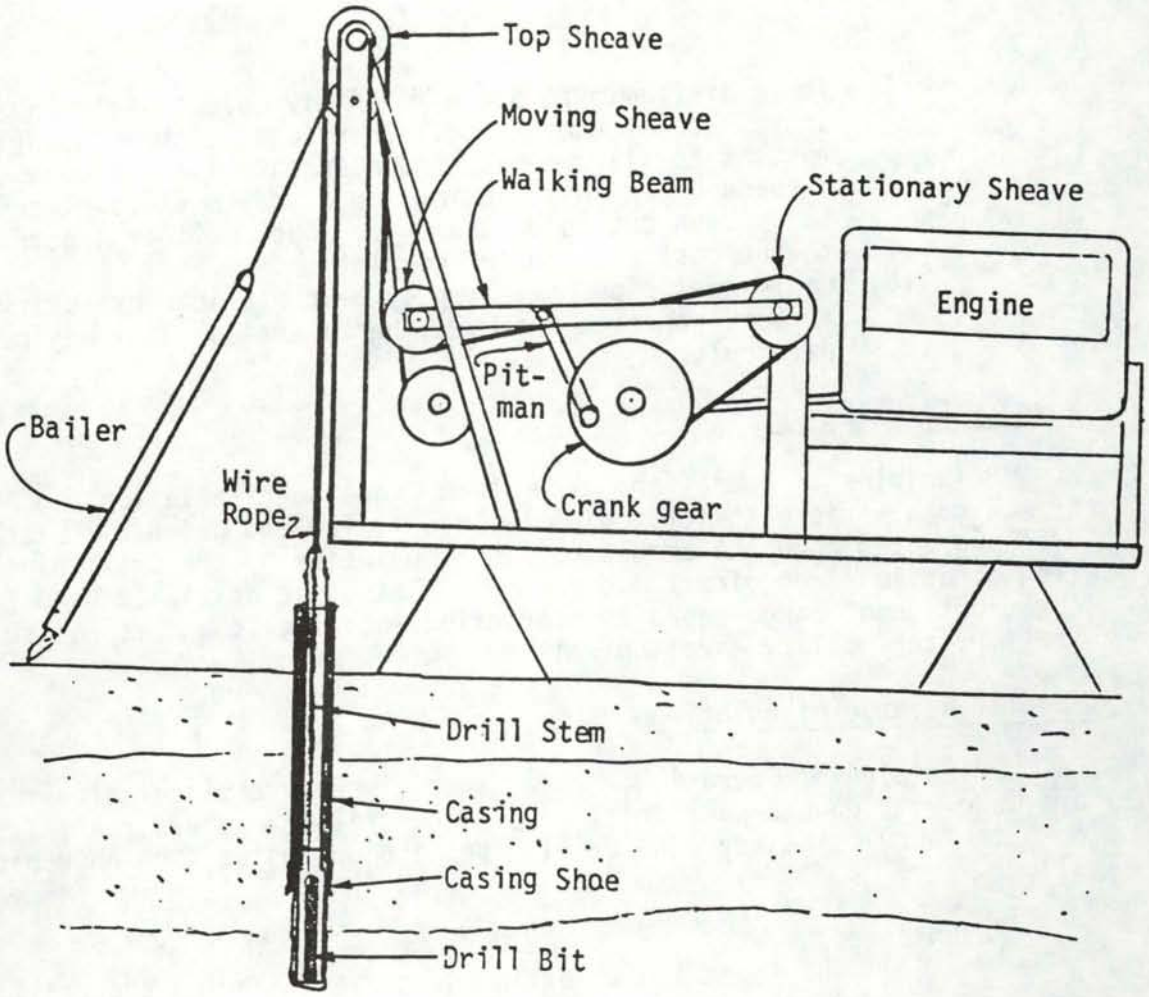
When soft caving formations are encountered, it is necessary to drive casing as the hole is advanced to prevent collapse of the hole. Often the drilling can be only a few feet below the bottom of the casing. Because the drill bit is lowered through the casing, the hole created by the bit is smaller than the casing. Therefore, the casing (with a sharp, hardened casing shoe on the bottom) must be driven into the hole. The shoe in fact cuts a slightly largerhole than the drill bit. This tight-fitting drive shoe should not, however, be relied upon to form a seal from overlying water-bearing zones in water quality investigations.

Advantages:

(1) Formation samples can be excellent with a skilled driller using a sand-pump bailer.
(2) Information regarding water-bearing zones is readily available during the drilling. Even relative permeabilities and rough water quality data from different zones penetrated can be obtained by skilled operators.
(3) The cable-tool rig can operate satisfactorily in all formations, but is best suited for caving, large gravel type formations or formations with large cavities above the water table (such as limestones).

Disadvantages:

(1) Drilling is slow compared with rotary rigs.
(2) The necessity of driving the casing along with drilling in unconsolidated formations requires that the casing be pulled back to expose selected water-bearing zones. This process complicates the well completion process and often increases costs.
(3) The relatively large diameters required (minimum of 4-inch casing) plus the cost of steel casing result in large costs compared with rotary drilling and plastic casing.



The cable tool (sometimes called churn drill or percussion drill) operates as follows: Rotation of the crank gear causes the pitman to raise and lower the walking beam which is anchored at the stationary sheave end. The moving sheave end of the walking beam moves up and down causing the wire rope passing over the top sheave to alternately raise and lower the heavy drill stem and bit which drills the hole. The bailer is used to remove cuttings, and the casing is driven into the hole to prevent caving in soft formations.

Figure 10. Cable Tool Drilling

(4) It is difficult to place a positive grout seal above the drive shoe of the casing. Therefore, either the drive casing must be totally removed and the seal placed around the outside of an inner casing, or a seal must be placed above the screen but below the drive shoe. Either procedure adds to the cost and time of completion.
(5) Cable-tool rigs have largely been replaced by rotary rigs in some parts of the U.S., hence availability may be difficult.

Reverse Circulation

Principles of Operation: The common reverse-circulation rig is a water or mud rotary rig with large diameter drill pipe and which circulates the drilling water down the annulus and up the inside of the drill pipe (reverse flow direction from direct mud rotary). This type of rig is used for the construction of large-capacity production water wells and is not suited for small, water-quality sampling wells.

Special Reverse Circulation

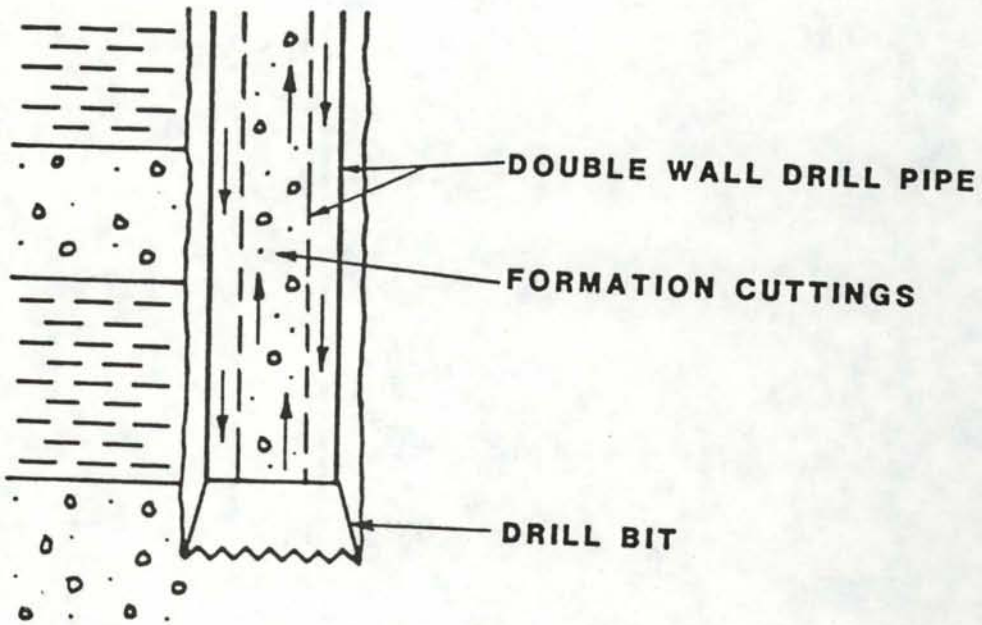
Principles of Operation: A few special reverse-circulation rotary rigs are made with double-wall drill pipe. The drilling water or air is circulated down the annulus between the drill pipes and up inside the inner pipe (Figure 11).

Advantages:
(1) The formation water is not contaminated by the drilling water.
(2) Excellent formation samples can be obtained.
(3) When drilling with air, immediate information is available regarding the water-bearing properties of formations penetrated.
(4) Caving of the hole in unconsolidated formations is not as great a problem as when drilling with the normal air rotary rig.

Disadvantages:
(1) Double-wall, reverse-circulation rigs are very rare and expensive to operate.
(2) Placing cement grout around the outside of the casing above the screen of the permanent well often is difficult - especially when the screen and casing are placed down through the inner drill pipe before the drill pipe is pulled out.

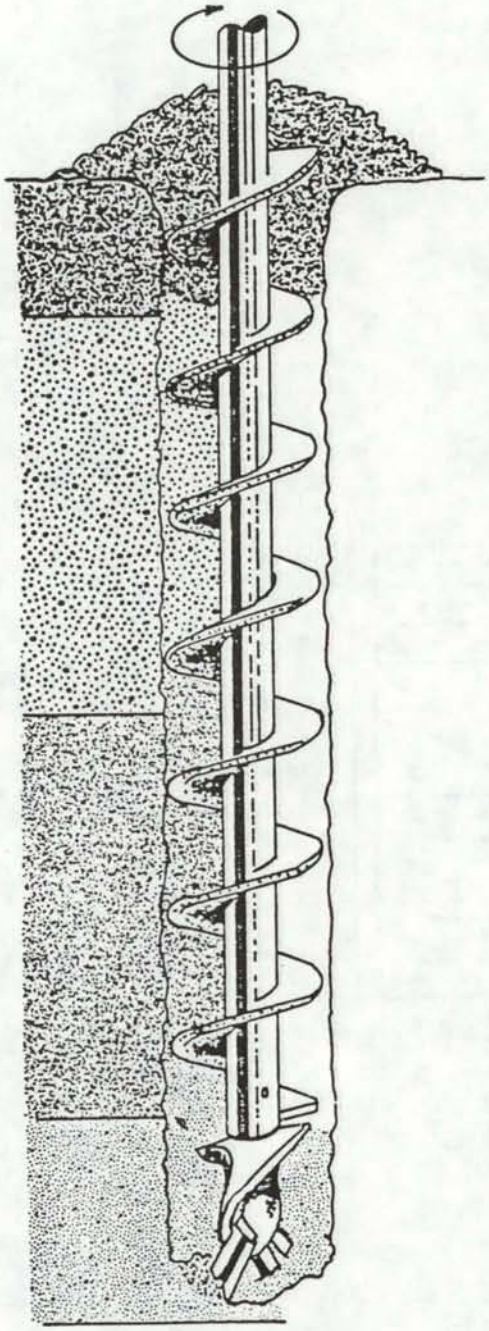
Solid-Stem Continuous-Flight Auger

Principles of Operation: Drilling is accomplished by rotating the solid stem, continuous-flight augers into the soils. As the augers are "screwed" into the soils, the cuttings are brought to the surface on the rotating flights (Figure 12). Auger bits are essentially of two types: fish tail or drag bits for use in unconsolidated materials, and claw or finger bits for



Air or drilling fluid is pumped down the annulus of the double-wall drill pipe. Formation cuttings are brought up the inside of the inner pipe along with the return air or fluid.

Figure 11. Special Reverse Circulation



The continuous-flight auger bores into the soil and rotates the cuttings upward along the flights. The uppermost cuttings are discharged at the surface to make room for the space of the auger as it penetrates additional soils.

Figure 12. Continuous Flight Auger Drilling

use in more compacted, lithified or cemented soils. Once the desired depth is reached, the augers are allowed to rotate to clean out the borehole. The augers are then removed from the borehole and well screen and casing installed. This method is best applied when installing monitor wells in shallow unconsolidated formations.

Advantages:

(1) The auger drilling rigs are generally mobile, fast and inexpensive to operate in unconsolidated formations.
(2) No drilling fluid is used, therefore contamination problems are minimized.

Disadvantages:

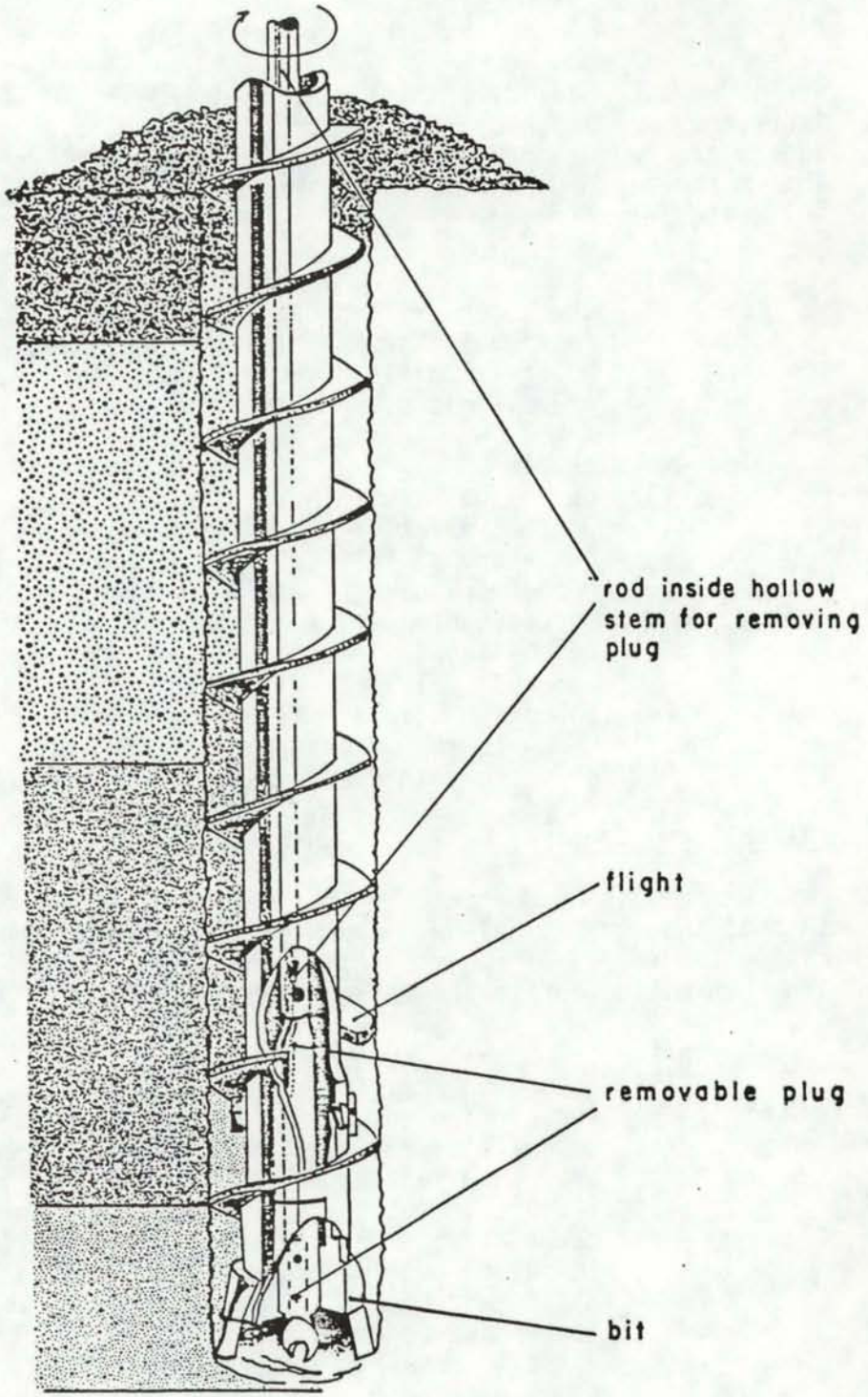
(1) Cannot be used in hard rock.
(2) Depth limitation varies with equipment and type of soils but approximately 150 feet is maximum.
(3) Once the augers have been withdrawn, the degree to which the borehole will remain open is dependent upon the degree of soil consolidation and saturation. Most boreholes will collapse below the water table.
(4) Formation samples may not be completely accurate.
(5) Depth to the water table may be difficult to determine accurately in deep borings.

Hollow-Stem, Continuous-Flight Auger

Principles of Operation: This method differs from the solid stem augers in that the stem is hollow. Upon reaching the desired depth, a small diameter casing and screen can be set inside the hollow stem (Figure 13). The augers are then pulled-out as the casing is held in place.

Advantages:

(1) The auger drilling rigs are generally mobile, fast, and inexpensive to operate in unconsolidated formations.
(2) No drilling fluid is used, therefore contamination problems are minimized.
(3) The problem of the hole caving in saturated, unconsolidated material, as when the solid-stem, continuous-flight auger is pulled out of the hole, is overcome by placing the casing and screen down inside the hollow stem before the augers are removed.
(4) Natural gamma-ray logging can be done inside the hollow stem which permits defining the nature and thickness of the formations penetrated.
(5) A grout seal can be placed around the permanent casing by attaching a cement basket above the screen before setting the assembly inside the hollow stem. Grout is placed in the annulus between the casing and hollow stem and the augers are pulled out. Grout is continuously injected or placed until all augers are removed.



The hollow-stem, continuous-flight auger bores into soft soils carrying the cuttings upward along the flights. When the desired depth is reached, the plug is removed from the bit and withdrawn from inside the hollow stem. A well point (1¼-in. or 2-in.) can then be inserted to the bottom of the hollow stem and the auger pulled out leaving the small-diameter monitoring well in place.

Figure 13. Hollow Stem Auger Drilling

Disadvantages:

(1) Cannot be used in hard rock.
(2) Depth limitation varies with equipment and type of soils but approximately 150 feet is practical.
(3) Formation samples may not be completely accurate.
(4) Depth to the water table may be difficult to determine accurately in deep borings.

Keck Screened, Hollow Stem, Continuous Flight Auger (14)

Principles of Operation: This method operates the same as the hollow-stem augers except that the lead section incorporates a well screen (Figure 14).

Advantages:

(1) The auger drilling rigs are generally mobile, fast and inexpensive to operate in unconsolidated formations.
(2) No drilling fluid is used, therefore contamination problems are minimized.
(3) The problem of the hole caving in saturated, unconsolidated material, as when the solid-stem, continuous-flight auger is pulled out of the hole, is overcome by placing the casing and screen down inside the hollow stem before the augers are removed.
(4) Natural gamma-ray logging can be done inside the hollow stem which permits defining the nature and thickness of the formations penetrated.
(5) A grout seal can be placed around the permanent casing by attaching a cement basket above the screen before setting the assembly inside the hollow stem. Grout is placed in the annulus between the casing and hollow stem and the augers are pulled out. Grout is continuously injected or placed until all augers are removed.
(6) Depth to water table can be accurately determined.
(7) Water samples can be collected at any desired depth below the water table during the drilling operation without removing the augers or setting a screen and casing.

Disadvantages:

(1) Cannot be used in hard rock.
(2) Depth limitation varies with equipment and type of soils but approximately 150 feet is practical.
(3) Formation samples may not be completely accurate.

Bucket Auger

Principles of Operation: The bucket auger consists of a relatively large (8-inch minimum diameter by 2 feet long) bucket with a cutting edge on the bottom which is slowly rotated by a square, telescoping kelley or drill stem. When the bucket fills with cuttings, it is brought to the surface and emptied. This method is good for constructing shallow wells just into the water table in unconsolidated formations.

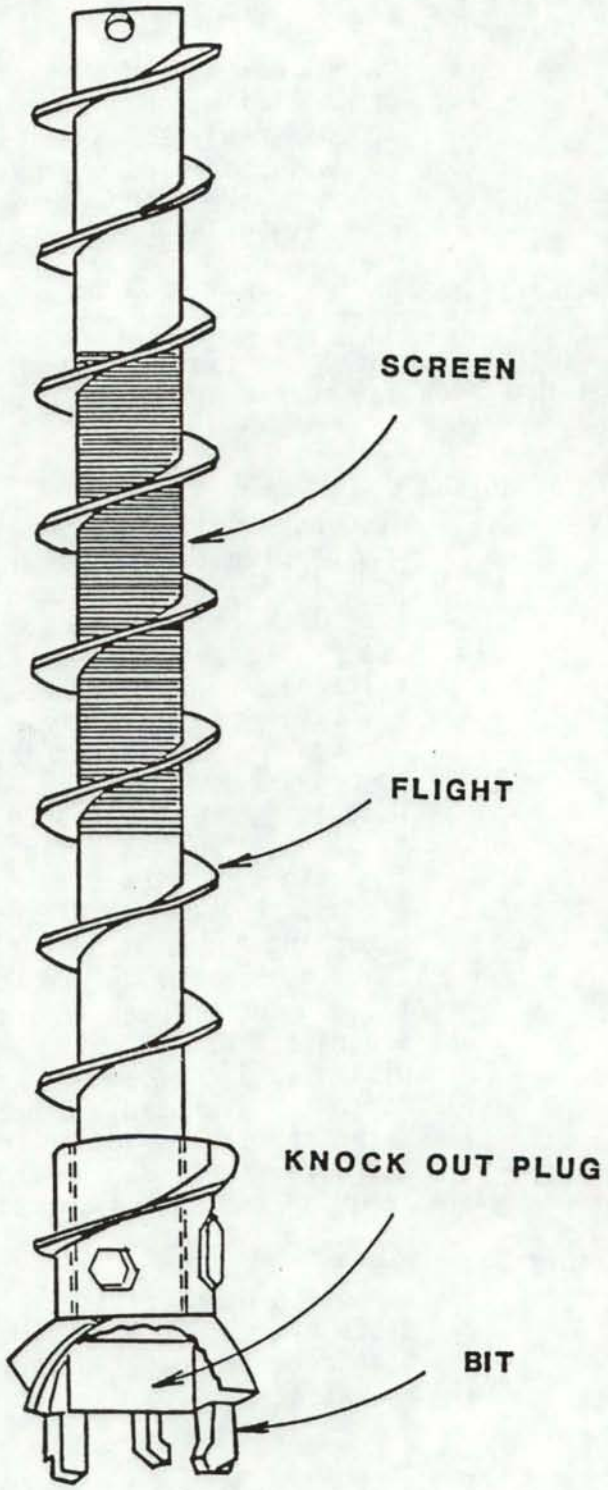


Figure 14. Keck Screened, Hollow Stem, Continuous Flight Auger

Advantages:

(1) No drilling water is required when either drilling above the saturated zone, or below the saturated zone in non-caving formations.
(2) After the hole has been drilled, the setting of casing with screen and grouting the outside of the casing to form a seal is relatively easy.
(3) Formation sampling is excellent.

Disadvantages:

(1) The hole diameter is large, hence the annular space is large when small diameter casing is used. This requires careful grouting and backfilling to insure water sample integrity.
(2) In caving formations below the water table it is necessary to continuously add water to prevent caving.
(3) Use of the bucket auger is restricted to soft formations and depths less than about 50 feet.
(4) These rigs are not widely available.

Jetting

Principles of Operation: Jetting consists of pumping water or drilling mud down through a small diameter (1½ to 2-inch) standard pipe. The pipe may be fitted with a chisel bit or a special jetting screen. Formation materials dislodged by the bit and jetting action of the water are brought to the surface through the annulus around the pipe. As the pipe is jetted deeper, additional lengths of pipe may be added at the surface.

This method is acceptable in very soft formations, for shallow sampling, and when introduction of drilling water to the formation is not a consideration.

Advantages:

(1) Jetting is fast and very inexpensive.
(2) Because of the small amount of equipment required, jetting can be accomplished in locations where it would be very difficult to get a normal drilling rig. For example, it would be possible to jet down a well point in the center of a lagoon at a fraction of the cost of using a drill rig.
(3) Jetting numerous well points just into a shallow water table is an inexpensive method for determining the water table contours, hence flow direction.

Disadvantages:

(1) A large amount of foreign water or drilling mud is introduced above and into the formation to be sampled.
(2) It is not possible to place a grout seal above the screen to assure depth-discrete sampling.
(3) The diameter of the casing is usually limited to two inches therefore, obtaining samples must be either by suction lift, air lift, bailer, or other methods applicable to small diameter casings.
(4) Jetting is only possible in very soft formations, and the depth limitation is shallow - say 30 feet without special equipment.
(5) Large quantities of water are often needed.

Use of Bore-Hole Geophysics

The use of geophysics can greatly enhance the amount of information gained from a borehole (Figure 15). Each geophysical logging method is designed to operate in specific borehole conditions, involves lowering a sensing device into the borehole and can be interpreted to determine lithology, geometry, resistivity, bulk density, porosity, permeability, moisture content and to define the source, movement, chemical and physical characteristics of ground water (5).

1. Spontaneous-Potential Log: These logs are records of the natural potentials developed between the borehole fluid and the surrounding rock/soil materials. The SP log is mainly used for geologic correlation, determining bed thickness and separating non-porous from porous rocks in shale-sandstone and shale-carbonate sequences. It can be run only in open, uncased and fluid filled boreholes.

2. Normal Resistivity Logs: Normal logs measure the apparent resistivity of a volume of rock/soil surrounding. The short normals give good vertical detail and records the apparent resistivity of the mud invaded zone. The long normals record the apparent resistivity beyond the invaded zone. The radius of investigation is generally equal to the distance between the borehole current and measuring electrodes. These logs can be run only in open, uncased and fluid filled boreholes.

3. Natural-Gamma Logs: Natural-gamma logs or gamma-ray logs are records of the amount of natural-gamma radiation emitted by rocks/soils. The main use of this logging method is for the identification of lithology and stratigraphic correlation. These logs can be run in open or cased, fluid or air filled boreholes. The radius of investigation extends to about 6-12 inches of the borehole wall.

4. Gamma-gamma Logs: These logs record the intensity of gamma radiation from a source in the probe after it is backscattered and attenuated within the borehole and surrounding rocks/soil. The main uses of gamma-gamma logs are for identification of lithology and measurement of bulk density and porosity of rocks/soils. They are also used for

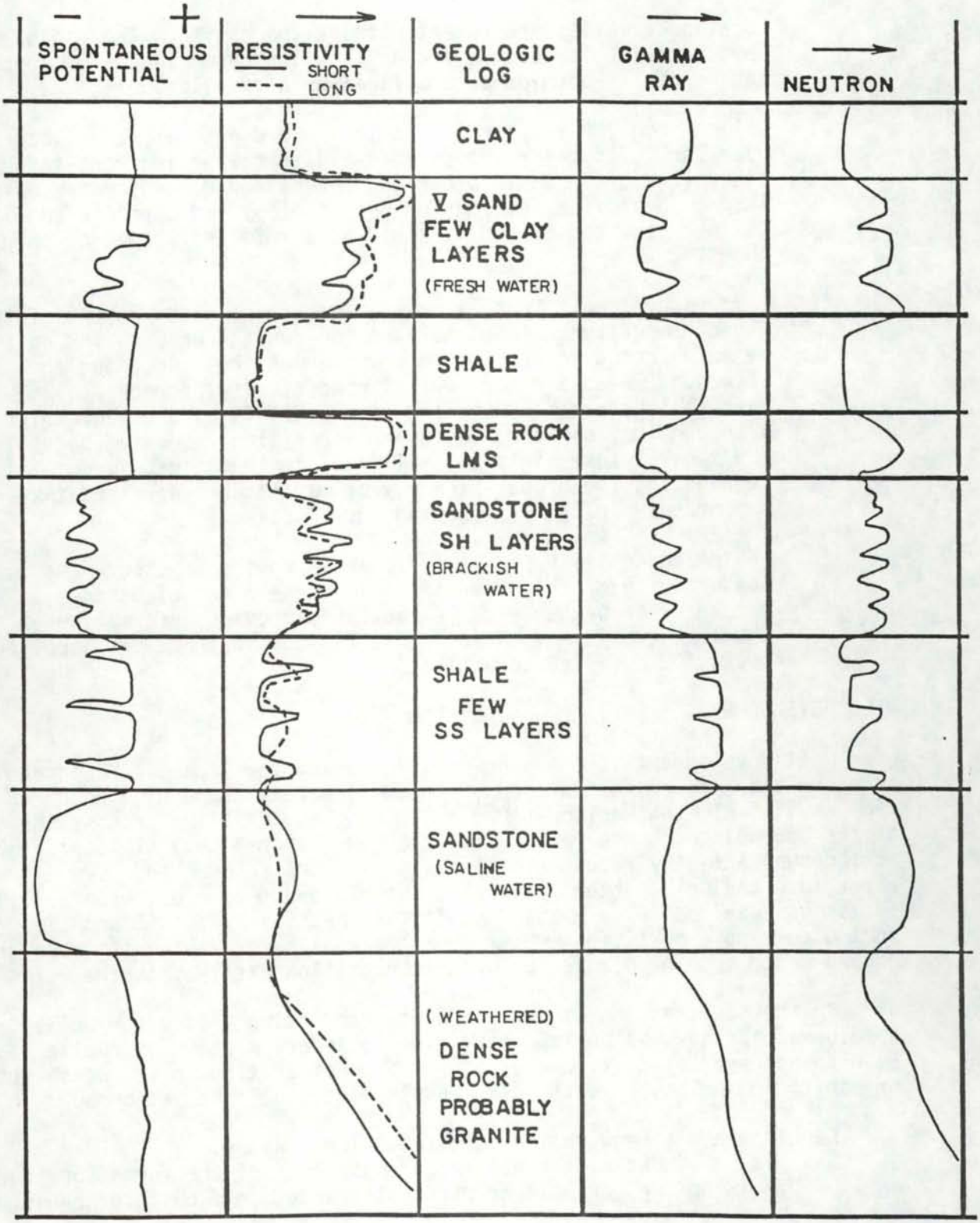


Figure 15. Comparison of Electric and Radioactive Bore Hole Logs

locating cavaties and cement outside the casing. The radius of investigation is about 6 inches from the borehole wall. These logs can be run in open or cased, fluid or air filled boreholes.

5. Caliper Log: A caliper log is the record of the average borehole diameter. Its major use is to evaluate the environment in which other logs are made in order to correct for hole-diameter effects. They also provide information on lithology and borehole conditions. Caliper logs can be run in fluid or air filled, cased or open boreholes.

6. Temperature Log: These logs provide a continuous record of the fluid temperature immediately surrounding the probe. The data can be interpreted to provide information on the source and movement of ground water and the thermal conductivity of rocks/soils. Temperature logs are best applied in fluid filled, open boreholes although they can also be run in air filled and cased boreholes. The zone of investigation is limited to that fluid immediately surrounding the probe which may or may not be representative of the temperature in the surrounding rocks/soils.

7. Fluid-Conductivity Logs: These logs provide a measurement of the conductivity of the borehole fluid between the electrodes in the probe. When properly corrected, they provide information on the chemical quality of the borehole fluid. They are best applied in open, fluid filled boreholes.

WELL DEVELOPMENT

Well development is the process of cleaning the face of the borehole and the formation around the outside of the well screen to permit ground water to flow easily into the monitoring well. During any drilling process the side of the borehole becomes smeared with clays or other fines. This plugging action substantially reduces the permeability and retards the movement of water into the well screen. If these fines are not removed, especially in formations having low permeability, it then becomes difficult and time consuming to remove sufficient water from the well before obtaining a fresh ground-water sample because the water cannot flow easily into the well.

In the construction of high-capacity production type water wells, the development process is an important step to assure maximum hydraulic efficiency. Even though hydraulic efficiency is not a consideration in the construction of monitoring wells, nevertheless, development should be performed.

Development is required for the following reasons:

(1) To restore the natural permeability of the formation adjacent to the borehole to permit the water to flow into the screen easily.

(2) To remove the clay, silt and other fines from the formation so that during subsequent sampling the water will not be turbid or contain suspended matter which can easily interfere with chemical analysis.

The development process is best accomplished for monitoring wells by causing the natural formation water inside the well screen to move vigorously in and out through the screen in order to agitate the clay and silt, and move these fines into the screen. The use of water other than the natural formation water is not recommended.

Methods suitable for the development of monitoring wells are as follows:

(1) Surge block.

A surge block is a round plunger with pliable edges such as belting that will not catch on the well screen. Moving the surge block forcefully up and down inside the well screen causes the water to surge in and out through the screen accomplishing the desired cleaning action.

Surge blocks are commonly used with cable-tool drilling rigs, but are not easily used by other types of drilling rigs.

(2) Air lift.

Compressed air pumped down a pipe inside the well casing can be used to blow water out of the monitoring well. If air is applied to the well intermittently and for short periods then the water is only raised inside the casing rather than blown out and will fall back down the casing causing the desired back washing action. Finally, blowing the water out will remove the fines brought into the screen by the agitating action.

Considerable care must be exercised to avoid injecting air into the well screen. Such air can become trapped in the formation outside the well screen and alter subsequent chemical analyses of water samples. For this reason, the bottom of the air pipe should never be placed down inside the screen.

Another restriction on the use of air is the submergence factor. Submergence is the feet of water above the bottom of the air pipe while pumping (blowing water out) divided by the total length of the air pipe. Submergence should be on the order of at least 20 percent, which may be difficult to achieve with many shallow monitoring wells.

(3) Bailer.

A bailer sufficiently heavy that it will sink rapidly through the water can be raised and lowered through the well screen. The resulting agitating action of the water is similar to that caused by a surge block. The bailer, however, has the added advantage of removing the fines each time it is brought to the surface and dumped. Bailers can be custom-made for small diameter wells, and can be hand-operated in shallow wells.

(4) Surging by pumping.

Starting and stopping a pump so that the water is alternately pulled into the well through the screen and backflushed through the screen is an effective development method. Periodically pumping to waste will remove the fines from the well and permit checking the progress to assure that development is complete.

In conclusion, development of monitoring wells, although often overlooked, is an important function of the well construction in order to facilitate future sampling and to obtain samples free of turbidity.

MULTIPLE-COMPLETION SAMPLING WELLS

Most ground water pollution is relatively shallow and affects the first and sometimes the second permeable layers. Conventional wells completed in specific permeable layers are constructed so that each well is depth-specific.

Occasionally, it is desired to sample numerous permeable layers at considerable depth, perhaps at a few hundred feet. If, for example, it is desired to define the bottom of the pollution plume and then to periodically sample the lower-most contaminated layer, a cemented and gun-perforated well can be constructed. Or, if permanent monitoring in several deep layers is required such as for underground injection wells, then the permanent type multiple-completion well should be considered.

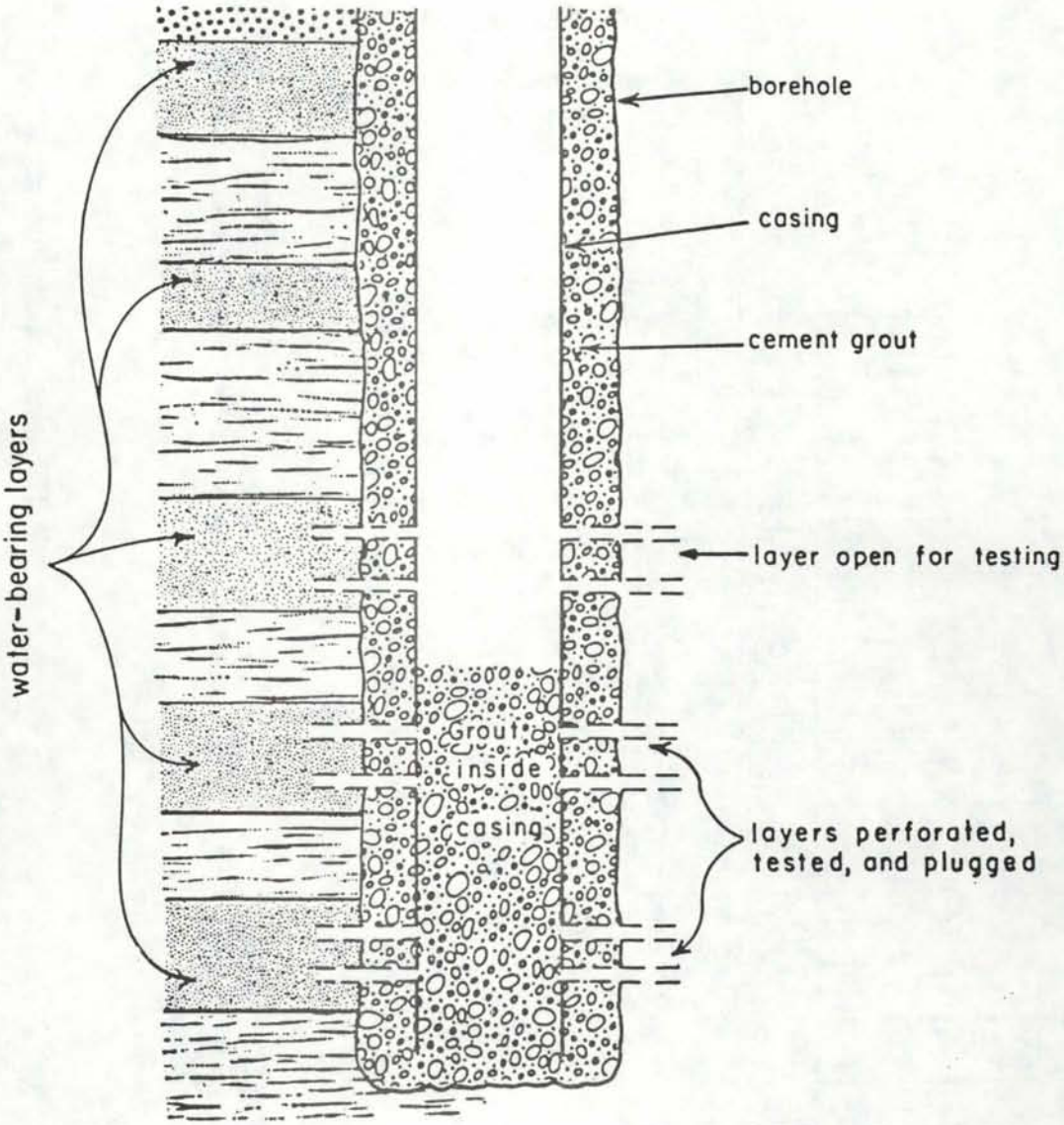
Figure 16 illustrates the construction of a gun-perforated well. This type of well is commonly drilled and logged to define the depth of all the permeable layers. Then casing is installed with centralizers and cement grout is placed in the annulus from the bottom up to surround the casing. The grout prevents intercommunication between permeable layers along the outside of the casing.

The casing is then perforated opposite the bottom-most permeable layer. Water from this layer is pumped out, sampled, and analyzed and the static level is measured. If no contaminants are present, then cement grout is pumped through a tremie pipe to fill the inside of the casing up past the perforations thereby permanently sealing that zone. The second zone from the bottom may then be perforated, sampled, and sealed if no contaminants are found. This procedure may be repeated until contaminants are observed at which time the well may be left to periodically monitor that layer, or plugged and upper layers sampled.

Care must be exercised to assure that sufficient water is pumped from the layer being sampled and that the sample is representative of the formation water before that layer is plugged. This approach is not recommended when the pollutants are reactive with cement.

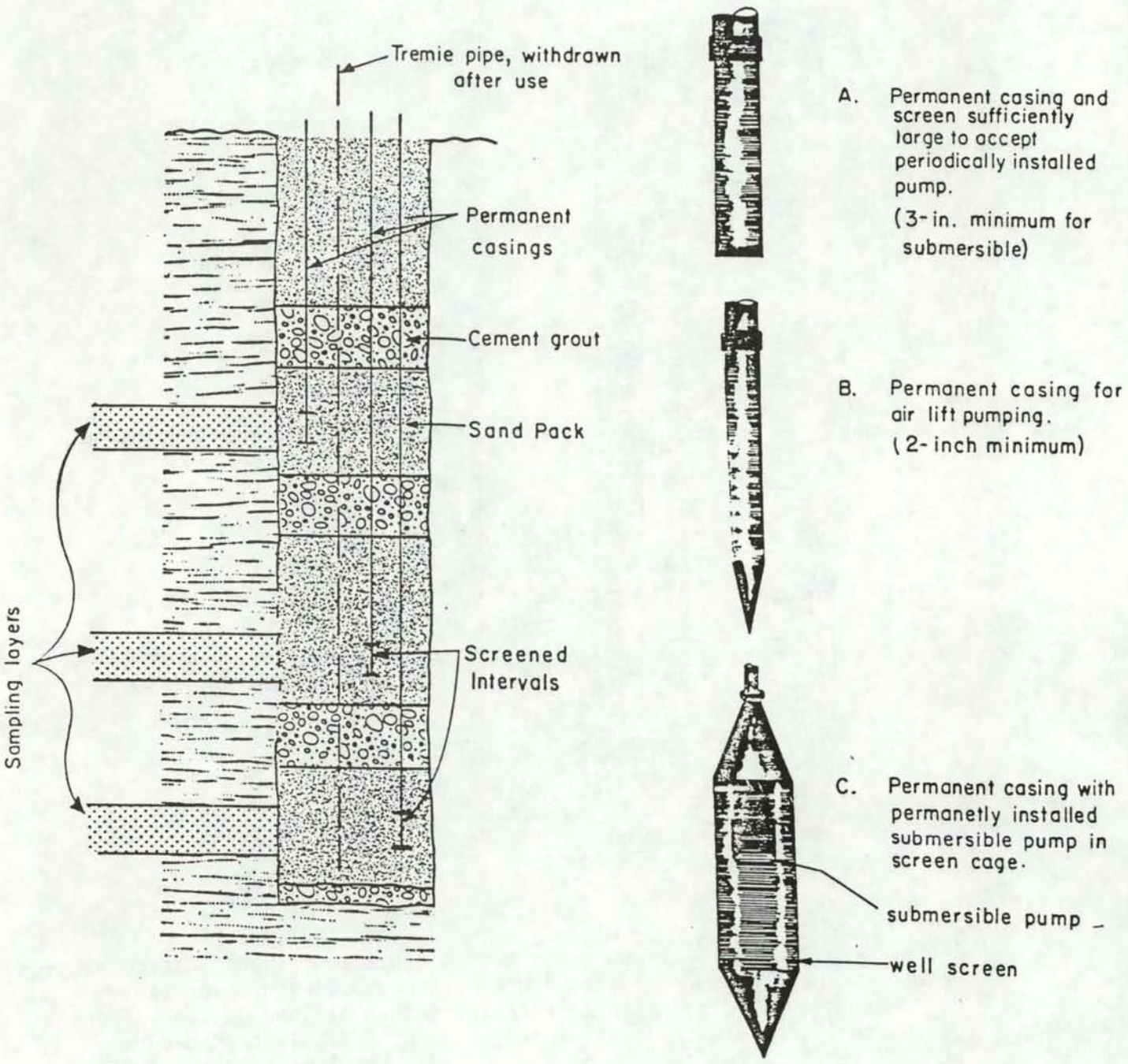
Figure 17 depicts another alternative for constructing a multiple-completion monitoring well. This approach provides for periodic sampling and permanent monitoring of each permeable layer screened rather than one-time sampling as shown in Figure 16. However, because of construction difficulties it is rarely practical to monitor at more than three depths in a well. The approach shown in Figure 16, on the other hand, permits sampling as many layers as desired, but all layers cannot be permanently monitored.

The construction of a multiple-completion monitoring well as shown in Figure 17 is difficult from the standpoint of lowering the various components in the hole simultaneously. The drilling contractor must plan and execute



The entire casing is surrounded by cement grout to prevent interconnection between permeable layers. Starting at the bottom, each layer is perforated, sampled as often as warranted, then plugged on the inside of the casing before the next layer is perforated. This procedure permits vertical delineation of the contaminant plume in deep aquifer systems at minimum cost.

Figure 16. Multiple Completion Well, for One-Time Sampling



A multiple completion sampling well may be completed with pumping arrangements of A, B, or C. The sand pack material and cement grout are placed from the bottom up through the tremie pipe as the pipe is pulled out.

Figure 17. Multiple Completion Well, for Periodic Sampling

this work carefully to be successful. The tremie pipe, commonly a 2-inch pipe, is lowered into the hole along with the other pipes. Sand is pumped through the tremie pipe to place the sand pack at the desired depths, and cement grout is also pumped through the tremie to place the grout seals. A wash plug and clear water can be pumped through to clean the grout out of the pipe before the next layer of sand is placed. Or, in some cases, it may be more feasible to use two tremie pipes, one for sand and one for cement grout. In either case careful measurements are required to place the sand and grout from the bottom up as the tremie pipe is withdrawn.

After the well is completed, each screened layer should be pumped thoroughly to remove the effects of foreign water in the formation due to drilling, flushing, and placement of sand grout.

Several optional methods for constructing multiple-completion wells are available. Option "A", Figure 17, utilizes two or three 3-inch or larger casings from each screen depth all the way to ground surface. In addition the temporary tremie pipe must be installed thereby requiring a hole diameter of at least 11 to 12 inches. This option has the advantage of using one pump, which is installed as required in each casing.

Option "B", Figure 17, is the least expensive. An 8-inch hole is probably sufficient diameter for the installation of three permanent 2-inch casings plus the tremie pipe. Conceivably it may be feasible to install more than three permanent casings in a larger diameter hole, however, the difficulties in handling the materials during installation become greater. The disadvantage of the 2-inch casings is the limitation on pumping. If the layers to be sampled are highly permeable then the time required to remove invaded water from the formations becomes excessive due to the pumping limitation imposed by the small casing. Also with 2-inch casings, specialized pumping systems are required which may not be desirable considering either the aquifer characteristics or the nature of the pollutants.

Option "C", Figure 17 utilizes a permanently-installed submersible pump in a well-screen cage set at each layer to be sampled. Each pump discharges through a 2-inch pipe to the surface. Foot valves are removed from the pumps to permit static water levels to be measured. This approach has the advantage of using submersible pumps for sampling highly permeable layers with deep static levels, yet keeping the diameter of the hole smaller than that required for Option "A". The maximum installed diameter would be the OD of the screen (4-inches), plus two 2-inch discharge pipes, plus the 2-inch tremie pipe; therefore, installation into a 9 or 10 inch hole should be feasible. Installation of this system is complicated, however, by the electric wiring that must be installed to operate each pump. A disadvantage is the questionable life-expectancy of the pumps; they cannot be replaced if they fail.

With any type of multiple completion well in which more than one discrete depth can be sampled at any one time there is always the question of hydraulic intercommunication between layers via the well. A possible test to evaluate this potential is to measure the static levels in each casing, pump one of the monitoring wells, and if the water levels in the other monitoring wells

do not draw down, then intercommunication is probably not a factor.

Because of the intercommunication potential and because of the difficulties in construction, the use of multiple completion wells should be avoided except where this approach is significantly more cost-effective than individual wells.

OVERVIEW OF GROUNDWATER IMPACTS OF RCA ON SOLID WASTE LANDFILLS IN WASHINGTON

OVERVIEW OF

GROUNDWATER IMPACTS OF RCRA

ON SOLID WASTE LANDFILLS IN WASHINGTON

1. PURPOSE

2. WHAT IS SOLID WASTE ?

3. WHAT IS RCRA ?

4. WHO IS RESPONSIBLE FOR ADMINISTERING RCRA ?

5. WHAT ARE THE MAJOR PROVISIONS OF RCRA ?

6. WHAT ARE THE MAJOR PROVISIONS OF HSWA

7. HOW DOES RCRA RELATE TO CERCLA ?

8 . SUBTITLE D: SOLID WASTE DISPOSAL FACILITY CRITERIA:
(40 CFR Parts 257 and 258)

9. EXISTING SOLID WASTE REGULATIONS
(40 CFR Part 257)

10. REVISIONS TO GROUNDWATER REQUIREMENTS
(40 CFR Sections 257.3 - 4)

11. PROPOSED ADDITION TO PART 257
(40 CFR Part 258)

12. PROPOSED RULE 40 CFR 258 Subpart D: Design Criteria

13. PROPOSED RULE 40 CFR 258 Subpart E: Groundwater Monitoring and Corrective Action

14. OVERVIEW OF GROUNDWATER MONITORING REQUIREMENTS
(40 CFR Sections 258.51 - 55)

15. IMPLEMENTATION OF THE CORRECTIVE ACTION PROGRAM
(40 CFR Section 258.58)

1. PURPOSE

To provide a regulatory framework for developing groundwater monitoring networks at solid waste disposal sites.

2. WHAT IS SOLID WASTE ?

Solid waste means any garbage, refuse, sludge from a waste 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 activites.

COMMERICAL SOLID WASTE means all types of solid waste generated by stores, offices, restaurants, warehouses, and other nonmanufacturing activities, excluding residential and industrial wastes.

HOUSEHOLD WASTE means any solid waste (including garbage, trash, and sanitary waste in septic tanks) derived from households.

INDUSTRIAL SOLID WASTE means solid waste generated by manufacturing or industrial processes that is not a hazardous waste regulated under Subtitle C of RCRA.

3. WHAT IS RCRA ?

The Resource and Conservation Act (RCRA was enacted as Public law 94-580 in 1976 as an admendment to the Solid Waste Disposal Act. RCRA has been amended by several public laws, including the Used Oil Recycling Act of 1980 and the Hazardous and Solid Waste Amendments of 1984 (HSWA). The primary objective of RCRA is to protect human health and the environment. A secondary objective is to conserve valuable material and energy resources by providing assistance to state and local governments for:

- o prohibiting open dumping,
- o regulating the management of hazardous wastes;
- o encouraging recycling, reuse, and treatment and promoting beneficial solid waste management;
- o providing guidelines for solid waste management; and,
- o promoting beneficial solid waste management, resource recovery, and resource conservation systems.

RCRA provides for "cradle to grave" tracking of hazardous waste, from generator to transporter to treatment, storage, or disposal.

4. WHO IS RESPONSIBLE FOR ADMINISTERING RCRA ?

Congress authorized EPA to develop regulations to carry out the RCRA statute, as amended. In turn, EPA may delegate authority to a state to operate a hazardous waste program in lieu of part or all of the federal hazardous waste program. In states with EPA-authorized hazardous waste programs, EPA may retain certain oversight authority.

If a state program is equivalent to or more stringent than the federal program, EPA may delegate final authority to the state. In the past EPA first granted interim authorization to give the state time to bring its program up to federal RCRA requirements. Once a state demonstrated that its program was equivalent to federal RCRA requirements, EPA granted final authorization, giving the state responsibility to act in lieu of EPA (See Figure A).

Figure A
States with Final Authorization*

Key

EPA authorization for State RCRA programs

States without authorization

Note: *As of May 15, 1986 even states without authorization have hazardous waste regulations that you must comply with.

5. WHAT ARE THE MAJOR PROVISIONS OF RCRA ?

The RCRA statute as amended by HSWA is divided into nine subtitles:

- o Subtitle A - General Provisions
- o Subtitle B - Office of Solid Waste
- o Subtitle C - Hazardous Waste Management
- o Subtitle D - State or Regional Solid Waste Plans
- o Subtitle E - Duties of the Secretary of Commerce in Resource Recovery
- o Subtitle F - Federal Responsibilities
- o Subtitle G - Miscellaneous Provisions (Employee Protection, Citizen Suits, Imminent Hazard, Law Enforcement Authority, etc.)
- o Subtitle H - Research Development, Demonstration, and Information
- o Subtitle I - Regulation of Underground Storage Tanks

6. WHAT ARE THE MAJOR PROVISIONS OF HSWA

The Hazardous and Solid Waste Admendments of 1984 expanded the scope of regulatory control. Some of the key provisions are:

- o Land Disposal Ban: Treatment of hazardous waste is preferred over land disposal.

- o Retrofitting Existing Surface Impoundments: Interim status impoundments must either comply with new double-liner, leachate collection and groundwater monitoring requirements for new impoundments, or stop receiving storing or treating hazardous wastes, or close the impoundment.

- o Minimum Technology Standards: No new landfills or other hazardous waste facilities can be built without first having a permit. As part of your Part B application for a new landfill or impoundment, you must include a double liner with leachate collection and leak detection systems installed above the liner for landfill, and between the liners for surface impoundments. Groundwater monitors also must be in place (see Figure B).

- o Groundwater Monitoring: Groundwater monitoring requirements at landfills, surface impoundments, waste piles, and land treatment facilities apply in all cases. Previously a facility could get an exemption if:

    - o the base of the facility was located above the seasonal high water table;

    - o two liners and a leachate collection system were installed; or,

    - o the liners were inspected.

  HSWA eliminated these variances.

7. HOW DOES RCRA RELATE TO CERCLA ?

The principal objective of RCRA is to regulate the management of active hazardous waste facilities in order to avoid new Superfund sites in the future. Through stringent permitting and chain-of-custody requirements, RCRA is designed to prevent hazardous releases in the first place.

In contrast, CERCLA is concerned with the cleanup of toxic releases at uncontrolled or abandoned hazardous waste sites.

8. SUBTITLE D: SOLID WASTE DISPOSAL FACILITY CRITERIA
(40 CFR Parts 257 and 258)

Subtitle D of RCRA establishes a framework for Federal, State, and local government cooperation in controlling the management of nonhazardous solid wastes. The Federal role in this arrangement is

- o to establish the overall regulatory direction;
- o to provide minimum standards for protecting human health and the environment; and,
- o to provide technical assistance to the States for planning and developing environmentally sound waste management practices.

The actual planning and direct implementation of solid waste programs are State and local functions.

9. EXISTING REGULATIONS (40 CFR Part 257)

Part 257 is the existing minimum national performance criteria necessary to ensure that "no reasonable probability of adverse effects on health or the environment" will result from solid waste disposal facilities or practices

Revisions to the Part 257 will address location restrictions, groundwater monitoring, and corrective action. In addition, the revisions will addresss methane monitoring, closure and post-closure care, and financial assurance requirements.

A facility or practice that meet the criteria is classified as a "sanitary landfill". A facility failing to satisfy any of the standards is considered an "open dump" for purposes of State solid waste management planning. State plans developed under the "Guidelines for Development and Implementation of State Solid Waste Management Plans" (40 CFR Part 256) must provide for closing or upgrading all existing "open dumps" within the State.

The existing part 257 criteria include general environmental performance standards addressing eight major topics:

- o 257.3-1: Floodplains
- o 257.3-2: Endangered species
- o 257.3-3: Surface water
- o 257.3-4: Groundwater
- o 257.3-5: Land application
- o 257.3-6: Disease
- o 257.3-7: Air
- o 257.3-8: Safety

10. REVISIONS TO GROUNDWATER REQUIREMENTS (40 CFR 257.3-4)

This section lays out the groundwater protection standards, which require that facilities and practices not exceed the Safe Drinking Water Act maximum contaminant levels (MCL's) in an underground drinking water source beyond the solid waste boundary or beyond an alternate boundary specified by the State.

The EPA is proposing to update the MCLs which are used as groundwater protection criteria in Part 257, to include any MCLs that have been established by EPA since the promulgation of Part 257 in 1979.

Currently, Part 257 imposes basic environmental criteria for the protection of human health and environment. At the time Part 257 was promulgated, the available interim MCLs for the protection of human drinking water were included as groundwater protection criteria. The revised Part 257 regulation would include any new MCLs as groundwater protection criteria. Therefore the EPA is proposing to simply reference the MCL regulations (40 CFR Part 141) directly, rather than update Appendix I, which now includes only the MCLs promulgated prior to 1979.

11. PROPOSED ADDITION TO PART 257 (40 CFR 258)

Part 258 sets forth minimum national criteria for the location, design, operation, cleanup, and closure of municipal solid waste landfills. A municipal solid waste landfill (MSWLF) that does not meet these criteria would be considered an open dump for purposes of State solid wste management planning under RCRA. Open dumping is prohibited under section 4005 of RCRA.

Part 258 would apply to all new and existing municipal solid waste landfills, except those units that closed prior to the effective date of the proposed rule. The major subparts of the proposed rule are:

- o Subpart A: General
- o Subpart B: Location Restrictions
- o Subpart C: Operating Criteria
- o Subpart D: Design Criteria
- o Subpart E: Groundwater Monitoring and Corrective Action

12. PROPOSED RULE 40 CFR 258 Subpart D: Design Criteria

The proposed rule would require new MSWLF units be designed with liner systems, leachate collection systems, and final cover systems as necessary to meet the design goal in the aquifer at the waste management unit boundary or an alternative boundary specified by the State. The two key components of this performance standard are the:

- o Design Goal which is a human health- and environmental-based groundwater risk level. The design goal is an overall groundwater carinogenic risk level that must be established by the State. The EPA is considering three alternative risk ranges. These are 1 x 10-4 to 1 x 10-7; a fixed level of 1 x 10-5; or an upper bound risk level of 1 x 10-4. The design goal represents the overall groundwater risk level (i. e. the combined risk from all constituents).

- o Point of Compliance in the aquifer (i. e. the waste management unit boundary or an alternative boundary specified by the State). The State must consider at least the following factors in establishing an alternative boundary:

    1) Hydrogeologic characteristics of the facility and surrounding land;

    2) Volume and physical and chemical characteristics of the leachate;

    3) Quantity, quality, and direction of groundwater flow;

    4) Proximity and withdrawal rate of the groundwater users;

    5) Availability of alternative drinking water supplies;

    6) The existing quality of the groundwater; and,

    7) Public health, safety, and welfare effects.

13. PROPOSED RULE 40 CFR 258 Subpart E: Groundwater Monitoring and Corrective Action

The EPA is proposing groundwater monitoring and corrective action requirements to ensure that groundwater contamination at new and existing MSWLFs will be detected and cleaned up as necessary to protect human health and the environment.

The existing rules under Part 257.3-4 require that a facility or practice shall not contaminate an underground drinking water source beyond the solid waste boundary or beyond an alternate boundary established by the State. The existing Part 257 does not specifically require facilities to monitor groundwater beneath their units or to implement a corrective action program when groundwater contamination has occurred. Facilities that are in violation of the current requlations, however are required to close or enter into a compliance schedule with their respective State.

The proposed revisions completely replace the existing regulations for MSWLFs under 40 CFR 257.3-4, providing groundwater monitoring and corrective action requirements under 40 CFR Part 258 for all new and existing MSWLF units. The proposed requiremnts call for assessment of the hydrogeology beneath landfill units, groundwater monitoring, reports on groundwater quality, the establishment of groundwater trigger levels and groundwater protection standards, and corrective action.

The proposed groundwater monitoring and corrective action requirements apply to the owners or operator of all new and existing MSWLFs. This action effectively prohibits the location of MSWLFs in areas where subsurface conditions prevent monitoring of contaminant migration from the landfill unit. MSWLFs in such unmonitorable areas will be unable to receive an operating permit from the State. Some geologic settings that could preclude effective groundwater monitoring are fractured bedrock where complex fractures and joint systems impede flow direction prediction, and areas where extensive subsurface mining or faulting has modified flow directions.

The ability to perform corrective action as necessary also must be considered. It is the responsibility of the owner or operator to prove that a landfill unit can be monitored.

13. PROPOSED RULE 40 CFR 258 Subpart E: Groundwater Monitoring and Corrective Action (continued)

Section 258.50(b) specifies that groundwater monitoring requirements of 253.50 through 258.55 will be suspended for owners and operators who can demonstrate that there is no potential for migration of hazardous constituents from the landfill unit to the uppermost aquifer during the active life, closure, or post-closure periods. The proposed limited suspension of the groundwater monitoring requirements is designed for MSWLF units located in hydrogeolgic settings that prevent leachate migration to groundwaer for very long periods of time. In such a setting, leachate from the MSWLF should not be able to reach the uppermost aquifer during the active life, closure, or during post-closure care. Because of the very favorable hydrogeologic conditions, such settings are highly desirable for the location of the MSWLF.

The EPA intends to ensure that there is a high degree of confidence in the demonstration that no leachate will reach the uppermost aquifer before an exemption from the groundwater monitoring requirements is allowed. Therefore, the proposal requires that the demonstration be conducted by a qualified geologist or geotechnical engineer based on site-specific hydrogeologic information or, where that is insufficient, based on assumptions that maximize the rate of hazardous constituent migration.

The EPA is proposing to ease the burden of this requirement by phasing in the groundwater monitoring requirements over time. This approach is proposed because the thousands of wells that will be needed at the approximately 6,000 existing MSWLFs are expected to cause shortfalls in the availability of competent hydrogeologists and drilling companies who must assist the owner or operator in:

- Sampling and analyzing the landfill hydrogeology;
- Providing recommendations on well placement; and,
- Drilling the appropriate boreholes and installing the monitoring wells.

14. OVERVIEW OF GROUNDWATER MONITORING REQUIREMENTS
(40 CFR 258.51 - 55)

The proposed revisions require a system of monitoring wells to be installed at new and existing MSWLFs. The revisions also provide procedures for sampling these wells and methods for statistical analysis of the analytical data derived from the well samples to detect the presence of hazardous constituents released from the landfills.

The EPA is proposing a two-phased groundwater monitoring and corrective action programs. As shown in Figure C, all new and existing MSWLFs begin their groundwater monitoring programs by complying with the Phase I monitoring requirements. When a statistically significant change of indicator parameters (Appendix I) occurs, Phase II monitoring of an expanded list of hazardous constituents is required (Appendix II).

If any of the Phase II parameters are detected at statistically significant levels above background, the owner or operator must compare those levels to the appropriate groundwater trigger levels set by the State. These trigger levels start the assessment of corrective measures and establishment of groundwater protection standards. Corrective action continues until the owner or operator demonstrates compliance with the groundwater protection standards for a period of time determined by the State to be appropriate, based on site-specific factors.

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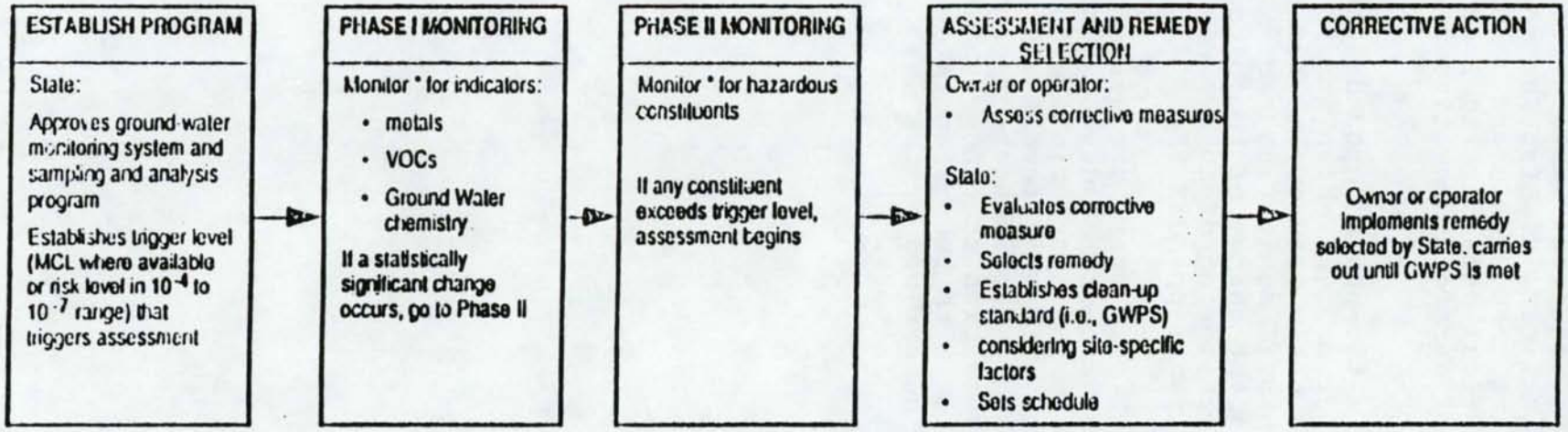
FIGURE C

SUBTITLE D GROUND-WATER MONITORING AND CORRECTIVE ACTION



* Minimum monitoring frequencies: Semiannual during Phase I and quarterly during Phase II for constituents found above background.

15. IMPLEMENTATION OF THE CORRECTIVE ACTION PROGRAM
(40 CFR 258.58)

Implementation of a corrective action program is required when hazardous constituents are detected at levels higher than the groundwater protection standards. First, a corrective action groundwater monitoring program is necessary to meet the requirements of the Phase II monitoring program, demonstrate the effectiveness of the remedy(s), and demonstrate compliance with the groundwater protection standards.

Second, the owner or operator must implement the remedy(s) selected by the State.

Third, the owner or operator must notify all persons who own or reside on the land that overlies any part of the plume of contamination.

The State may require interim measures to mitigate actual threats and prevent potential threats from being realized while a long-term conprehensive response can be developed.

OVERVIEW OF THE GROUNDWATER IMPACTS OF THE STATE OF WASHINGTON MINIMUM FUNCTIONAL STANDARDS FOR SOLID WASTE HANDLING

WASHINGTON ADMINISTRATIVE CODE (WAC) 173-304

SECTION 015: APPLICABILITY

APPLIES TO ALL SOLID WASTES EXCEPT FOR

- o MINING OVERBURDEN
- o LIQUIDS PERMITTED UNDER WATER LAWS
- o DANGEROUS WASTES
- o AGRICUTURAL WASTES
- o WOOD WASTE
- o CLEAN SOILS AND DREDGE SPOILS
- o SEPTAGE SENT TO A SEWAGE TREATMENT PLANT

SECTION 130: LOCATION STANDARDS FOR DISPOSAL SITES

FOR NEW AND EXPANDED DISPOSAL SITES

INCLUDES:

- GEOLOGY
- GROUNDWATER
- NATURAL SOILS
- FLOODING
- SURFACE WATER
- SLOPE
- COVER MATERIAL
- CAPACITY
- CLIMATE FACTORS
- LAND USE
- TOXIC AIR EMISSIONS

SECTION 190: OWNER RESPONSIBILITIES

OWNERS OR OCCUPANTS RESPONSIBLE FOR LEGAL DISPOSAL OF SOILD WASTES GENERATED ON THEIR PROPERTY

SECTION 195: PERMIT REQUIRED

HANDLING FACILITIES MUST OBTAIN A PERMIT FROM THE JURISDICTIONAL HEALTH DEPARTMENT

SECTION 460: LANDFILLING STANDARDS

(1) APPLICABILITY

(2) PERFORMANCE

(3) DESIGN

(4) OPERATING AND MAINTENANCE

(5) CLOSURE AND POST-CLOSURE

SECTION 460: PERFORMAMCE STANDARDS

- LANDFILLS SHALL NOT CONTAMINATE:
  - GROUNDWATER
  - AIR QUALITY
  - SURFACE WATERS

SECTION 460: GROUNDWATER PERFORMANCE STANDARDS

"AN OWNER OR OPERATOR OF A LANDFILL SHALL NOT CONTAMINATE THE GROUNDWATER UNDERLYING THE LANDFILL BEYOUND THE POINT OF COMPLIANCE."

CONTAMINATE:

PRIMARY DRINKING WATER STANDARDS OR INCREASE ABOVE BACKGROUND FOR AREAS ALREADY ABOVE D.W.S. OR FOR NON-D.W.S. PARAMETERS INCREASE AVOBE BACKGROUND WHERE SUBSTANTIAL RISK EXISTS.

POINT OF COMPLIANCE:

GROUNDWATER THAT LIES BENATH THE PERIMETER OF A SOLID WASTE FACILITY'S ACTIVE AREA AS THAT ACTIVE AREA WOULD EXIST AT CLOSURE OF THE FACILITY.

SECTION 460: DESIGN STANDARDS

- MINIMIZING LIQUIDS
    - o COVERING DAILY
    - o NO LIQUIDS OR SLUDGES WITH FREE LIQUIDS
    - o PREVENT RUN-ON OF SURFACE WATERS
    - o COLLECT RUN-OFF
- LEACHATE SYSTEMS
    - o DESIGN FROM WATER BALANCE OR EQUIVALENT
    - o 2 FEET MAXIMUM BUILDUP
    - o TREAT LEACHATE OR DISCHARGE TO MUNICIPAL SYSTEM

SECTION 460: LINER DESIGN

- STANDARD DESIGN
  - o 4 FEET OF 1 x 10-7 CM/SEC SOIL
  - o MINIMUM 2 PERCENT SLOPE, OR

- ALTERNATE DESIGN
  - o 50 MILL SYNTHETIC LINER, AND
  - o 2 FEET OF 1 x 10-7 CM/SEC SOIL
  - o MINIMUM 2 PERCENT SLOPE, OR

- EQUIVALENT DESIGN AS EFFETIVE USING
  - o OTHER METHODS
  - o OPERATING PRACTICES AND
  - o LOCATIONAL CHARACTERISTICS

- ARID DESIGN (>12 INCHES PRECIPITATION)
  - o VADOSE ZONE MONITORING IN LIEU OF LINER

- SMALL LANDFILL DESIGN
  - o CASE-BY-CASE

    (<200,000 CUBIC YARDS AT CLOSURE)

SECTION 490: GROUNDWATER MONITORING

FOR:

- o LANDFILLS
- o PILES
- o LANDSPREADING
- o PONDS

REQUIREMENTS:

- o WELL PLACEMENT
- o WELL CONSTRUCTION
- o SAMPLING METHODS
- o DETECTION MONITORING
- o COMPLIANCE MONITORING
- o STATISTICAL PROCEDURES
- o QUARTERLY MONITORING

PARAMETERS:

- o TEMPERATURE
- o CONDUCTIVITY
- o pH
- o CHLORIDE
- o NITRATE, NITRATE AND AMMONIA, AS NITROGEN
- o SULFATE
- o DISSOLVED IRON, ZINC, AND MANGANESE
- o CHEMICAL OXYGEN DEMAND
- o TOTAL INORGANIC CARBON AND
- o TOTAL COLIFORM

SECTION 490: GROUNDWATER MONITORING

- IF INCREASE IN DETECTION PARAMETERS, OWNER OR OPERATOR MUST:

    - o NOTIFY HEALTH DEPARTMENT
    - o RE-SAMPLE USING COMPLIANCE PARAMETERS
    - o REPORT AGAIN TO HEALTH DEPARTMENT IF PERFORMANCE STANDARD EXCEEDED.

- CORRECTIVE ACTIONS

    - o MAY BE REQUIRED
    - o PERMIT MAY BE REVOKED
    - o REAPPLICATION REQUIRED

Chapter 173-304 WAC

MINIMUM FUNCTIONAL STANDARDS FOR SOLID WASTE HANDLING

Chapter 173-304 WAC
MINIMUM FUNCTIONAL STANDARDS FOR SOLID WASTE HANDLING

WAC

WAC 173-304-010 Authority and purpose. This regulation is promulgated under the authority of chapter 70.95 RCW to protect public health, to prevent land, air, and water pollution, and conserve the state's natural, economic, and energy resources by:

(1) Setting minimum functional performance standards for the proper handling of all solid waste materials originating from residences, commercial, agricultural and industrial operations and other sources;

(2) Identifying those functions necessary to assure effective solid waste handling programs at both the state and local level;

(3) Following the direction set by the legislature for the management of solid waste in order of descending priority as applicable:

(a) Waste reduction;

(b) Waste recycling;

(c) Energy recovery or incineration;

(d) Landfill.

(4) Describing the responsibility of persons, municipalities, regional agencies, state and local government under existing laws and regulations related to solid waste;

(5) Requiring use of the best available technology for siting, and all known available and reasonable methods for designing, constructing, operating and closing solid waste handling facilities; and

(6) Establishing these standards as minimum standards for solid waste handling to provide a state-wide consistency and expectation as to the level at which solid waste is managed throughout the state. Local ordinances setting standards for solid waste handling shall not be less stringent than these minimum standards, and shall be adopted not later than one year after the effective date of this regulation. Local ordinances need not adopt WAC 173-304-011, County planning requirements, but shall otherwise comply with the requirements of WAC 173-304-011. Solid waste regulations or ordinances adopted by counties, cities, or jurisdictional boards of health shall be filed with the department ninety days following adoption. [Statutory Authority: Chapter 43-.21A RCW. 85-22-013 (Order 85-18), § 173-304-010, filed 10/28/85.]

WAC 173-304-011 County planning requirements. The concept of "solid waste management" includes in addition to proper storage, collection, and disposal of discards, other management functions or operational activities including waste reduction, source separation, waste recycling, transportation, processing, treatment, resource recovery, energy recovery, incineration, and landfilling. Under the State Solid Waste Management Act, chapter 70.95 RCW, primary responsibility for managing solid waste is assigned to local government (RCW 70.95.020). The state, however, is responsible for assuring that effective local programs are established throughout Washington state. Therefore, state and local solid waste planning for the aforementioned activities is an essential part of proper solid waste management.

(1) State responsibility. As described in RCW 70.95-.260, the department shall coordinate the development of a state solid waste management plan in cooperation with local government, the department of community development, and other appropriate state and regional agencies. The state plan shall be reviewed at two-year intervals, revised as necessary, and extended so that the plan shall look to the future for twenty years as a guide in carrying out a coordinated state solid waste management program.

(2) Local government responsibility. The overall purpose of local comprehensive solid waste planning is to determine the nature and extent of the various solid waste categories and to establish management concepts for their handling, utilization, and disposal consistent with the priorities established in RCW 70.95.010 for waste reduction, waste recycling, energy recovery and incineration, and landfill. Each local plan shall be prepared in accordance with RCW 70.95.080, 70.95.090, 70.95.100, and 70.95.110. Additionally, the department

has available "Guidelines for the development of local or regional solid waste management plans and plan revisions" to be followed by local government. RCW 70.95-.165 also requires counties to establish a local solid waste advisory committee to assist in the development of programs and policies concerning solid waste handling and disposal and to review and comment upon proposed rules, policies, or ordinances prior to their adoption. [Statutory Authority: Chapter 43.21A RCW. 85-22-013 (Order 85-18), § 173-304-011, filed 10/28/85.]

WAC 173-304-015 Applicability. These regulations apply to solid wastes as that term is defined in WAC 173-304-100. These regulations shall not apply to the following solid wastes:

(1) Overburden from mining operations intended for return to the mine;

(2) Liquid wastes whose discharge or potential discharge is regulated under federal, state or local water pollution permits;

(3) Dangerous wastes as defined by chapter 70.105 RCW and chapter 173-303 WAC;

(4) Woodwaste used for ornamental, animal bedding, mulch and plant bedding, or roadbuilding purposes;

(5) Agricultural wastes, limited to manures and crop residues, returned to the soils at agronomic rates;

(6) Clean soils and clean dredge spoils as defined in WAC 173-304-100 or as otherwise regulated by section 404 of the Federal Clean Water Act (PL 95-217);

(7) Septage taken to a sewage treatment plant permitted under chapter 90.48 RCW;

(8) Radioactive wastes, defined by chapters 402-12 and 402-19 WAC; and

(9) Wood debris resulting from the harvesting of timber and whose disposal is permitted under chapter 76.04 RCW, the State Forest Practices Act. [Statutory Authority: Chapter 43.21A RCW. 85-22-013 (Order 85-18), § 173-304-015, filed 10/28/85.]

WAC 173-304-100 Definitions. When used in this regulation, the following terms have the meanings given below.

(1) "Active area" means that portion of a facility where solid waste recycling, reuse, treatment, storage, or disposal operations are being, are proposed to be, or have been conducted. Buffer zones shall not be considered part of the active area of a facility.

(2) "Agricultural wastes" means wastes on farms resulting from the production of agricultural products including but not limited to manures, and carcasses of dead animals weighing each or collectively in excess of fifteen pounds.

(3) "Agronomic rates" means the rates of application of sludges, manures, or crop residues in accordance with rates specified by the appropriate fertilizer guide for the crop under cultivation.

(4) "Air quality standard" means a standard set for maximum allowable contamination in ambient air as set forth in chapter 173-400 WAC, General regulations for air pollution sources.

(5) "Aquifer" means a geologic formation, group of formations, or part of a formation capable of yielding a significant amount of ground water to wells or springs.

(6) "Ashes" means the residue including any air pollution flue dusts from combustion or incineration of material including solid wastes.

(7) "Balefill" means a landfill which uses compacted bales of solid waste to form discrete lifts as the landfill is filled.

(8) "Buffer zone" means that part of a facility that lies between the active area and the property boundary.

(9) "Bulky waste" means large items of refuse, such as appliances, furniture, and other oversize wastes which would typically not fit into reusable or disposable containers.

(10) "Clean soils and clean dredge spoils" means soils and dredge spoils which are not dangerous wastes or problem wastes as defined in this section.

(11) "Closure" means those actions taken by the owner or operator of a solid waste site or facility to cease disposal operations and to ensure that all such facilities are closed in conformance with applicable regulations at the time of such closures and to prepare the site for the post-closure period.

(12) "Collecting agency" means any agency, business or service operated by a person for the collecting of solid waste.

(13) "Compliance schedule" means a written schedule of required measures in a permit including an enforceable sequence leading to compliance with these regulations.

(14) "Composting" means the controlled degradation of organic solid waste yielding a product for use as a soil conditioner.

(15) "Container" means a device used for the collection, storage, and/or transportation of solid waste including but not limited to reusable containers, disposable containers, detachable containers and tanks, fixed or detachable.

(16) "Contaminate" means to allow to discharge a substance into ground water that would cause:

(a) The concentration of that substance in the ground water to exceed the maximum contamination level specified in WAC 173-304-9901, or

(b) A statistically significant increase in the concentration of that substance in the ground water where the existing concentration of that substance exceeds the maximum contaminant level specified in WAC 173-304-9901, or

(c) A statistically significant increase above background in the concentration of a substance which:

(i) Is not specified in WAC 173-304-9901, and

(ii) Is present in the solid waste, and

(iii) Has been determined to present a substantial risk to human health or the environment in the concentrations found at the point of compliance by the jurisdictional health department in consultation with the department and the department of social and health services.

(17) "Cover material" means soil or other suitable material that has been approved by the jurisdictional health department as cover for wastes.

(18) "Dangerous wastes" means any solid waste designated as dangerous waste by the department under chapter 173-303 WAC.

(19) "Demolition waste" means solid waste, largely inert waste, resulting from the demolition or razing of buildings, roads and other man-made structures. Demolition waste consists of, but is not limited to, concrete, brick, bituminous concrete, wood and masonry, composition roofing and roofing paper, steel, and minor amounts of other metals like copper. Plaster (i.e., sheet rock or plaster board)or any other material, other than wood, that is likely to produce gases or a leachate during the decomposition process and asbestos wastes are not considered to be demolition waste for the purposes of this regulation.

(20) "Department" means the department of ecology.

(21) "Detachable containers" means reusable containers that are mechanically loaded or handled such as a "dumpster" or drop box.

(22) "Disposable containers" means containers that are used once to handle solid waste such as plastic bags, cardboard boxes and paper bags.

(23) "Disposal" or "deposition" means the discharge, deposit, injection, dumping, leaking, or placing of any solid waste into or on any land or water.

(24) "Disposal site" means the location where any final treatment, utilization, processing, or deposition of solid waste occurs. See also the definition of interim solid waste handling site.

(25) "Drop box facility" means a facility used for the placement of a detachable container including the area adjacent for necessary entrance and exit roads, unloading and turn-around areas. Drop box facilities normally serve the general public with loose loads and receive waste from off-site.

(26) "Energy recovery" means the recovery of energy in a useable form from mass burning or refuse derived fuel incineration, pyrolysis or any other means of using the heat of combustion of solid waste that involves high temperature (above twelve hundred degrees Fahrenheit) processing.

(27) "Existing facility" means a facility which is owned or leased, and in operation, or for which construction has begun, on or before the effective date of this regulation and the owner or operator has obtained permits or approvals necessary under federal, state and local statutes, regulations and ordinances. A facility has commenced construction if either:

(a) A continuous on-site physical construction program has begun; or

(b) The owner or operator has entered into contractual obligations which cannot be cancelled or modified without substantial financial loss for physical construction of the facility to be completed within a reasonable time.

Lateral extensions of a landfill's active area on land purchased and permitted by the jurisdictional health department for the purpose of landfilling before the effective date of this regulation shall be considered existing facilities.

(28) "Expanded facility" means a facility adjacent to an existing facility for which the land is purchased and approved by the jurisdictional health department after the effective date of this regulation. A vertical expansion approved and permitted by the jurisdictional health department after the effective date of this regulation shall also be considered an expanded facility.

(29) "Facility" means all contiguous land (including buffer zones) and structures, other appurtenances, and improvements on the land used for solid waste handling.

(30) "Facility structures" means buildings, sheds, utility lines, and drainage pipes on the facility.

(31) "Final treatment" means the act of processing or preparing solid waste for disposal, utilization, reclamation, or other approved method of use.

(32) "Free liquids" means any sludge which produces measurable liquids when the Paint Filter Liquids Test, Method 9095 of EPA Publication Number SW-846, is used.

(33) "One hundred year floodplain" means any land area which is subject to one percent or greater chance of flooding in any given year from any source.

(34) "Garbage" means unwanted animal and vegetable wastes and animal and vegetable wastes resulting from the handling, preparation, cooking and consumption of food, swill and carcasses of dead animals, and of such a character and proportion as to be capable of attracting or providing food for vectors, except sewage and sewage sludge.

(35) "Ground water" means that part of the subsurface water which is in the zone of saturation.

(36) "Holocene fault" means a fracture along which rocks on one side have been displaced with respect to those on the other side and that has occurred in the most recent epoch of the quaternary period extending from the end of the pleistocene to the present.

(37) "Incineration" means reducing the volume of solid wastes by use of an enclosed device using controlled flame combustion.

(38) "Interim solid waste handling site" means any interim treatment, utilization or processing site engaged in solid waste handling which is not the final site of disposal. Transfer stations, drop boxes, baling and compaction sites, source separation centers, and treatment are considered interim solid waste handling sites.

(39) "Industrial solid wastes" means waste by-products from manufacturing operations such as scraps, trimmings, packing, and other discarded materials not otherwise designated as dangerous waste under chapter 173-303 WAC.

(40) "Inert wastes" means noncombustible, nondangerous solid wastes that are likely to retain their physical and chemical structure under expected conditions of disposal, including resistance to biological attack and chemical attack from acidic rainwater.

(41) "Jurisdictional health department" means city, county, city-county or district public health department.

(42) "Landfill" means a disposal facility or part of a facility at which solid waste is permanently placed in or on land and which is not a landspreading disposal facility.

(43) "Landspreading disposal facility" means a facility that applies sludges or other solid wastes onto or incorporates solid waste into the soil surface at greater than vegetative utilization and soil conditioners/immobilization rates.

(44) "Leachate" means water or other liquid that has been contaminated by dissolved or suspended materials due to contact with solid waste or gases therefrom.

(45) "Local fire control agency" means a public or private agency or corporation providing fire protection such as a local fire department, the department of natural resources or the United States Forest Service.

(46) "Lower explosive limits" means the lowest percentage by volume of a mixture of explosive gases which will propagate a flame in air at twenty-five degrees centigrade and atmospheric pressure.

(47) "Medical waste" means all the infectious, and injurious waste originating from a medical, veterinary, or intermediate care facility.

(48) "New facility" means a facility which begins operation or construction after the effective date of this regulation (see also definition of "existing facility").

(49) "Nonconforming site" means a solid waste handling facility which does not currently comply with the facility requirements of WAC 173-304-400 but does comply with a compliance schedule issued in a solid waste permit by the jurisdictional health department.

(50) "Nuisance" consists in unlawfully doing an act, or omitting to perform a duty, which act or omission either annoys, injures, or endangers the comfort, repose, health or safety of others, offends decency, or unlawfully interferes with, obstructs or tends to obstruct, any lake or navigable river, bay, stream, canal, or basin, or any public park, square, street or highway; or in any way renders other persons insecure in life, or in the use of property.

(51) "Open burning" means the burning of solid waste materials in an open fire or an outdoor container without providing for the control of combustion or the control of emissions from the combustion.

(52) "Performance standard" means the criteria for the performance of solid waste handling facilities.

(53) "Permeability" means the ease with which a porous material allows liquid or gaseous fluids to flow through it. For water, this is usually expressed in units of centimeters per second and termed hydraulic conductivity. Soils and synthetic liners with a permeability for water of 1×10^{-7} cm/sec or less may be considered impermeable.

(54) "Permit" means an authorization issued by the jurisdictional health department which allows a person to perform solid waste activities at a specific location and which includes specific conditions for such facility operations.

(55) "Person" means an individual, firm, association, copartnership, political subdivision, government agency, municipality, industry, public or private corporation, or any other entity whatsoever.

(56) "Pile" means any noncontainerized accumulation of solid waste that is used for treatment or storage.

(57) "Plan of operation" means the written plan developed by an owner or operator of a facility detailing how a facility is to be operated during its active life and during closure and post-closure.

(58) "Point of compliance" means that part of ground water that lies beneath the perimeter of a solid waste facilities' active area as that active area would exist at closure of the facility.

(59) "Post-closure" means the requirements placed upon disposal facilities after closure to ensure their environmental safety for a number of years after closure.

(60) "Premises" means a tract or parcel of land with or without habitable buildings.

(61) "Problem wastes" means: (a) Soils removed during the cleanup of a remedial action site, or a dangerous waste site closure or other cleanup efforts and actions and which contain harmful substances but are not designated dangerous wastes, or (b) dredge spoils resulting from the dredging of surface waters of the state where contaminants are present in the dredge spoils at concentrations not suitable for open water disposal and the dredge spoils are not dangerous wastes and are not regulated by section 404 of the Federal Clean Water Act (PL 95-217).

(62) "Processing" means an operation to convert a solid waste into a useful product or to prepare it for disposal.

(63) "Putrescible waste" means solid waste which contains material capable of being decomposed by micro-organisms.

(64) "Pyrolysis" means the process in which solid wastes are heated in an enclosed device in the absence of oxygen to vaporization, producing a hydrocarbon-rich gas capable of being burned for recovery of energy.

(65) "Reclamation site" means a location used for the processing or the storage of recycled waste.

(66) "Reusable containers" means containers that are used more than once to handle solid waste such as garbage cans.

(67) "Run-off" means any rainwater, leachate or other liquid which drains over land from any part of the facility.

(68) "Run-on" means any rainwater or other liquid which drains over land onto any part of a facility.

(69) "Scavenging" means the removal of materials at a disposal site, or interim solid waste handling site without the approval of the owner or operator and the jurisdictional health department.

(70) "Septage" means a semisolid consisting of settled sewage solids combined with varying amounts of water and dissolved materials generated from a septic tank system.

(71) "Sludge" means a semisolid substance consisting of settled sewage solids combined with varying amounts

of water and dissolved materials generated from a wastewater treatment plant or other source.

(72) "Sole source aquifer" means an aquifer designated by the Environmental Protection Agency pursuant to Section 1424e of the Safe Drinking Water Act (PL 93-523).

(73) "Solid waste" means all putrescible and nonputrescible solid and semisolid wastes, including but not limited to garbage, rubbish, ashes, industrial wastes, swill, demolition and construction wastes, abandoned vehicles or parts thereof, and discarded commodities. This includes all liquid, solid and semisolid, materials which are not the primary products of public, private, industrial, commercial, mining, and agricultural operations. Solid waste includes but is not limited to sludge from wastewater treatment plants and septage, from septic tanks, woodwaste, dangerous waste, and problem wastes.

(74) "Solid waste handling" means the management, storage, collection, transportation, treatment, utilization, processing or final disposal of solid wastes, including the recovery and recycling of materials from solid wastes, the recovery of energy resources from such wastes or the conversion of the energy in such wastes to more useful forms or combinations thereof.

(75) "Solid waste management" means the systematic administration of activities which provide for the collection, source separation, storage, transportation, transfer, processing, treatment, and disposal of solid waste.

(76) "Storage" means the holding of solid waste materials for a temporary period.

(77) "Twenty-five year storm" means a storm of a particular duration and of such an intensity that it has a four percent probability of being equalled or exceeded each year.

(78) "Twenty-four hour, twenty-five year storm" means a twenty-five year storm of twenty-four hours duration.

(79) "Stream" means the point at which any confined freshwater body of surface water reaches a mean annual flow of twenty cubic feet per second.

(80) "Surface impoundment" means a facility or part of a facility which is a natural topographic depression, man-made excavation, or diked area formed primarily of earthen materials (although it may be lined with man-made materials), and which is designed to hold an accumulation of liquids or sludges. The term includes holding, storage, settling, and aeration pits, ponds, or lagoons, but does not include injection wells.

(81) "Surface water" means all lakes, rivers, ponds, streams, inland waters, salt waters and all other water and water courses within the jurisdiction of the state of Washington.

(82) "Transfer station" means a permanent, fixed, supplemental collection and transportation facility, used by persons and route collection vehicles to deposit collected solid waste from off-site into a larger transfer vehicle for transport to a solid waste handling facility. Transfer stations may also include recycling facilities.

(83) "Treatment" means the physical, chemical or biological processing of solid waste to make such solid wastes safer for storage or disposal, amenable for energy or material resource recovery or reduced in volume.

(84) "Utilization" means consuming, expending, or exhausting by use, solid waste materials.

(85) "Vadose zone" means that portion of a geologic formation in which soil pores contain some water, the pressure of that water is less than atmospheric pressure, and the formation occurs above the zone of saturation.

(86) "Vector" means a living animal, insect or other arthropod which transmits an infectious disease from one organism to another.

(87) "Waste recycling" means reusing waste materials and extracting valuable materials from a waste stream.

(88) "Waste reduction" means reducing the amount or type of waste generated.

(89) "Water quality standard" means a standard set for maximum allowable contamination in surface waters as set forth in chapter 173-201 WAC, Water quality standards for waters of the state of Washington.

(90) "Wetlands" means those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support a prevalence of vegetative or aquatic life that requires saturated or seasonally saturated soil conditions for growth and reproduction. Wetlands generally include swamps, marshes, bogs, estuaries, and similar areas.

(91) "Woodwaste" means solid waste consisting of wood pieces or particles generated as a by-product or waste from the manufacturing of wood products, handling and storage of raw materials and trees and stumps. This includes but is not limited to sawdust, chips, shavings, bark, pulp, hog fuel, and log sort yard waste, but does not include wood pieces or particles containing chemical preservatives such as creosote, pentachlorophenol, or copper-crome-arsenate.

(92) "Zone of saturation" means that part of a geologic formation in which soil pores are filled with water and the pressure of that water is equal to or greater than atmospheric pressure.

(93) "Buy-back recycling center" means any facility which collects, receives, or buys recyclable materials from household, commercial, or industrial sources for the purpose of accumulating, grading, or packaging recyclable materials for subsequent shipment and reuse, other than direct application to land.

(94) "Domestic wastewater facility" means all structures, equipment, or processes required to collect, carry away, treat, reclaim, or dispose of domestic wastewater together with such industrial waste as may be present.

(95) "Industrial wastewater facility" means all structures, equipment, or processes required to collect, carry away, treat, reclaim, or dispose of industrial wastewater.

(96) "Liquid" means a substance that flows readily and assumes the form of its container but retains its independent volume.

(97) "Reserved" means a section having no requirements and which is set aside for future possible rule-making as a note to the regulated community.

(98) "Limited purpose landfills" means a landfill that receives solid waste of limited types, known and consistent composition, other than woodwastes, garbage, inert

waste, and demolition waste. [Statutory Authority: Chapter 43.21A RCW. 85-22-013 (Order 85-18), § 173-304-100, filed 10/28/85.]

WAC 173-304-130 Locational standards for disposal sites. (1) Applicability. These standards apply to all new and expanded disposal sites including landfills, landspreading disposal sites, and piles and surface impoundments that are to be closed as landfills. These standards do not apply to:

(a) Existing facilities or facilities that have engaged in closure and closed before the effective date of this regulation;

(b) Interim solid waste handling sites;

(c) Energy recovery and incineration sites;

(d) Piles and surface impoundments used for storage, unless otherwise referred to in WAC 173-304-400, Solid waste handling facility standards;

(e) Utilization of sludge and other waste on land;

(f) Inert wastes and demolition wastes as defined in WAC 173-304-100 unless otherwise referred to in WAC 173-304-400, Solid waste handling facility standards; and

(g) Problem wastes, as defined in WAC 173-304-100.

(2) Locational standards. All applicable solid waste facilities shall be subject to the following locational standards:

(a) Geology. No facility shall be located over a holocene fault, in subsidence areas, or on or adjacent to geologic features which could compromise the structural integrity of the facility.

(b) Ground water.

(i) No facility shall be located at a site where the bottom of the lowest liner is any less than ten feet above the seasonal high level of ground water in the uppermost aquifer, or five feet when a hydraulic gradient control system or the equivalent has been installed to control ground water fluctuations;

(ii) No landfill shall be located over a sole source aquifer; and

(iii) No facility's active area shall be located closer than one thousand feet to a down-gradient drinking water supply well, in use and existing at the time of the county's adoption of the comprehensive solid waste management plan unless the owner or operator can show that the active area is no less than ninety days travel time hydraulically to the nearest down-gradient drinking water supply well in the uppermost useable aquifer.

(c) Natural soils. See WAC 173-304-400, such as WAC 173-304-460 (3)(c)(i), landfill liners;

(d) Flooding. See WAC 173-304-400 such as WAC 173-304-460 (3)(d), landfill, floodplains;

(e) Surface water. No facility's active area shall be located within two hundred feet measured horizontally, of a stream, lake, pond, river, or salt water body, nor in any wetland nor any public land that is being used by a public water system for watershed control for municipal drinking water purposes in accordance with WAC 248-54-660(4);

(f) Slope. No facility's active area shall be located on any hill whose slope is unstable;

(g) Cover material. See WAC 173-304-400, such as WAC 173-304-460 (3)(e), landfills, closure;

(h) Capacity. See WAC 173-304-400, such as WAC 173-304-460, Landfilling standards, (for standards that vary according to capacity);

(i) Climatic factors. See WAC 173-304-400 such as WAC 173-304-460(3) landfill standards, (for standards applicable to arid climates);

(j) Land use. No facility shall be located:

(i) Within ten thousand feet of any airport runway currently used by turbojet aircraft or five thousand feet of any airport runway currently used by only piston-type aircraft unless a waiver is granted by the federal aviation administration. This requirement is only applicable where such facility is used for disposing of garbage such that a bird hazard to aircraft would be created;

(ii) In areas designated by the United States Fish and Wildlife Service or the department of game as critical habitat for endangered or threatened species of plants, fish, or wildlife;

(iii) So that the active area is any closer than one hundred feet to the facility property line for land zoned as nonresidential, except that the active area may be no closer than two hundred and fifty feet to the property line of adjacent land zoned as residential existing at the time of the county's adoption of the comprehensive solid waste management plan;

(iv) So as to be at variance with any locally-adopted land use plan or zoning requirement unless otherwise provided by local law or ordinance; and

(v) So that the active area is any closer than one thousand feet to any state or national park.

(k) Toxic air emissions. See WAC 173-304-400 such as WAC 173-304-460 (2)(b), landfill performance standards. [Statutory Authority: Chapter 43.21A RCW. 85-22-013 (Order 85-18), § 173-304-130, filed 10/28/85.]

WAC 173-304-190 Owner responsibilities for solid waste. The owner, operator, or occupant of any premise, business establishment, or industry shall be responsible for the satisfactory and legal arrangement for the solid waste handling of all solid waste accumulated by them on the property. [Statutory Authority: Chapter 43.21A RCW. 85-22-013 (Order 85-18), § 173-304-190, filed 10/28/85.]

WAC 173-304-195 Permit required. After approval by the department of the comprehensive solid waste plan required by RCW 70.95.100, no solid waste disposal site or facility shall be maintained, established, substantially altered, expanded or improved until the county, city or other person operating or owning such site has obtained a permit from the jurisdictional health department pursuant to the provisions of WAC 173-304-600. [Statutory Authority: Chapter 43.21A RCW. 85-22-013 (Order 85-18), § 173-304-195, filed 10/28/85.]

WAC 173-304-200 On-site containerized storage, collection and transportation standards for solid waste. (1) Applicability. These standards apply to all persons storing containerized solid waste generated on-site, and to all persons who are engaged in the collection and transportation of solid waste of more than one single family residence or single family farm including collection and transportation of septage and septic tank pumpings.

(2) On-site storage standards.

(a) The owner or occupant of any premises, business establishment, or industry shall be responsible for the safe and sanitary storage of all containerized solid wastes accumulated at that premises.

(b) The owner, operator, or occupant of any premises, business establishment, or industry shall store containerized solid wastes in containers that meet the following requirements:

(i) Disposable containers shall be sufficiently strong to allow lifting without breakage and shall be thirty-two gallons in capacity or less where manual handling is practiced;

(ii) Reusable containers, except for detachable containers, shall be:

(A) Rigid and durable;

(B) Corrosion resistant;

(C) Nonabsorbent and water tight;

(D) Rodent-proof and easily cleanable;

(E) Equipped with a close fitting cover;

(F) Suitable for handling with no sharp edges or other hazardous conditions; and

(G) Equal to or less than thirty-two gallons in volume where manual handling is practiced.

(iii) Detachable containers shall be durable, corrosion-resistant, nonabsorbent, nonleaking and having either a solid cover or screen cover to prevent littering.

(3) Collection and transportation standards.

(a) All persons collecting or transporting solid waste shall avoid littering, or the creation of other nuisances at the loading point, during transport and for the proper unloading of the solid waste at a permitted transfer station, or other permitted solid waste handling site.

(b) Vehicles or containers used for the collection and transportation of solid waste shall be tightly covered or screened where littering may occur, durable and of easily cleanable construction. Where garbage is being collected or transported, containers shall be cleaned as necessary to prevent nuisances, odors and insect breeding and shall be maintained in good repair.

(c) Vehicles or containers used for the collection and transportation of any solid waste shall be loaded and moved in such manner that the contents will not fall, leak in quantities to cause a nuisance, or spill therefrom. Where such spillage or leakage does occur, the waste shall be picked up immediately by the collector or transporter and returned to the vehicle or container and the area otherwise properly cleaned.

(d) All persons commercially collecting or transporting solid waste shall inspect collection and transportation vehicles monthly, for repairs to containers such as missing or loose-fitting covers or screens, leaking containers, etc., and maintain such inspection records at the facility normally used to park such vehicles or such other location that maintenance records are kept. Such records shall be kept for a period of at least two years, and be made available upon the request of the jurisdictional health department. [Statutory Authority: Chapter 43-.21A RCW. 85-22-013 (Order 85-18), § 173-304-200, filed 10/28/85.]

WAC 173-304-300 Waste recycling facility standards. (1) Applicability.

(a) These standards apply to facilities engaged in recycling or utilization of solid waste on the land, including but not limited to:

(i) Noncontainerized composting in piles;

(ii) Utilization of sewage sludge, septage and other organic wastes on land for beneficial use;

(iii) Accumulation of wastes in piles for recycling or utilization.

(b) These standards do not apply to:

(i) Single family residences and single family farms engaged in composting of their own wastes;

(ii) Facilities engaged in the recycling of solid waste containing garbage, such as garbage composting, which are subject to WAC 173-304-400, Solid waste handling facility standards;

(iii) Facilities engaged in the storage of tires which are subject to WAC 173-304-400, Solid waste handling facility standards;

(iv) Problem wastes as defined in WAC 173-304-100;

(v) Facilities engaged in recycling of solid waste stored in surface impoundments which are subject to WAC 173-304-400, Solid waste handling facility standards; and

(vi) Woodwaste or hog fuel piles to be used as fuel or raw materials stored temporarily in piles being actively used so long as the criteria of WAC 173-304-300 (3)(c)(i) are met.

(c) These standards do not apply to any facility that recycles or utilizes solid wastes in containers, tanks, vessels, or in any enclosed building, including buy-back recycling centers.

(2) Effective dates. All existing facilities recycling solid waste not in conformance with this section shall be placed upon a compliance schedule under WAC 173-304-600(1) to assure compliance within two years of the effective date of this regulation.

(3) Waste recycling requirements.

(a) All applicable solid waste recycling facilities shall apply for and obtain a solid waste permit under WAC 173-304-600, permits.

(b) Applicable waste recycling facilities shall submit annual reports to the jurisdictional health department and the department by March 1 of the following year for which the data is collected on forms supplied by the department. The annual reports shall include quantities and types of waste recycled for purposes of determining progress towards achieving the goals of waste reduction, waste recycling, and treatment in accordance with RCW 70.95.010(4). Such facilities may request and be assured

of confidentiality for their reports in accordance with chapter 42.17 RCW and RCW 43.21A.160.

(c) All facilities storing solid waste in outdoor piles or surface impoundments for the purpose of waste recycling shall be considered to be storing or disposing of solid waste if:

(i) At least fifty percent of the material has not been shown to have been recycled in the past three years and any material has been on-site more than five years; or

(ii) Ground water or surface water, air, and/or land contamination has occurred or will likely occur under current conditions of storage or in case of fire, or flood.

Upon such a determination by the jurisdictional health department that (c)(i) or (ii) of this subsection are met, the jurisdictional health department may require a permit application and issuance of a permit under WAC 173-304-600 of these rules.

(d) Waste recycling facilities shall allow jurisdictional health department and department representatives entry for inspection purposes and to determine compliance with these rules at reasonable times.

(e) All applicable waste recycling facilities shall not conflict with the county comprehensive solid waste management plan required by WAC 173-304-011 of these rules.

(f) All waste recycling facilities shall comply with applicable local, state and federal laws and regulations, including but not limited to environmental regulations and laws.

(4) Sewage sludge utilization requirements.

In addition to the requirements of subsection (3) of this section, all facilities utilizing sewage sludge, including septage shall comply with the department's "Municipal and Domestic Sludge Utilization Guidelines" WDOE 82-11, dated September 1982 or as hereafter amended. Facilities utilizing sewage sludge on the land in a manner not consistent with nor meeting the requirement of the guidelines are required to meet the landspreading disposal standards of WAC 173-304-450.

(5) Woodwaste and other organic sludge utilization requirements.

(a) Facilities utilizing woodwaste not otherwise excluded under WAC 173-304-015, shall comply with these recycling standards. Applying woodwaste and other primarily organic sludges such as pulp and paper mill treatment sludges to the land shall be in a manner consistent with the "Municipal and Domestic Sludge Utilization Guidelines" WDOE 82-11 dated September 1982 or as hereafter amended. Only agricultural or silvicultural sites where such sludges are demonstrated to have soil conditioning or fertilizer value shall be acceptable, provided that the woodwaste and other primarily organic sludges are applied as a soil conditioner or fertilizer in accordance with accepted agricultural and silvicultural practice. Facilities utilizing woodwaste or other primarily organic sludges on the land in a manner not consistent with nor meeting the requirement of the guidelines are required to meet the landspreading disposal standards of WAC 173-304-450.

(b) Facilities utilizing woodwaste or other primarily organic sludges shall also comply with the standards of subsection (3) of this section. [Statutory Authority: Chapter 43.21A RCW. 85-22-013 (Order 85-18), § 173-304-300, filed 10/28/85.]

WAC 173-304-400 Solid waste handling facility standards. (1) Applicability. The standards of WAC 173-304-405 through 173-304-490 are the solid waste handling facility standards and apply to all solid waste handling facilities, except for:

(a) Waste recycling facilities, whose standards are spelled out in WAC 173-304-300;

(b) On-site containerized storage, collection and transportation facilities which are spelled out in WAC 173-304-200;

(c) Single family residences and single family farms whose year round occupants engage in solid waste handling of the single family's solid waste on-site;

(d) Problem wastes as defined in WAC 173-304-100;

(e) Solid waste handling facilities that have engaged in closure and closed before the effective date of this regulation; and

(f) Domestic wastewater facilities and industrial wastewater facilities otherwise regulated by federal, state, or local water pollution permits except for any portion that utilizes or engages in landspreading disposal sludges or solid residues directly on the land.

(2) Standards for permits. The standards of WAC 173-304-405 through 173-304-490 shall be used as the basis for permitting as required in WAC 173-304-600.

(3) Effective dates.

(a) All existing facilities not in conformance with the following sections of the facility standards shall be placed upon compliance schedules under WAC 173-304-600 (1)(c) to assure full compliance within eighteen months of the effective date of this regulation for:

(i) The general facility standards, WAC 173-304-405;

(ii) The transfer stations, baling and compaction standards, WAC 173-304-410;

(iii) Ground water monitoring required in WAC 173-304-490;

(iv) The landfill operating and maintenance standards, WAC 173-304-460(4);

(v) The tire pile standards of WAC 173-304-420(4); and

(vi) The landspreading disposal standards of WAC 173-304-450(5).

(b) All existing solid waste facilities not in conformance with facility standards other than those in (a) of this subsection shall be placed upon compliance schedules under WAC 173-304-600 (1)(c) to assure full compliance within four years of the effective date of this regulation.

(c) All new and expanded facilities shall meet the facility standards of WAC 173-304-405 to 173-304-490 after the effective date of this regulation. [Statutory Authority: Chapter 43.21A RCW. 85-22-013 (Order 85-18), § 173-304-400, filed 10/28/85.]

WAC 173-304-405 General facility requirements. (1) Applicability. All applicable solid waste handling facilities shall meet the requirements of this section.

(2) Plan of operation. Each owner or operator shall develop, keep and abide by a plan of operation approved as part of the permitting process in WAC 173-304-600. The plan shall describe the facilities' operation and shall convey to site operating personnel the concept of operation intended by the designer. The plan of operation shall be available for inspection at the request of the jurisdictional health officer. The facility must be operated in accordance with the plan or the plan must be so modified with the approval of the jurisdictional health department. Owners or operators of drop boxes may develop a generic plan of operation applicable to all such drop boxes, owned or operated.

Each plan of operation shall include:

(a) How solid wastes are to be handled on-site during its active life;

(b) How the facility will be closed and, for land disposal facilities, how post-closure will be carried out;

(c) How inspections and monitoring are conducted and their frequency;

(d) Actions to take if there is a fire or explosion;

(e) Actions to take if leaks are detected;

(f) Corrective action programs to take if ground water is contaminated;

(g) Actions to take for other releases (e.g. failure of run-off containment system);

(h) How equipment such as leachate collection and gas collection equipment are to be maintained;

(i) A safety plan or procedure; and

(j) Other such details as required by the jurisdictional health department.

(3) Recordkeeping. Each owner or operator shall maintain daily operating records on the weights (or volumes), number of vehicles entering and, if available, the types of wastes received. Major deviations from the plan of operation shall also be noted on the operating record.

(4) Reporting. Each owner or operator shall prepare and submit a copy of an annual report to the jurisdictional health department and the department by March 1 of each year. The annual report shall cover facility activities during the previous year and must include the following information:

(a) Name and address of the facility;

(b) Calendar year covered by the report;

(c) Annual quantity, in tons, or volume, in cubic yards, and estimated in-place density in pounds per cubic yard of solid waste handled, by type of solid waste if available, for each type of treatment, storage, or disposal facility, including applicable recycling facilities; and

(d) Results of ground water monitoring required in WAC 173-304-490.

(5) Inspections. The owner or operator shall inspect the facility to prevent malfunctions and deterioration, operator errors and discharges which may cause or lead to the release of wastes to the environment or a threat to human health. The owner or operator must conduct these inspections often enough to identify problems in time to correct them before they harm human health or the environment. The owner or operator shall keep an inspection log or summary including at least the date and time of inspection, the printed name and the handwritten signature of the inspector, a notation of observations made and the date and nature of any repairs or corrective action. The log or summary must be kept at the facility or other convenient location if permanent office facilities are not on-site, for at least three years from the date of inspection. Inspection records shall be available to the jurisdictional health department upon request.

(6) Closure. Each owner or operator shall close the facility according to plans spelled out in the plan of operation. Solid waste facilities shall be restored by the owner or operator to be as compatible as possible with the surrounding environs following the closure. Closure includes but is not limited to grading, seeding, landscaping, contouring, and screening. For interim solid waste handling sites, closure includes waste removal and decontamination. For disposal facilities, post-closure includes ground water monitoring and gas monitoring, the maintenance of the site for its intended use, and other activities deemed appropriate by the jurisdictional health department until the site becomes stabilized (i.e. little or no settlement, gas production or leachate generation) and monitoring ground water and gases can be safely discontinued.

(7) Recording with county auditor. Maps and a statement of fact concerning the location of the disposal site shall be recorded as part of the deed with the county auditor not later than three months after closure. Records and plans specifying solid waste amounts, location and periods of operation shall be submitted to the local zoning authority or the authority with jurisdiction over land use and be made available for inspection.

(8) State and local requirements. All solid waste disposal facilities shall comply with all state and local requirements such as zoning land use, fire protection, water pollution prevention, air pollution prevention, nuisance and aesthetics. [Statutory Authority: Chapter 43-.21A RCW. 85-22-013 (Order 85-18), § 173-304-405, filed 10/28/85.]

WAC 173-304-410 Transfer stations, baling and compaction systems, and drop box facilities. (1) Applicability. All transfer stations, baling and compaction systems and drop boxes receiving solid waste from off-site shall meet the requirements of this section. Facilities receiving solid waste from on-site shall meet the requirements of WAC 173-304-200.

(2) Transfer stations, baling and compacting systems standards. Transfer stations, baling and compaction systems shall be designed, constructed, and operated so as to:

(a) Be surrounded by a fence, trees, shrubbery, or natural features so as to control access and be screened from the view of immediately adjacent neighbors, unless the tipping floor is fully enclosed by a building;

(b) Be sturdy and constructed of easily cleanable materials;

(c) Be free of potential rat harborages, and provide effective means to control rodents, insects, birds and other vermin;

(d) Be adequately screened to prevent blowing of litter and to provide effective means to control litter;

(e) Provide protection of the tipping floor from wind, rain or snow other than below grade bins or detachable containers;

(f) Have an adequate buffer zone around the operating area to minimize noise and dust nuisances, and for transfer stations, baling, or compaction systems, a buffer zone of fifty feet from the active area to the nearest property line in areas zoned residential;

(g) Comply with local zoning and building codes including approved local variances and waivers;

(h) Provide pollution control measures to protect surface and ground waters, including run-off collection and discharge designed and operated to handle a twenty-four hour, twenty-five year storm and equipment cleaning and washdown water;

(i) Provide all-weather approach roads, exit roads, and all other vehicular areas;

(j) Provide pollution control measures to protect air quality including a prohibition against all burning and the development of odor and dust control plans to be made a part of the plan of operation in WAC 173-304-405(2);

(k) Prohibit scavenging;

(l) Provide attendant(s) on-site during hours of operation;

(m) Have a sign that identifies the facility and shows at least the name of the site, and, if applicable, hours during which the site is open for public use, what constitutes materials not to be accepted and other necessary information posted at the site entrance;

(n) Have communication capabilities to immediately summon fire, police, or emergency service personnel in the event of an emergency; and

(o) Remove all wastes at closure, as defined in WAC 173-304-100, from the facility to a permitted facility.

(3) Drop box facility standards. Drop box facilities, as defined in WAC 173-304-100, shall:

(a) Be constructed of durable water tight materials with a lid or screen on top that prevents the loss of materials during transport and access by rats and other vermin;

(b) Be located in an easily identifiable place accessible by all-weather roads;

(c) Be designed and serviced as often as necessary to ensure adequate dumping capacity at all times. Storage of solid waste outside the drop boxes is prohibited;

(d) Comply with subsection (2)(m) of this section, signs; and

(e) Remove all remaining wastes at closure, as defined in WAC 173-304-100, to a permitted facility, and remove the drop box from the facility. [Statutory Authority: Chapter 43.21A RCW. 85-22-013 (Order 85-18), § 173-304-410, filed 10/28/85.]

WAC 173-304-420 Piles used for storage and treatment—Facility standards. (1) Applicability.

(a) This section is applicable to solid wastes stored or treated in piles as defined in WAC 173-304-100 where putrescible wastes (other than garbage) are in place for more than three weeks, other wastes not intended for recycling are in place for more than three months, and garbage is in place for more than three days. These standards are also applicable to composting or storing of garbage and sludge in piles, and to tire piles where more than eight hundred tires are stored at one facility.

(b) Other solid wastes stored or treated in piles prior to waste recycling including compost piles of vegetative waste, piles of woodwaste used for fuel or raw materials are subject to WAC 173-304-300.

(c) Waste piles stored in fully enclosed buildings are not subject to these standards, provided that no liquids or sludges with free liquids are added to the pile.

(d) Inert wastes and demolition wastes are not subject to these standards.

(2) Requirements. All owners and operators shall:

(a) Comply with the requirements of the General facility requirements, WAC 173-304-405;

(b) Design piles located in a one hundred year flood plain to:

(i) Comply with local flood plain management ordinances and chapter 508-60 WAC, Administration of flood control zones; and

(ii) To avoid washout or restriction of flow; and

(c) Remove all solid wastes from the pile at closure to another permitted facility.

(3) Requirements for putrescible wastes or wastes likely to produce leachate.

(a) Waste piles shall be placed upon a surface such as sealed concrete, asphalt, clay or an artificial liner underlying the pile, to prevent subsurface soil and potential ground water contamination and to allow collection of run-off and leachate. The liner shall be designed of sufficient thickness and strength to withstand stresses imposed by pile handling vehicles and the pile itself;

(b) Run-off systems shall be installed, designed and maintained to handle a twenty-four hour, twenty-five year storm event;

(c) Waste piles having a capacity of greater than ten thousand cubic yards shall have either:

(i) A ground water monitoring system that complies with WAC 173-304-490; or

(ii) A leachate detection, collection and treatment system.

For purposes of this subsection, capacity refers to the total capacity of all putrescible or leachate-generating piles at one facility (i.e., two, five thousand cubic yard piles will subject the facility to the requirements of this subsection).

(d) Run-on prevention systems shall be designed and maintained to handle the maximum flow from a twenty-five year storm event; and

(e) A jurisdictional health department may require that the entire base or liner shall be inspected for wear and integrity and repaired or replaced by removing stored wastes or otherwise providing inspection access to the base or liner; the request shall be in writing and cite the reasons including valid ground water monitoring or

leachate detection data leading the jurisdictional health department to request such an inspection, repair or replacement.

(4) Requirements for tire piles. Owners or operators shall:

(a) Control access to the tire pile by fencing;

(b) Limit the tire pile to a maximum of one-half acre in size;

(c) Limit the height of the tire pile to twenty feet;

(d) Provide for a thirty foot fire lane between tire piles; and

(e) Provide on-site fire control equipment. [Statutory Authority: Chapter 43.21A RCW. 85-22-013 (Order 85-18), § 173-304-420, filed 10/28/85.]

WAC 173-304-430 Surface impoundment standards. (1) Applicability.

(a) These standards are applicable to solid wastes that are liquids or sludges containing free liquids as defined in WAC 173-304-100 and applicable under WAC 173-304-015(2) and are stored or treated in surface impoundments;

(b) These standards are also applicable to sludges and septage stored or treated in surface impoundments; and

(c) These standards are not applicable to:

(i) Surface impoundments whose facilities and discharges are otherwise regulated under federal, state, or local water pollution permits; and

(ii) Retention or detention basins used to collect and store stormwater runoff.

(2) Requirements. All surface impoundments must be designed, constructed, and operated so as to:

(a) Meet the performance standards of WAC 173-304-460(2);

(b) Have an inplace or imported soil liner of at least two feet of 1×10^{-7} cm/sec permeability or an equivalent combination of any thickness greater than two feet and a greater permeability to protect the underlying aquifers or a thirty mil reinforced artificial liner placed on top of a structurally stable foundation to support the liners and solid waste and to prevent settlement that would destroy the liner; natural soils shall be recompacted to achieve an equivalent permeability. Owners or operators shall be allowed to use alternative designs, operating practices and locational characteristics which prevent migration of solid waste constituents or leachate into the ground or surface waters at least as effectively as the liners described in this subsection;

(c) Avoid washout including the use of an extended liner or dikes or restriction of flow in the one hundred year floodplain and to comply with local floodplain management ordinances and chapter 508-60 WAC, Administration of flood control zones;

(d) Have dikes designed with slopes so as to maintain the structural integrity under conditions of a leaking liner and capable of withstanding erosion from wave action;

(e) Have the freeboard equal to or greater than eighteen inches to avoid overtopping from wave action, overfilling, or precipitation;

(f) Have either a ground water monitoring system, or a leachate detection, collection and treatment system, for surface impoundments having a capacity of more than two million gallons unless the jurisdictional health department and the department require either for smaller surface impoundments. For purposes of this subsection, capacity refers to the total capacity of all surface impoundments on-site (i.e., two, one million gallon surface impoundments on one site will trigger these monitoring requirements);

(g) Be closed in a manner which removes all solid wastes including liners, etc. to another permitted facility and the site returned to its original or acceptable topography except that surface impoundments closed with the waste remaining in place shall meet the requirements of WAC 173-304-460(5) and 173-304-130;

(h) A jurisdictional health department may require that the liner be inspected for wear and integrity and repaired or replaced by removing stored solid wastes or otherwise inspecting the liner or base at any time. The request shall be in writing and cite the reasons including valid ground water monitoring or leachate detection data leading to such an inspection and repair;

(i) Surface impoundments containing septage will also be subject to the department's "criteria for sewage works design" used to review plans for septage surface impoundments; and

(j) Surface impoundments that have the potential to impound more than ten acre-feet of waste measured from the top of the dike and which would be released by a failure of the containment dike shall be reviewed and approved by the dam safety section of the department. [Statutory Authority: Chapter 43.21A RCW. 85-22-013 (Order 85-18), § 173-304-430, filed 10/28/85.]

WAC 173-304-440 Energy recovery and incinerator standards. (1) Applicability. These standards apply to all facilities designed to burn more than twelve tons of solid waste per day, except for facilities burning woodwaste or gases recovered at a landfill.

(2) Requirements for energy recovery facilities and incinerators.

(a) Incinerators and energy recovery facilities storing putrescible wastes shall be confined to storage compartments specifically designed to store wastes temporarily in piles, surface impoundments, tanks or containers. The storage facilities shall meet the facility standards of WAC 173-304-400. Storage of wastes other than in the specifically designed storage compartments is prohibited. Equipment and space shall be provided in the storage and charging areas, and elsewhere as needed, to allow periodic cleaning as may be required in order to maintain the plant in a sanitary and clean condition;

(b) All residues from energy recovery facilities or incinerator facilities shall be used, handled or disposed of as solid or dangerous wastes according to these standards or the standards of the dangerous waste regulation, chapter 173-303 WAC;

(c) Each owner or operator of an energy recovery facility or incinerator facility shall comply with WAC

173-304-405. The plan of operation shall address alternative storage, and/or disposal plans for all breakdowns that would result in overfilling of the storage facility;

(d) Energy recovery facilities and incinerators must be designed, constructed and operated in a manner to comply with appropriate state and local air pollution control authority emission and operating requirements;

(e) Each owner or operator shall close their energy recovery facility or incinerator by removing all ash, solid wastes and other residues to a permitted facility;

(f) Each owner or operator of an energy recovery facility or incinerator shall be required to provide recycling facilities in a manner equivalent to WAC 173-304-460 (4)(f); and

(g) Owners or operators of energy recovery facilities or incinerators shall not knowingly dispose of, treat, store or otherwise handle dangerous waste unless the requirements of chapter 173-303 WAC are met. [Statutory Authority: Chapter 43.21A RCW. 85-22-013 (Order 85-18), § 173-304-440, filed 10/28/85.]

WAC 173-304-450 Landspreading disposal standards. (1) Applicability. These standards apply to facilities that engage in landspreading disposal of solid wastes. These standards do not apply to:

(a) Facilities utilizing sludge, woodwaste or other primarily organic sludges according to "The Municipal and Domestic Sludge Utilization Guidelines" WDOE 82-11, specified in WAC 173-304-300 (4) and (5);

(b) Agricultural solid wastes resulting from the operation of a farm including farm animal manure and agricultural residues; and

(c) Inert wastes and demolition wastes.

(2) Owners or operators of landspreading disposal facilities shall meet the minimum functional standards for performance of WAC 173-304-460(2) and the general facilities standards of WAC 173-304-405.

(3) Owners or operators of landspreading disposal facilities shall meet the locational standards of WAC 173-304-130.

(4) Minimum functional standard for design. Owners or operators of landspreading disposal facilities shall design landspreading facilities so as to:

(a) Provide interim waste storage facilities that meet the requirements of WAC 173-304-400 standards (i.e., for piles, surface impoundments, etc.);

(b) Collect and treat all run-off from a twenty-four hour, twenty-five year storm, and divert all run-on for the maximum flow of a maximum twenty-five year storm around the active area;

(c) Avoid standing water anywhere on the active area;

(d) Avoid slopes and other features that will lead to soil and waste erosion, unless contour plowing or other measures are taken to avoid erosion;

(e) Monitor ground water according to WAC 173-304-490; and

(f) Control access to site by fencing or other means and erect signs.

(5) Minimum functional standards for maintenance and operation. Owners or operators of landspreading disposal facilities shall maintain and operate the facilities so as to:

(a) Avoid any landspreading disposal of garbage or medical waste;

(b) Analyze solid wastes according to the requirements spelled out in "The Municipal and Domestic Sludge Utilization Guidelines" WDOE 82-11;

(c) Avoid applying wastes at rates greater than ten times agronomic rates using the proposed cover crop, or depths greater than would allow for discing the soil by tracked vehicles;

(d) Provide discing of soils during the growing season and after each application of waste to maintain aerobic soil conditions, minimize odors and lessen run-off;

(e) Avoid applying waste to any active area having standing water;

(f) Conform to the operating plan and the requirements of WAC 173-304-405;

(g) Avoid food chain crops during the active life of the facility and until demonstrated to be safe, after closure, according to the closure and post-closure plans filed with the plan of operation. Specific approval in writing from the jurisdictional health department is required for any landspreading disposal facility that is used to raise food crops after closure. Any new owner or operator of a closed landspreading disposal facility shall notify the jurisdictional health department within sixty days of the purchase; and

(h) Provide for a written contract between landowners, waste generators, waste haulers and waste operators requiring compliance with rules as a condition of the contract.

(6) Minimum functional standards for closure.

(a) All owners or operators of landspreading disposal facilities shall close in such a manner as to comply with WAC 173-304-405(6);

(b) All owners or operators of landspreading facilities shall also close such facilities in a manner that:

(i) Minimizes the need for further maintenance;

(ii) Controls, minimizes or eliminates, to the extent necessary, threats to human health and the environment, post-closure escape of solid waste, constituents, leachate, contaminated rainfall or waste decomposition products to the ground, surface water, ground water or the atmosphere;

(iii) Returns the land to the appearance and use of surrounding land areas to the degree possible; and

(iv) Allows for continued monitoring of all media (air, land and water) as long as necessary to protect human health and the environment during the post-closure period;

(c) Financial assurance. All owners or operators of landspreading disposal facilities shall have a written estimate, in current dollars, of the cost of closing the facility. The closure cost estimate must equal the cost of closure at the point in the operating life of the facility when the extent and manner of operation would make closure the most expensive, as indicated by the closure plan.

In addition, all facilities shall have a written post-closure estimate, in current dollars, the cost of post-

closure monitoring and maintenance during the post-closure period. [Statutory Authority: Chapter 43.21A RCW. 85-22-013 (Order 85-18), § 173-304-450, filed 10/28/85.]

WAC 173-304-460 Landfilling standards. (1) Applicability. These standards apply to facilities that dispose of solid waste in landfills except for:

(a) Inert wastes and demolition wastes landfills, that must meet WAC 173-304-461 standards; and

(b) Woodwaste landfills that must meet WAC 173-304-462 standards.

(2) Minimum functional standards for performance.

(a) Ground water. An owner or operator of a landfill shall not contaminate the ground water underlying the landfill, beyond the point of compliance. Contamination and point of compliance are defined in WAC 173-304-100.

(b) Air quality and toxic air emissions.

(i) An owner or operator of a landfill shall not allow explosive gases generated by the facility whose concentration exceeds:

(A) Twenty-five percent of the lower explosive limit for the gases in facility structures (excluding gas control or recovery system components);

(B) The lower explosive limit for the gases at the property boundary or beyond; and

(C) One hundred parts per million by volume of hydrocarbons (expressed as methane) in off-site structures.

(ii) An owner or operator of a landfill shall not cause a violation of any ambient air quality standard at the property boundary or emission standard from any emission of landfill gases, combustion or any other emission associated with a landfill.

(c) Surface waters. An owner or operator of a landfill shall not cause a violation of any receiving water quality standard or violate chapter 90.48 RCW from discharges of surface run-off, leachate or any other liquid associated with a landfill.

(3) Minimum functional standards for design.

(a) Minimizing liquids. All owners or operators of landfills shall minimize liquids admitted to active areas of landfills by:

(i) Covering according to WAC 173-304-460 (4)(d);

(ii) Prohibiting the disposal of noncontainerized liquids or sludges containing free liquids in landfills unless approved by the jurisdictional health department;

(iii) Designing the landfill to prevent all the run-on of surface waters and other liquids resulting from a maximum flow of a twenty-five year storm into the active area of the landfill;

(iv) Designing the landfill to collect the run-off of surface waters and other liquids resulting from a twenty-four hour, twenty-five year storm from the active area and the closed portions of a landfill;

(b) Leachate systems. All owners or operators of landfills shall:

(i) Install a leachate collection system sized according to water balance calculations or using other accepted engineering methods either of which shall be approved by the jurisdictional health department;

(ii) Install a leachate collection system so as to prevent no more than two feet of leachate developing at the topographical low point of the active area; and

(iii) Install a leachate treatment, or a pretreatment system if necessary in the case of discharge to a municipal waste water treatment plant, to meet the requirements for permitted discharge under chapter 90.48 RCW and the Federal Clean Water Act (PL 95-217).

(c) Liner designs. All owners or operators of landfills shall use liners of one of the following designs:

(i) Standard design. The liner shall be constructed of at least a four feet thick layer of recompacted clay or other material with a permeability of no more than 1×10^{-7} cm/sec and sloped no less than two percent; or

(ii) Alternative design. The design shall have two liners:

(A) An upper liner of at least fifty mils thickness made of synthetic material; and

(B) A lower liner of at least two feet thickness of recompacted clay or other material with a permeability of no more than 1×10^{-6} cm/sec and sloped no less than two percent; or

(iii) Equivalent design. The design shall use alternative methods, operating practices and locational characteristics which will minimize the migration of solid waste constituents or leachate into the ground or surface water at least as effectively as the liners of (c)(i) and (ii) of this subsection; or

(iv) Arid design. This design will apply to locations having less than twelve inches of precipitation annually, and, in lieu of (c)(i), (ii), and (iii) of this subsection, shall consist of vadose zone moisture monitoring, provided that:

(A) Waste material is no less than ten feet above the seasonal high level of ground water in the uppermost aquifer; and

(B) Any evidence of leachate or waste constituents detected in the vadose zone that violates or could be expected to violate the performance standard of WAC 173-304-460(2) shall cause the owner or operator to:

(I) Take corrective action, and either

(II) Close the facility according to these rules, or

(III) For all future expansions at that facility, meet the liner requirement of (c)(i) or (ii) of this subsection.

(v) Small landfill designs. For a landfill whose design and permit allow a total capacity at closure of two hundred thousand cubic yards or less, the need for a liner and leachate collection system shall be determined on a case-by-case basis by the jurisdictional health department in consultation with the department.

(d) Floodplains. All owners or operators of landfills that are located in a one hundred year floodplain shall:

(i) Comply with local floodplain management ordinances and chapter 508-60 WAC, Administration of flood control zones; and

(ii) Design the landfill so that the landfill entrance or exit roads or practices 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, land or water resources.

(e) Closure. All owners and operators shall design landfills so that at closure:

(i) At least two feet of 1×10^{-6} cm/sec or lower permeability soil or equivalent shall be placed upon the final lifts unless the landfill is located in an area having mean annual precipitation of less than twelve inches in which case at least two feet of 1×10^{-5} cm/sec or lower permeability soil or equivalent shall be placed upon the final lifts. Artificial liners may replace soil covers provided that a minimum of fifty mils thickness is used;

(ii) The grade of surface slopes shall not be less than two percent, nor the grade of side slopes more than thirty-three percent; and

(iii) Final cover of at least six inches of topsoil be placed over the soil cover and seeded with grass, other shallow rooted vegetation or other native vegetation.

(f) Gas control.

(i) All owners and operators shall design landfills, having a permitted capacity of greater than ten thousand cubic yards per year, so that methane and other gases are continuously collected, and

(A) Purified for sale;

(B) Flared; or

(C) Utilized for its energy value.

(ii) Collection and handling of landfill gases shall not be required if it can be shown that little or no landfill gases will be produced or that landfill gases will not support combustion; in such cases installation of vents shall be required.

(g) Other requirements. All owners and operators of landfills shall design landfills to:

(i) Be fenced at the property boundary or use other means to impede entry by the public and animals. A lockable gate shall be required at the entry to the landfill;

(ii) Monitor ground water according to WAC 173-304-490 using a design approved by the local jurisdictional health department with the guidance of the department. The jurisdictional health department may also require monitoring of:

(A) Surface waters, including run-off;

(B) Leachate;

(C) Subsurface landfill gas movement and ambient air; and

(D) Noise.

(iii) Weigh all incoming waste on scales for landfills having a permitted capacity of greater than ten thousand cubic yards per year or provide an equivalent method of measuring waste tonnage capable of estimating total annual solid waste tonnage to within plus or minus five percent;

(iv) Provide for employee facilities including shelter, toilets, hand washing facilities and potable drinking water for landfills having the equivalent of three or more full-time employees;

(v) Erect a sign at the site entrance that identifies at least the name of site, if applicable, the hours during which the site is open for public use, unacceptable materials and an emergency telephone number. Other pertinent information may be required by the jurisdictional health department;

(vi) Provide on-site fire protection as determined by the local and state fire control jurisdiction;

(vii) Prevent potential rat and other vectors (such as insects, birds, and burrowing animals) harborages in buildings, facilities, and active areas;

(viii) Provide the unloading area(s) to be as small as possible, consistent with good traffic patterns and safe operation;

(ix) Provide approach and exit roads to be of all-weather construction, with traffic separation and traffic control on-site, and at the site entrance; and

(x) Provide communication between employees working at the landfill and management offices on-site and off-site (such as telephones) to handle emergencies.

(4) Minimum functional standards for maintenance and operation.

(a) Operating plans. All owners or operators of landfills shall maintain and operate the facility so as to conform to the approved plan of operation.

(b) Operating details. All owners or operators of landfills shall operate the facility so as to:

(i) Control road dust;

(ii) Perform no open burning unless permitted by the jurisdictional air pollution control agency or the department under the Washington clean air act, chapter 70.94 RCW. Garbage shall not be open burned.

(iii) Collect scattered litter as necessary to avoid a fire hazard or an aesthetic nuisance;

(iv) Prohibit scavenging;

(v) Conduct on-site reclamation in an orderly sanitary manner, and in a way that does not interfere with the disposal site operation;

(vi) Insure that at least two landfill personnel are on-site with one person at the active face when the site is open to the public for landfills with a permitted capacity of greater than fifty thousand cubic yards per year;

(vii) Control insects, rodents and other vectors; and

(viii) Insure that reserve operational equipment shall be available to maintain and meet these standards.

(c) Boundary posts. All owners or operators of landfills shall clearly mark the active area boundaries authorized in the permit, with permanent posts or using equivalent method clearly visible for inspection purposes.

(d) Compaction and daily cover. All owners or operators of landfills shall:

(i) Thoroughly compact the solid waste before succeeding layers are added; and

(ii) Cover compacted waste containing garbage fully with at least six inches of compacted cover material after each day of operation. The jurisdictional health department may allow less frequent covering by considering:

(A) The characteristics of the solid waste;

(B) The climatic and geologic setting;

(C) The size of the facility; and

(D) The potential for nuisance conditions.

(e) Monitoring systems. All owners and operators of landfills shall maintain the monitoring system required in subsection (3)(g)(ii)of this section.

(f) Recycling required.

(i) All owners or operators of landfills at which the general public delivers household solid waste shall provide the opportunity for the general public to recycle cans, bottles, paper and other material for which a market exists and brought to the landfill site:

(A) During the normal hours of operation;

(B) In facilities convenient to the public (i.e., near entrance to the gate).

(ii) Owners or operators may demonstrate alternative means to providing an opportunity to the general public to recycle household solid waste.

(g) Disposal of dangerous waste prohibited. Owners or operators of landfills shall not knowingly dispose, treat, store, or otherwise handle dangerous waste unless the requirements of the dangerous waste regulation, chapter 173-303 WAC are met.

(5) Minimum functional standards for closure and post-closure.

(a) All owners or operators of landfills shall close landfills in such a manner as to comply with WAC 173-304-405(6).

(b) All owners or operators of landfills shall close landfills in a manner that:

(i) Minimizes the need for further maintenance;

(ii) Controls, minimizes or eliminates to the extent necessary threats to human health and the environment from post-closure escape of solid waste constituents, leachate, landfill gases, contaminated rainfall or waste decomposition products to the ground, surface water, ground water or the atmosphere;

(iii) Returns the land to the appearance and use of surrounding land areas to the degree possible; and

(iv) Allows for continued monitoring of all media (air, land and water) as long as necessary for the waste to stabilize and to protect human health and the environment.

(c) All owners or operators of landfills must have a written estimate, in current dollars, of the cost of closing the facility. The closure cost estimate must equal the cost of closure at the point in the operating life of the facility when the extent and manner of operation would make closure the most expensive; as indicated by the closure plan.

In addition, all facilities must have a written post-closure estimate, in current dollars, the cost of post-closure monitoring and maintenance during the post-closure period.

(6) Limited purpose landfill standards.

(a) Limited purpose landfills shall meet the following requirements:

(i) The general facility standards of WAC 173-304-405;

(ii) The performance standards of WAC 173-304-460(2);

(iii) The ground water monitoring standards of WAC 173-304-490;

(b) In addition, limited purpose landfills must meet all other standards of WAC 173-304-130 and 173-304-460 unless the owner or operator applies for relief from each of these requirements as part of his permit application and includes evidence or reasons why the nature of the waste, the disposal site and other factors can protect the environment and the public health. [Statutory Authority: Chapter 43.21A RCW. 85-22-013 (Order 85-18), § 173-304-460, filed 10/28/85.]

WAC 173-304-461 Inert waste and demolition waste landfilling facility requirements. (1) Applicability. These standards apply to facilities that landfill more than two thousand cubic yards of inert wastes and demolition wastes, as defined in WAC 173-304-100, including facilities that use inert waste and demolition waste as a component of fill. Inert wastes and demolition wastes used as road building materials are excluded from this section. These standards do not apply to asbestos containing waste regulated under the federal 40 CFR Part 61 rules and the dangerous waste regulation, chapter 173-303 WAC.

(2) Inert wastes and demolition waste landfilling facilities shall not be subject to the Locational standards for disposal sites, WAC 173-304-130 except for WAC 173-304-130 (2)(f), slope.

(3) Owners or operators of inert waste and demolition waste landfill shall maintain a record of the weights or volumes and types of waste disposed of at each site.

(4) Owners or operators of inert wastes and demolition landfills shall employ measures to prevent emission of fugitive dusts, when weather conditions or climate indicate that transport of dust off-site is liable to create a nuisance. Preventative measures include watering of roads and covering.

(5) Timbers, wood and other combustible waste shall be covered as needed during the summer months to avoid a fire hazard.

(6) Owners or operators of inert wastes and demolition landfills shall close the facility by leveling the wastes to the extent practicable and shall fill any voids posing a physical hazard for persons after closure and to maintain an aesthetic appearance. A minimum of one foot of soil cover shall be used to close landfills.

(7) Owners or operators of inert waste and demolition waste landfills shall obtain a permit, as set forth in WAC 173-304-600 from the jurisdictional health department.

(8) Owners or operators of inert wastes and demolition landfills shall meet the requirements of WAC 173-304-405(7), Recording with the county auditor.

(9) Owners or operators of inert waste or demolition waste landfills shall not accept any other form of waste except inert waste and demolition waste.

(10) Owners or operators of inert waste and demolition waste landfills shall prevent unauthorized disposal during off-hours by controlling entry (i.e., lockable gate or barrier) when the facility is not being used. [Statutory Authority: Chapter 43.21A RCW. 85-22-013 (Order 85-18), § 173-304-461, filed 10/28/85.]

WAC 173-304-462 Woodwaste landfilling facility requirements. (1) Applicability. These requirements apply to facilities that landfill more than two thousand cubic yards of woodwaste including facilities that use woodwaste as a component of fill. Woodwaste is defined

in WAC 173-304-100. These standards are not applicable to woodwaste landfills on forest lands regulated under the Forest Practices Act, chapter 76.09 RCW.

(2) Minimum functional standards.

(a) Woodwaste landfills are not subject to WAC 173-304-130 standards, Locational standards for disposal sites, except for WAC 173-304-130 (2)(c) surface water locational standards and WAC 173-304-130 (2)(b)(iii) down gradient drinking water supply wells. Woodwastes may be used as a component of fill within a shoreline and associated wetlands only if a demonstrated and proven technology to prevent ground and surface water contamination is used.

(b) Owners or operators of woodwaste landfills shall maintain a record of the weights or volumes of waste disposed of at each facility.

(c) Owners or operators of woodwaste landfills shall not accept any other wastes except woodwaste.

(d) Owners or operators of woodwaste landfills shall prevent run-on from a maximum twenty-five year storm.

(e) All wood waste landfills having a capacity of greater than ten thousand cubic yards at closure shall either:

(i) Have a ground water monitoring system that complies with WAC 173-304-490 and the woodwaste landfill meet the performance standards of WAC 173-304-460(2); or

(ii) Have a leachate collection and treatment system.

(f) Owners or operators of woodwaste landfills shall not deposit woodwaste in lifts to a height of more than ten feet per lift with at least one foot of cover material between lifts to avoid hot spots and fires in the summer and to avoid excessive build-up of leachate in the winter, and shall compact woodwaste as necessary to prevent voids.

(g) Owners or operators of woodwaste landfills shall prevent unauthorized disposal during off-hours by controlling entry (i.e., lockable gate or barrier), when the facility is not being used.

(h) Owners or operators of woodwaste landfills shall close the facility by leveling and compacting the wastes and applying a compacted soil cover of at least two feet thickness.

(i) Owners or operators of woodwaste landfills shall obtain a permit as set forth in WAC 173-304-600 from the jurisdictional health department. [Statutory Authority: Chapter 43.21A RCW. 85-22-013 (Order 85-18), § 173-304-462, filed 10/28/85.]

WAC 173-304-463 Problem waste landfills. (reserved) [Statutory Authority: Chapter 43.21A RCW. 85-22-013 (Order 85-18), § 173-304-463, filed 10/28/85.]

WAC 173-304-470 Other methods of solid waste handling. (1) Applicability. This section applies to other methods of solid waste handling such as a material resource recovery system for municipal waste not specifically identified elsewhere in this regulation, nor excluded from this regulation.

(2) Requirements. Owners and operators of other methods of solid waste handling shall:

(a) Comply with the requirements in WAC 173-304-405;

(b) Obtain a permit under WAC 173-304-600 from the jurisdictional health department, by submitting an application containing information required in WAC 173-304-600 (3)(a), and such other information as may be required by the jurisdictional health department and the department, including:

(i) Preliminary engineering reports and plans and specifications; and

(ii) A closure plan. [Statutory Authority: Chapter 43-.21A RCW. 85-22-013 (Order 85-18), § 173-304-470, filed 10/28/85.]

WAC 173-304-490 Ground water monitoring requirements. (1) Applicability. These requirements apply to owners and operators of landfills, piles, landspreading disposal facilities, and surface impoundments that are required to perform ground water monitoring under WAC 173-304-400.

(2) Ground water monitoring requirements.

(a) The ground water monitoring system must consist of at least one background or upgradient well and three down gradient wells, installed at appropriate locations and depths to yield ground water samples from the upper most aquifer and all hydraulically connected aquifers below the active portion of the facility.

(i) Represent the quality of background water that has not been affected by leakage from the active area; and

(ii) Represent the quality of ground water passing the point of compliance. Additional wells may be required by the jurisdictional health department in complicated hydrogeological settings or to define the extent of contamination detected.

(b) All monitoring wells must be cased in a manner that maintains the integrity of the monitoring well bore hole. This casing must allow collection of representative ground water samples. Wells must be constructed in such a manner as to prevent contamination of the samples, the sampled strata, and between aquifers and water bearing strata and in accordance with chapter 173-160 WAC, Minimum standards for construction and maintenance of water wells.

(c) The ground water monitoring program must include at a minimum, procedures and techniques for:

(i) Decontamination of drilling and sampling equipment;

(ii) Sample collection;

(iii) Sample preservation and shipment;

(iv) Analytical procedures and quality assurance;

(v) Chain of custody control; and

(vi) Procedures to ensure employee health and safety during well installation and monitoring.

(d) Sample constituents.

(i) All facilities shall test for the following parameters:

(A) Temperature;

(B) Conductivity;

(C) pH;
(D) Chloride;
(E) Nitrate, nitrite, and ammonia as nitrogen;
(F) Sulfate;
(G) Dissolved iron;
(H) Dissolved zinc and manganese;
(I) Chemical oxygen demand;
(J) Total organic carbon; and
(K) Total coliform.

(ii) The jurisdictional health department in consultation with the department may specify additional or fewer constituents depending upon the nature of the waste; and

(iii) Test methods used to detect the parameters of (d)(i) of this subsection shall be EPA Publication Number SW-846, "Test Methods for Evaluating Solid Waste - Physical/Chemical Methods" except for total coliform which shall use the latest edition of "Standard Methods for the Examination of Water and Wastewater."

(e) The ground water monitoring program must include a determination of the ground water surface elevation each time ground water is sampled.

(f) The owner or operator shall use a statistical procedure for determining whether a significant change over background has occurred. The jurisdictional health department will approve such a procedure with the guidance of the department.

(g) The owner or operator must determine ground water quality at each monitoring well at the compliance point at least quarterly during the life of an active area (including the closure period) and the post-closure care period. The owner or operator must express the ground water quality at each monitoring well in a form necessary for the determination of statistically significant increases.

(h) The owner or operator must determine and report the ground water flow rate and direction in the uppermost aquifer at least annually.

(i) If the owner or operator determines that there is a statistically significant increase for parameters or constituents at any monitoring well at the compliance point, the owner or operator must:

(i) Notify the jurisdictional health department of this finding in writing within seven days of receipt of the sampling data. The notification must indicate what parameters or constituents have shown statistically significant increases;

(ii) Immediately resample the ground water in all monitoring wells and determine the concentration of all constituents listed in the definition of contamination in WAC 173-304-100 including additional constituents identified in the permit and whether there is a statistically significant increase such that the ground water performance standard has been exceeded, and notify the jurisdictional health department within fourteen days of receipt of the sampling data.

(j) The jurisdictional health department may require corrective action programs including facility closure if the performance standard of WAC 173-304-460 (2)(a) is exceeded and, in addition, may revoke any permit and require reapplication under WAC 173-304-600.

(3) Corrective action program. An owner or operator required to establish a corrective action program under this section must, at a minimum with the approval of the jurisdictional health officer:

(a) Implement a corrective action program that reduces contamination and if possible prevents constituents from exceeding their respective concentration limits at the compliance point by removing the constituents, treating them in place, or other remedial measures;

(b) Begin corrective action according to a written schedule after the ground water performance standard is exceeded;

(c) Terminate corrective action measures once the concentrations of constituents are reduced to levels below the limits under WAC 173-304-460 (2)(a). [Statutory Authority: Chapter 43.21A RCW. 85-22-013 (Order 85-18), § 173-304-490, filed 10/28/85.]

WAC 173-304-600 Permit requirements for solid waste facilities. (1) Applicability.

(a) All facilities which are subject to the standards of WAC 173-304-130, 173-304-300, and 173-304-400 are required to obtain permits. Permits are not required for single family residences and single family farms dumping or depositing solid waste resulting from their own activities on to or under the surface of land owned or leased by them when such action does not create a nuisance, violate statutes, ordinances, or regulations, including this regulation.

(b) Permits are not required for corrective actions at solid waste handling facilities performed by the state and/or in conjunction with the United States Environmental Protection Agency to implement the Comprehensive Environmental Response Compensation and Liability Act of 1980 (CERCLA), or corrective actions taken by others to comply with a state and/or federal cleanup order provided that:

(i) The action results in an overall improvement of the environmental impact of the site;

(ii) The action does not require or result in additional waste being delivered to the site or increase the amount of waste or contamination present at the site;

(iii) The facility standards of WAC 173-304-400 are met; and

(iv) The jurisdictional health department is informed of the actions to be taken and is given the opportunity to review and comment upon the proposed corrective action plans.

(c) Effective dates. The effective dates are as follows:

(i) The permit requirements of this section apply to all existing waste handling facilities eighteen months after the effective date of this regulation.

(ii) Between the effective date of this regulation and eighteen months thereafter, existing facilities will operate under the terms and conditions of existing permits valid on the effective date of this regulation. Jurisdictional health departments shall incorporate compliance schedules into valid existing permits; such compliance schedules shall insure that existing facilities meet the effective dates of WAC 173-304-400(3).

(iii) New and expanded waste handling facilities shall meet the requirements of this section on the effective date of this regulation.

(2) Procedures for permits.

(a) Any owner or operator subject to the permit requirements who intends to operate a facility must apply for a permit with the jurisdictional health department. Filing shall not be complete until two copies of the application have been signed by the owner and operator and received by the jurisdictional health department, and the applicant has filed an environmental checklist required under the state environmental policy act rules, chapter 197-11 WAC.

(b) Applications for a permit must contain the information set forth in subsection (3) of this section.

(c) Once the jurisdictional health department determines that an application for a permit is factually complete, it shall refer one copy to the appropriate regional office of the department for review and comment.

(d) The jurisdictional health department shall investigate every application to determine whether the facilities meet all applicable laws and regulations, conforms with the approved comprehensive solid waste handling plan and complies with all zoning requirements.

(e) The jurisdictional health department may establish reasonable fees for permits and renewal of permits. All permit fees collected by the health department shall be deposited in the county treasury in the account from which the health department's operating expenses are paid.

(f) The department shall report to the jurisdictional health department its findings on each permit application within forty-five days of receipt of a complete application or inform the jurisdictional health department as to the status of the application. Additionally, the department shall recommend for or against the issuance of each permit by the jurisdictional health department.

(g) When the jurisdictional health department has evaluated all pertinent information, it may issue a permit. Every completed solid waste permit application shall be approved or disapproved within ninety days after its receipt by the jurisdictional health department or the applicant shall be informed as to the status of the application.

(h) Except for applications specified in subsection (3)(h) of this section every permit issued by a jurisdictional health department shall be on a format prescribed by the department and shall contain specific requirements necessary for the proper operation of the permitted site or facility including the requirement that final engineering plans and specifications be submitted for approval to the jurisdictional health department.

(i) All issued permits must be filed with the department no more than seven days after the date of issuance.

(j) The owner or operator of a facility shall apply for renewal of the facility's permit annually. The jurisdictional health department shall annually:

(i) Review the original application for compliance with these regulations and submit such additional information as spelled out in subsection (4) of this section;

(ii) Review information collected from inspections, complaints, or known changes in the operations;

(iii) Collect the renewal fee;

(iv) Renew the permit; and

(v) File the renewed permit with the department no more than seven days after the date of issuance. The department shall review and may appeal the renewal as set forth in RCW 70.95.185 and 70.95.190.

(3) Application contents for permits for new or expanded facilities.

(a) All permit applications except for inert waste, demolition waste, special purpose landfills, woodwaste landfill and recycling facilities applications, which are specified in (h) of this subsection, shall contain the following:

(i) A general description of the facility;

(ii) The types of waste to be handled at the facility;

(iii) The plan of operation required by WAC 173-304-405(2);

(iv) The form used to record weights or volumes required by WAC 173-304-405(3);

(v) An inspection schedule and inspection log required by WAC 173-304-405(5); and

(vi) Documentation to show that any domestic or industrial waste water treatment facility, such as a leachate treatment system, is being reviewed by the department under chapter 173-240 WAC.

(b) Application contents for permits for new or expanded landfill facilities. In addition to the requirements of (a) of this subsection, each landfill application for a permit must contain:

(i) A geohydrological assessment of the facility that addresses:

(A) Local/regional geology and hydrology, including faults, unstable slopes and subsidence areas on site;

(B) Evaluation of bedrock and soil types and properties;

(C) Depths to ground water and/or aquifer(s);

(D) Direction and flow rate of local ground water;

(E) Direction of regional ground water;

(F) Quantity, location and construction (where available) of private and public wells within a two thousand foot radius of site;

(G) Tabulation of all water rights for ground water and surface water within a two thousand foot radius of the site;

(H) Identification and description of all surface waters within a one-mile radius of the site;

(I) Background ground and surface water quality assessment, and for expanded facilities, identification of impacts of existing facilities of the applicant to date upon ground and surface waters from landfill leachate discharges;

(J) Calculation of a site water balance;

(K) Conceptual design of a ground water and surface water monitoring system, including proposed installation methods for these devices and where applicable a vadose zone monitoring plan;

(L) Land use in the area, including nearby residences; and

(M) Topography of the site and drainage patterns.

(ii) Preliminary engineering report/plans and specifications that address:

(A) How the facility will meet the locational standards of WAC 173-304-130;

(B) Relationship of facility to county solid waste comprehensive plan and the basis for calculating the facility's life;

(C) The design of bottom and side liners;

(D) Identification of borrow sources for daily and final cover, and soil liners;

(E) Interim/final leachate collection, treatment, and disposal;

(F) Landfill gas control and monitoring;

(G) Trench design, fill methods, elevation of final cover and bottom liner, and equipment requirements; and

(H) Closure/post-closure design, construction, maintenance, and land use.

(iii) An operation plan that addresses:

(A) Operation and maintenance of leachate collection, treatment, and disposal systems;

(B) Operation and maintenance of landfill gas control systems;

(C) Monitoring plans for ground water, surface water, and landfill gases to include sampling technique, frequency, handling, and analyses requirements;

(D) Safety and emergency accident/fire plans;

(E) Routine filling, grading, cover, and housekeeping;

(F) Record system to address records on weights (or volumes), number of vehicles and the types of waste received;

(G) Vector control plans; and

(H) Noise control.

(iv) Closure plan to address:

(A) Estimate of closure season/year;

(B) Capacity of site in volume and tonnage;

(C) Maintenance of active fill versus completed, final covered acreage;

(D) Estimated closure construction timing and notification procedures;

(E) Inspection by regulatory agencies.

(v) Post-closure plan to address:

(A) Estimated time period for post-closure activities;

(B) Site monitoring of landfill gas, ground water, and surface water;

(C) Deed clause changes, land use, and zoning restrictions;

(D) Maintenance activities to maintain cover and run-off systems; and

(E) Identification of final closure costs including cost calculations and the funding mechanism.

(c) Application contents for new or expanded transfer stations, drop box facilities, and baling and compaction systems requiring a permit. In addition to the requirements of (a) of this subsection, each applicable application for a permit must contain preliminary engineering report/plans and specifications that address:

(i) The proposed facility's zoning status;

(ii) The relationship to the county solid waste comprehensive plan and the area to be served by the facility; and

(iii) The facility design to address how the facility shall meet requirements of WAC 173-304-410, including closure.

(d) Application contents for new or expanded surface impoundments requiring a permit. In addition to the requirements of (a) of this subsection, each applicable application for a permit must contain:

(i) A geohydrological assessment of the facility that addresses all of the factors of (b)(i) of this subsection;

(ii) Preliminary engineering report/plans and specifications that address, where applicable:

(A) How the proposed facility will meet the locational standards of WAC 173-304-130;

(B) The relationship of facility to the county solid waste comprehensive plan;

(C) The design of liners and foundation to be incorporated in the facilities design including the design leachate of collection and treatment systems;

(D) The design of ground water monitoring;

(E) The design of dikes including calculations on dike stability analyses under conditions of liner failure;

(F) Other design details, including sludge cleanout and disposal, overfilling alarms and inlet design; and

(G) Closure/post-closure design, construction maintenance and land use.

(iii) An operation plan that addresses:

(A) Operation and maintenance of leachate collection system, or ground water monitoring;

(B) Operation and maintenance of overfilling equipment or details of filling and emptying techniques;

(C) Inspection of dikes and liners for integrity; and

(D) Safety and emergency plans.

(iv) A closure plan to address:

(A) Estimate of closure year and cost;

(B) Methods of removing wastes, liners and any contaminated soils, and location of final disposal;

(C) Closure timing and notification procedures; and

(D) Final inspection by regulatory agencies.

(e) Application contents for new or expanded piles requiring a permit. In addition to the requirements of (a) of this subsection, each application for a permit must contain:

(i) Preliminary engineering reports/plans and specifications that address:

(A) How the proposed facility will meet the locational standards of WAC 173-304-130;

(B) The relationship of the facility to the county solid waste comprehensive plan and zoning;

(C) The design of the liner or sealed surface upon which the liner rests, including an analysis of the liners ability to withstand the stress;

(D) The design of the run-on and run-off system;

(E) The design to avoid washout when the pile is located in a one hundred year floodplain; and

(F) Maximum elevation and boundaries of the waste pile.

(ii) An operation plan that addresses:

(A) Methods of adding or removing wastes from the pile and equipment used;

(B) Inspection of the liner for integrity; and

(C) Safety and emergency plans.

(iii) A closure plan to address:

(A) Estimate of closure year and cost;

(B) Methods of removing wastes, liners and any contaminated soils, and location of final disposal;

(C) Closure timing and notification procedures; and

(D) Final inspection by regulatory agencies.

(f) Application contents for new or expanded energy recovery and incinerator facilities requiring a permit. In addition to the requirements of (a) of this subsection, each application for a permit must contain:

(i) Preliminary engineering reports/plans and specifications that address:

(A) The relationship of the facility to the county solid waste comprehensive plan and zoning;

(B) The design of the storage and handling facilities on-site for incoming waste as well as fly ash, bottom ash and any other wastes produced by air or water pollution controls; and

(C) The design of the incinerator or thermal treater, including changing or feeding systems, combustion air systems, combustion or reaction chambers, including heat recovery systems, ash handling systems, and air pollution and water pollution control systems. Instrumentation and monitoring systems design shall also be included.

(ii) An operation plan that addresses:

(A) Cleaning of storage areas as required by WAC 173-304-440 (2)(a);

(B) Alternative storage plans for breakdowns as required in WAC 173-304-440 (2)(c);

(C) Inspection to insure compliance with state and local air pollution laws and to comply with WAC 173-304-405(5). The inspection log or summary must be submitted with the application; and

(D) How and where the fly ash, bottom ash and other solid wastes will be disposed of.

(iii) A closure plan to address:

(A) Estimate of closure year and cost;

(B) Methods of closure and methods of removing wastes, equipment, and location of final disposal;

(C) Closure timing and notification procedures; and

(D) Final inspection by regulatory agencies.

(g) Application contents for new or expanded landspreading disposal facilities requiring a permit. In addition to the requirements of (a) of this subsection, each application for a permit must contain:

(i) A geohydrological assessment of the facility that addresses all of the factors of (b)(i) of this subsection;

(ii) Preliminary engineering reports/plans and specifications that address:

(A) How the proposed facility will meet the locational standards of WAC 173-304-130;

(B) The relationship of the facility to the county solid waste comprehensive plan and the basis for calculating the facility's life;

(C) Waste analyses and methods to periodically sample and analyze solid waste;

(D) Design of interim waste storage facilities if such facilities are not otherwise permitted by the department;

(E) Design of run-on and run-off systems;

(F) A contour map of the active area showing contours to the nearest foot;

(G) A ground water and surface water monitoring program; and

(H) Access barriers such as fences, and warning signs.

(iii) An operation plan that addresses:

(A) Operation and maintenance of run-off and run-on systems;

(B) Methods of taking ground water samples and for maintaining ground water monitoring systems;

(C) Methods of applying wastes to meet the requirements of WAC 173-304-450 (2)(d):

(I) Estimated multiples of agronomic rates;

(II) Frequency of discing; and

(III) Avoidance of standing water.

(D) The written contract required between landowners, waste generators and waste operators.

(iv) Closure plan to address:

(A) Estimate of closure season/year;

(B) Capacity of site in volume and tonnage;

(C) Year-to-year maintenance of the active area versus completed, final covered acreage;

(D) Closure construction timing and notification procedures; and

(E) Final inspection by regulatory agencies.

(v) Post-closure plan to address:

(A) Estimated time period for post-closure activities;

(B) Site monitoring of ground water;

(C) Deed clause changes, land use, and zoning restrictions;

(D) Maintenance activities to maintain cover and run-off systems;

(E) Plans for food chain crops being grown on the active areas, after closure; and

(F) Identification of final closure costs including cost calculations and the funding mechanism.

(h) Application contents for new or expanded inert waste and demolition waste, special purpose landfill, woodwaste landfills, and recycling facilities.

Applications for permits subject to the standards of WAC 173-304-300, 173-304-460(6), 173-304-461, and 173-304-462 shall be on forms whose content shall be specified by the jurisdictional health department.

(4) Application contents for existing facilities renewing permits. All owners or operators of existing facilities shall renew permits or application forms specified in subsection (3) of this section. Previous information submitted to the jurisdictional health department may be referred to on the application forms. Changes in operating methods or other changes must be noted on the application in order to be authorized by permit.

(5) Inspections. As a minimum, annual inspections of all permitted solid waste facilities shall be performed by the jurisdictional health department. Any duly authorized officer, employee, or representative of the jurisdictional health officer or his designee having jurisdiction may enter and inspect any property, premises or place at any reasonable time for the purpose of determining compliance with this chapter, and relevant laws and regulations. Findings shall be noted and kept on file. A copy

of the inspection report or annual summary shall be furnished to the site operator. [Statutory Authority: Chapter 43.21A RCW. 85-22-013 (Order 85-18), § 173-304-600, filed 10/28/85.]

WAC 173-304-700 Variances. (1) Any person who owns or operates a solid waste facility may apply to the jurisdictional health officer for a variance from any section of this regulation. The application shall be accompanied by such information as the jurisdictional health department may require. The jurisdictional health department may grant such variance, but only after due notice or a public hearing if requested, if it finds that:

(a) The solid waste handling practices or location do not endanger public health, safety or the environment; and

(b) Compliance with the regulation from which variance is sought would produce hardship without equal or greater benefits to the public.

(2) No variance shall be granted pursuant to this section until the jurisdictional health department has considered the relative interests of the applicant, other owners of property likely to be affected by the handling practices and the general public.

(3) Any variance or renewal shall be granted within the requirements of subsection (1) of this section and for time period and conditions consistent with the reasons therefor, and within the following limitations:

(a) If the variance is granted on the ground that there is no practicable means known or available for the adequate prevention, abatement, or control of pollution involved, it shall be only until the necessary means for prevention, abatement or control become known and available and subject to the taking of any substitute or alternative measures that the jurisdictional health department may prescribe;

(b) The jurisdictional health department may grant a variance conditioned by a time table if:

(i) Compliance with the regulation will require spreading of costs over a considerable time period; and

(ii) The time table is for a period that is needed to comply with the regulation.

(4) Any variance granted pursuant to this section may be renewed on terms and conditions and for periods which would be appropriate on initial granting of a variance. No renewal thereof shall be granted, unless following a public hearing on the complaint or due notice, the jurisdictional health department finds the renewal is justified. No renewal shall be granted except on application. Any such application shall be made at least sixty days prior to the expiration of the variance. Immediately upon receipt of an application for renewal, the jurisdictional health department shall give public notice of such application in accordance with rules and regulations of the jurisdictional health department.

(5) An application for a variance, or for the renewal thereof, submitted to the jurisdictional health department shall be approved or disapproved by the jurisdictional health department within ninety days of receipt unless the applicant and the jurisdictional health department agree to a continuance.

(6) No variance shall be granted by a jurisdictional health department except with the approval and written concurrence of the department prior to action on the variance by the jurisdictional health department.

(7) Variances granted by a jurisdictional health department will be accepted as variances under this regulation.

(8) Public notice shall be given by mailing a notice of the variance application to persons who have written to the jurisdictional health department asking to be notified of all variance requests. [Statutory Authority: Chapter 43.21A RCW. 85-22-013 (Order 85-18), § 173-304-700, filed 10/28/85.]

WAC 173-304-9901 Maximum contaminant levels for ground water. Maximum contaminant levels for ground water shall be those specified in chapter 248-54 WAC, as the primary drinking water standards. Analytical methods for these contaminants may be found in the code of federal regulations 40 CFR Part 141. (These contaminant levels are to be considered interim levels for the purpose of regulating solid waste handling facilities and shall be used until such time as the department establishes ground water quality standards for all types of activities impacting ground water.) [Statutory Authority: Chapter 43.21A RCW. 85-22-013 (Order 85-18), § 173-304-9901, filed 10/28/85.]

ENVIRONMENTAL PROTECTION AGENCY

40 CFR Parts 257 and 258

SOLID WASTE DISPOSAL FACILITY CRITERIA;

PROPOSED RULE

federal register

Tuesday
August 30, 1988

Part III

Environmental Protection Agency

40 CFR Parts 257 and 258
Solid Waste Disposal Facility Criteria; Proposed Rule

ENVIRONMENTAL PROTECTION AGENCY

40 CFR Parts 257 and 258

[FRL-3227-7]

Solid Waste Disposal Facility Criteria

AGENCY: Environmental Protection Agency (EPA).

ACTION: Proposed rule.

SUMMARY: The Environmental Protection Agency today is proposing revisions to the Criteria for Classification of Solid Waste Disposal Facilities and Practices set forth in 40 CFR Part 257. These revisions were developed in response to the 1984 Hazardous and Solid Waste Amendments to the Resource Conservation and Recovery Act (RCRA). This proposed action would amend Part 257 by including information requirements for certain solid waste disposal facilities and by excluding municipal solid waste landfills (MSWLFs) from Part 257. In addition, this action would add a new Part 258, which spells out specific requirements for MSWLFs.

Amended Part 257 would establish notification and exposure information requirements for owners and operators of industrial solid waste disposal facilities and construction/demolition waste landfills. The new Part 258 sets forth revised minimum Criteria for MSWLFs, primarily in the form of performance standards, including location restrictions, facility design and operating criteria, ground-water monitoring requirements, corrective action requirements, financial assurance, and closure and post-closure care requirements.

EPA believes that the provisions in today's proposal are necessary for the protection of human health and the environment and take into account the practicable capability of owners and operators of municipal solid waste landfills. The Agency is requesting comment on the overall approach proposed and on specific components of the proposal.

Today's proposal also is intended to fulfill a portion of EPA's mandate under section 405(d) of the Clean Water Act (CWA) to promulgate regulations governing the use and disposal of sewage sludge. Under today's proposal, Part 258 would be co-promulgated under the authority of the CWA; this authority would apply to all municipal solid waste facilities in which sewage sludge is co-disposed with household wastes. A separate regulation for sludge monofills (landfills in which only sewage sludge is disposed of) is being prepared for future proposal under 40 CFR Part 503.

DATES: Comments on this proposed rule must be submitted on or before October 31, 1988.

Public hearings are scheduled as follows:

(1) October 13, 1988, 9:00 a.m. to 4:30 p.m., at the Sheraton National Hotel, 900 Orme Street, Arlington, VA. 22204, (703) 521–1900.

(2) October 18, 1988, 9:00 a.m. to 4:30 p.m., at the Sheraton Century Center Hotel, 2000 Century Boulevard, NE, Atlanta, Georgia. 30345–3377, (404) 325–0000.

(3) October 20, 1988, 9:00 a.m. to 4:30 p.m., at the Sheraton Anaheim, 1015 West Ball Rd., Anaheim, CA. 92802, (714) 778–1700

(4) October 25, 1988, 9:00 a.m. to 4:30 p.m., at the O'Hare Hilton Hotel, P.O. Box 66414, O'Hare International Airport, Chicago, Illinois. 60666 (312) 686–8000.

The meetings may be adjourned earlier if there are no remaining comments. Requests to present oral testimony should be received by EPA at least 10 days before each public meeting.

A block of rooms has been reserved at the above mentioned hotels for the convenience of individuals requiring lodging. Please make room reservations directly with the hotel and refer to the EPA hearings. The hearing registration will be at 8:00 a.m., with the hearings beginning at 9:00 a.m. and running until 4:30 p.m., unless concluded earlier. Anyone wishing to make a statement at the hearing must notify, in writing, Public Participation Officer, Office of Solid Waste (WH–562A), U.S. Environmental Protection Agency, 401 M Street, SW; Washington, DC 20460. Those wishing to make oral presentations must restrict them to 15 minutes and are encouraged to have written copies of their complete comments for inclusion in the official record.

The Agency is tentatively planning to coordinate these Subtitle D Criteria public meetings with the public meetings on EPA's Draft National Strategy for Municipal Waste which is expected to be issued in the near future. EPA will announce these meetings in a separate FR notice. For information on the strategy please see 53 FR 13316 (April 22, 1988).

ADDRESSES: Commentors must send an original and two copies of their comments to: RCRA Docket Information Center, (OS–305), U.S. Environmental Protection Agency Headquarters, 401 M Street, SW; Washington, DC 20460. Comments should include the docket number F–88–CMLP–FFFFF. The public docket is located at EPA Headquarters (sub-basement) and is available for viewing from 9:00 a.m. to 4:00 p.m., Monday through Friday, excluding Federal holidays. Appointments may be made by calling (202) 475–9327. Copies cost $.15/page.

FOR FURTHER INFORMATION CONTACT: For general information, contact the RCRA/CERCLA Hotline, Office of Solid Waste, U.S. Environmental Protection Agency, 401 M Street, SW; Washington, DC 20460, (800) 424–9346, toll-free, or (202) 382–3000, local in the Washington, DC metropolitan area.

For information on specific aspects of this proposed rule, contact either Allen Geswein or Paul Cassidy, Office of Solid Waste (OS-323), U.S. Environmental Protection Agency, 401 M Street, SW., Washington, DC 20460, (202) 382-4659 or 382-3346.

SUPPLEMENTARY INFORMATION:

Copies of the following Subtitle D Criteria background documents are available for purchase through the National Technical Information Service (NTIS), U.S. Department of Commerce, 5285 Port Royal Road, Springfield, Virginia 22161, (703) 487-4650. EPA and NTIS numbers and NTIS prices are listed below. Documents cannot be obtained directly from EPA.

(1) U.S. EPA, Office of Solid Waste (OSW). Notification Requirements for Industrial Solid Waste Disposal Facilities—Criteria for Classification of Solid Waste Disposal Facilities and Practices (40 CFR Part 257)—Subtitle D of the Resource Conservation and Recovery Act (RCRA). August 1988 (draft). EPA/530-SW-88-044, PB88-242 508, $12.95.

(2) U.S. EPA, OSW. Location Restrictions (Subpart B)—Criteria for Municipal Solid Waste Landfills (40 CFR Part 258)—Subtitle D of the Resource Conservation and Recovery Act (RCRA). July 1988 (draft). EPA/530-SW-88-036, PB88-242 425, $19.95.

(3) U.S. EPA, OSW. Operating Criteria (Subpart C)—Criteria for Municipal Solid Waste Landfills (40 CFR Part 258)—Subtitle D of the Resource Conservation and Recovery Act (RCRA). July 1988 (draft). EPA/530-SW-88-037, PB88-242 433, $19.95.

(4) U.S. EPA, OSW. Closure/Post-Closure Care and Financial Responsibility Requirements (Subpart C, §§ 258.30-258.32)—Criteria for Municipal Solid Waste Landfills (40 CFR Part 258)—Subtitle D of the Resource Conservation and Recovery Act (RCRA). July 1988 (draft). EPA/530-SW-88-041, PB88-242 474, $19.95.

(5) U.S. EPA, OSW. Design Criteria (Subpart D)—Criteria for Municipal Solid Waste Landfills (40 CFR Part 258)—Subtitle D of the Resource Conservation and Recovery Act (RCRA). July 1988 (draft). EPA/530-SW-88-042, PB88-242 482, $19.95.

(6) U.S. EPA, OSW. Ground-Water Monitoring and Corrective Action (Subpart E)—Criteria for Municipal Solid Waste Landfills (40 CFR Part 258)—Subtitle D of the Resource Conservation and Recovery Act (RCRA). July 1988 (draft). EPA/530-SW-88-043, PB88-242 490, $19.95.

(7) U.S. EPA, OSW. Case Studies on Ground-Water and Surface Water Contamination from Municipal Solid Waste Landfills—Criteria for Municipal Solid Waste Landfills (40 CFR Part 258)—Subtitle D of the Resource Conservation and Recovery Act (RCRA). July 1988 (draft). EPA/530-SW-88-040, PB88-242 466, $14.95.

(8) U.S. EPA, OSW. Summary of Data on Municipal Solid Waste Landfill Leachate Characteristics—Criteria for Municipal Solid Waste Landfills (40 CFR Part 258)—Subtitle D of the Resource Conservation and Recovery Act (RCRA). July 1988 (draft). EPA/530-SW-88-038, PB88-242 441, $19.95.

(9) U.S. EPA, OSW. Updated Review of Selected Provisions of State Solid Waste Regulations—Criteria for Municipal Solid Waste Landfills (40 CFR Part 258)—Subtitle D of the Resource Conservation and Recovery Act (RCRA). July 1988 (draft). EPA/530-SW-88-039, PB88-242 458, $14.95.

(10) U.S. EPA, OSW. Regulatory Impact Analysis (RIA) of Proposed Revisions to Subtitle D Criteria for Municipal Solid Waste Landfills—Criteria for Municipal Solid Waste Landfills (40 CFR Part 258)—Subtitle D of the Resource Conservation and Recovery Act (RCRA). July 1988 (draft). EPA/530-SW-88-045, PB88-242 516, $25.95.

All documents can be microfiched for $6.95.

Preamble Outline

I. Authority

These regulations are being proposed under the authority of sections 1008, 4004, and 4010 of the Resource Conservation and Recovery Act of 1976. Section 1008 directed EPA to publish guidelines for solid waste management, including criteria that define solid waste management practices that constitute open dumping and are prohibited under Subtitle D of RCRA. Section 4004 further required EPA to promulgate regulations containing criteria for determining which facilities are sanitary landfills and which are open dumps. In response, EPA promulgated the "Criteria for Classification of Solid Waste Disposal Facilities and Practices" (40 CFR Part 257) in 1979. Section 4010, added by the Hazardous and Solid Waste Amendments of 1984 (HSWA), directs EPA to revise those Criteria promulgated under sections 1008 and 4004 for facilities that may receive household hazardous waste (HHW) or small quantity generator (SQG) hazardous waste.

For municipal solid waste landfills in which sewage sludge is disposed of together with household wastes, the Part 258 regulations also are being proposed under the authority of section 405 (d) and (e) of the CWA. Section 405 regulates the use and disposal of sewage sludge generated by treatment works treating domestic sewage. Section 405 requires that EPA develop standards for sludge use and disposal, including: An identification of the major use and disposal practices, factors to be taken into account in determining applicable measures and practices for each use or disposal, and concentrations of pollutants that interfere with each use or disposal. When the CWA was amended in February 1987, additional requirements were added to section 405. Congress directed EPA to identify toxic pollutants that may be present in sewage sludge in concentrations that may adversely affect public health and the environment and to establish numerical limitations and management practices for each identified pollutant for each use of disposal option. The numerical limitations and management practices are to be adequate to protect public health and the environment from any reasonably anticipated adverse effects of each pollutant. Further, the amendments require that these section 405(d) sludge standards be implemented through National Pollutant Discharges Elimination System (NPDES) permits issued to publicly owned treatment works (POTWs) or other treatment works treating domestic sewage unless the standards have been included in a permit issued under RCRA Subtitle C; the Safe Drinking Water Act; the Marine Protection, Research and Sanctuaries Act; the Clean Air Act; or a State permit where the State program has been approved as ensuring compliance with section 405. In addition section 405(e) prohibits any person from disposing of sludge from a POTW or other treatment works treating domestic sewage except in accordance with the section 405(d) regulations.

II. Background

Subtitle D of RCRA establishes framework for Federal, State, and local government cooperation in controlling the management of nonhazardous solid waste. The Federal role in this arrangement is to establish the overall regulatory direction, to provide minimum standards for protecting human health and the environment, and to provide technical assistance to States for planning and developing environmentally sound waste management practices. The actual planning and direct implementation of solid waste programs under Subtitle D, however, remain State and local functions.

Section 405(d)–(f) of the CWA establishes a comprehensive framework for regulating the use and disposal of sewage sludge. Section 405(d) provides for the Federal promulgation of numerical limitations and management practices governing the use and disposal of sludge. Section 405(e) provides for Federal enforcement of these standards. Section 405(f) requires the implementation of these regulations through permits issued to POTWs under section 402 of the CWA, unless they have been included in a permit issued under Subtitle C of RCRA or other authority listed in that section. The permits are to be issued by EPA or by a State with a program that has been approved as ensuring compliance with section 405 of the CWA.

A. Current Subtitle D Criteria

Under the authority of sections 1008(a)(3) and 4004(a) of RCRA, EPA promulgated the "Criteria for Classification of Solid Waste Disposal Facilities and Practices" (40 CFR Part 257) on September 13, 1979. EPA issued minor modifications to these Criteria on September 23, 1981. These Subtitle D Criteria establish minimum national performance standards necessary to ensure that "no reasonable probability of adverse effects on health or the environment" will result from solid waste disposal facilities or practices. A facility or practice that meets the Criteria is classified as a "sanitary landfill"; a facility failing to satisfy any of the Criteria is considered an "open dump" for purposes of State solid waste management planning. State plans developed under the "Guidelines for Development and Implementation of State Solid Waste Management Plans" (40 CFR Part 256) must provide for closing or upgrading all existing "open dumps" within the State.

The existing Part 257 Criteria include general environmental performance standards addressing eight major topics: Floodplains (§ 257.3–1), endangered species (§ 257.3–2), surface water (§ 257.3–3), ground water (§ 257.3–4), land application (§ 257.3–5), disease (§ 257.3–6), air (§ 257.3–7), and safety (257.3–8). The following briefly summarizes these provisions.

Section 257.3–1 specifies that facilities or practices in floodplains shall not interfere with the floodplain or result in washout of solid waste so as to pose a hazard to human life, wildlife, or land or water resources. Section 257.3–2 prohibits solid waste disposal facilities and practices that cause or contribute to the taking of any endangered or threatened species or result in the destruction or adverse modification of the critical habitats of such species. The surface water provision, § 257.3–3, specifies that disposal facilities shall not cause a discharge of pollutants or dredged or fill material to waters of the United States that is in violation of section 402 or 404 of the CWA. Section 257.3–4 lays out the ground-water protection standards, which require that facilities and practices not exceed the Safe Drinking Water Act maximum contaminant levels (MCLs) in an underground drinking water source beyond the solid waste unit boundary or beyond an alternative boundary specified by the State.

Section 257.3–5 requires that a facility or practice meet certain restrictions with respect to the concentrations of cadmium and polychlorinated biphenyls (PCBs) contained in waste applied to land used for producing food chain crops. Section 257.3–6 specifies that waste disposal facilities and practices must institute appropriate disease vector controls, such as periodic application of cover material. In

addition, § 257.3–6 requires pathogen reduction processes for sewage sludges and septic tank pumpings applied to land.

The air criterion in § 257.3–7 prohibits open burning of solid waste (with certain exceptions) and specifies that the applicable requirements of the State Implementation Plans developed under section 110 of the Clean Air Act must be met. Finally, the safety provisions of § 257.3–8 require control of explosive gases, fires, bird hazards to aircraft, and public access to the facility.

Currently, EPA does not have the authority to enforce these existing Part 257 Criteria directly, except in situations involving the disposal or handling of POTW sludge. Federal enforcement of POTW sludge handling facilities is authorized under the CWA. The existing Criteria, as they apply to non-sludge-handling facilities, are enforced by the States through State regulatory programs or by citizens through the citizen suit provisions of section 7002 of RCRA.

2. Hazardous and Solid Waste Amendments of 1984

In 1984, Congress made significant modifications to Subtitle D of RCRA through the Hazardous and Solid Waste Amendments. As described below, the major modifications to Subtitle D include requirements that EPA complete a Subtitle D study and revise the Part 257 Criteria, and that States implement revised permitting programs.

1. Subtitle D Study and Report to Congress

HSWA added a new section 4010 to RCRA, which requires EPA to "conduct a study of the extent to which the guidelines and Criteria under this Act (other than guidelines and Criteria for facilities to which Subtitle C applies) which are applicable to solid waste management and disposal facilities * * * are adequate to protect human health and the environment from ground water contamination." This study is to include a detailed assessment of the adequacy of the Criteria regarding monitoring, prevention of contamination, and remedial action for protecting ground water and also is to identify "recommendation with respect to any additional enforcement authorities which the Administrator, in consultation with the Attorney General, deems necessary." EPA anticipates submitting a Report to Congress on the results of the study shortly.

2. Criteria Revisions

Section 4010 also required EPA to revise the Subtitle D Criteria by March 31, 1988, for facilities that may receive household hazardous waste or hazardous waste from small quantity generators. These revisions must be those necessary to protect human health and the environment, but, at a minimum, should require ground-water monitoring as necessary to detect contamination, establish location standards for new or existing facilities, and provide for corrective action, as appropriate. Section 4010 further states that EPA may take into account the "practicable capability" of facilities to implement the Criteria. Today's proposal represents the first phase of the Agency's promulgation of these mandated revisions.

3. Implementation and Enforcement

HSWA amended section 4005 of RCRA to require States to establish by November 8, 1987, a permit program or other system of prior approval to ensure that facilities that receive HHW or SQG hazardous waste are in compliance with the existing Part 257 Criteria. Within 18 months of promulgation of revised Criteria, each State must modify its permit program to ensure compliance with the revised Criteria. If the Administrator determines that a State has not adopted an adequate permit program, EPA may enforce the revised Criteria at facilities that may receive HHW or SQG waste.

C. Current Sewage Sludge Criteria

The existing Part 257 Criteria discussed above were co-promulgated under the joint authority of RCRA and section 405(d) of the CWA. The Part 257 regulations thus apply to all sludge land disposal practices, except distributing and marketing sludge. Because these regulations apply to sewage sludge, they are directly enforceable by EPA against any person found to be in violation of them.

In February 1987, Congress enacted the Water Quality Act of 1987, which amended portions of the CWA, including section 405. First, Congress expanded section 405(d) to impose new standard-setting requirements with associated deadlines. Second, Congress established new sludge permitting requirements in section 405(f) along with State program requirements. EPA currently is developing sludge regulations to be proposed under section 405(d) and published in 40 CFR Part 503. In addition, EPA already has published a proposed regulation in 40 CFR Part 501 that would implement the requirements of section 405(f) (53 FR 7642, March 9, 1988). The comment period for these latter regulations closed on May 9, 1988.

The Part 503 regulations, when promulgated, will address the incineration, ocean disposal, land application, and distribution and marketing of sludge. Lastly, and most relevant here, they also will regulate sludge monofills, which are landfills in which only sewage sludge is disposed of (i.e., no other type of solid waste is co-disposed of with the sewage sludge). Those regulations will not, however, contain regulations for the co-disposal of sewage sludge with household wastes. Regulations for the co-disposal of sewage sludge and household wastes, rather, are part of today's proposal. By this action, the Agency seeks to achieve consistency in its regulation under two legal authorities of a single disposal practice—the co-disposal of sewage sludge and other solid wastes in municipal solid waste landfills.

III. Nature and Scope of the Problem

To fulfill its responsibilities under HSWA, EPA has conducted a series of studies and analyses of solid waste characteristics, waste disposal practices, and environmental and public health impacts resulting from solid waste disposal. Preliminary results of these studies were summarized in the "Subtitle D Study Phase I Report," issued in October 1986 (Ref. 34). Final results, which form the basis for Agency decision making for this rule, are incorporated in EPA's Subtitle D report to Congress, which is expected to be issued shortly. The key studies pertinent to today's proposal are summarized below. Copies of the reports mentioned below are available for public review in the docket for this rulemaking.

A. EPA Studies of Solid Waste Management

1. Analysis of Solid Waste Characteristics

To analyze the characteristics of solid waste, EPA conducted numerous studies to determine the volume, characteristics, and management methods of wastes regulated under Subtitle D. These studies revealed that more than 11 billion tons of solid waste are generated each year, including 7.6 billion tons of industrial nonhazardous waste (which includes about 55.8 million tons of electric utility wastes), 2 to 3 billion tons of oil and gas waste (including both drilling wastes and produced wastes), more than 1.4 billion tons of mining waste, and nearly 160 million tons of municipal solid waste.

Several Subtitle D wastes currently are being addressed under separate Agency efforts and thus were not

examined in detail in EPA's Subtitle D study. In particular oil and gas wastes, utility wastes, and mining waste have been the subject of special studies conducted under section 8002 of RCRA and are being considered separately for rulemaking. In addition, the Agency currently is closely evaluating, in a separate effort, the characteristics and management practices for municipal waste combustion ash. Thus, the following discussion focuses on the characteristics of municipal solid waste, household hazardous waste, and small quantity generator hazardous waste, which are the primary waste streams addressed by today's proposal, as well as industrial solid waste.

In 1986, EPA sponsored a study entitled "Characterization of Municipal Solid Waste in the United States, 1960 to 2000" (Ref. 16). This study examined the quantity and composition of municipal solid wastes and forecast the characteristics of municipal solid wastes in the U.S. through the end of the century. The study found that, on average, more than 50 percent of municipal solid waste comprises paper, paperboard, and yard wastes; nearly 40 percent is metals, food wastes, and plastics; and the remaining 10 percent is wood, rubber, leather, textiles, and miscellaneous inorganics. Waste composition was found to be highly site-dependent and influenced significantly by climate, season, and socioeconomic factors. The study determined that approximately 150 million tons of municipal solid waste were generated in 1984 (of which more than 128 million tons were landfilled) and that the waste volume was expected to increase significantly by the end of the century. EPA recently completed an update to this study entitled, "Characterization of Municipal Solid Waste in the United States, 1960–2000 (Update 1988)" (Ref. 17). This update estimated that 158 million tons of municipal solid waste were generated in 1986.

In October 1986, EPA published "A Survey of Household Hazardous Wastes and Related Collection Programs," which analyzed the existing information on characteristics of HHW and reviewed HHW collection programs (Ref. 30). This study indicated that common discarded household products, such as household cleaners, automotive products, paint thinners, and pesticides, may contain hazardous wastes that are either listed under Subtitle C or exhibit one or more hazardous characteristics. Household wastes, including HHW, currently are exempt from regulation under Subtitle C of RCRA.

A third study, "Summary of Data on Industrial Nonhazardous Waste Disposal Practices," compiled available data on industrial solid waste characteristics and land disposal practices in 22 major manufacturing industries (Ref. 29). This study estimated that roughly 390 million metric tons of industrial nonhazardous waste are generated by these industries each year, that 35 percent of these wastes are managed on site, and that 75 percent of these wastes are generated by four industries: Iron and steel, electric power generation, industrial inorganic chemicals, and plastics and resins. Additional information on industrial nonhazardous waste quantities was provided by the Industrial Facility Screening Survey (Ref. 35), which estimated that approximately 7.6 billion tons of industrial nonhazardous wastes are generated each year. The survey is described in more detail below.

In 1985, EPA also conducted the "National Small Quantity Generator Survey," which characterized SQG waste volumes and disposal practices (Ref. 14). (For purposes of this study, SQGs were defined as those operations yielding less than 1,000 kilograms of hazardous waste per month.) This survey indicated that SQGs annually produce 940,000 metric tons of hazardous waste, consisting largely of lead-acid batteries, solvents, and strongly acidic or alkaline wastes. Furthermore, the survey found that solid waste disposal facilities, including MSWLFs, are the second most frequent destination for SQG hazardous waste shipped off site. EPA estimates that MSWLFs may receive from 5 percent to 16 percent of the SQG hazardous waste produced.

Existing information on MSWLF leachate, summarized in the background document on MSWLF leachate quality (Ref. 8), indicates that leachate from MSWLFs generally contain a wide range of inorganic and organic hazardous constituents in varying concentrations. Landfill gas comprises 50 to 60 percent methane, 40 to 50 percent carbon dioxide, and less than 1 percent hydrogen, oxygen, nitrogen, and other trace gases.

2. Review of Waste Disposal Practices

EPA conducted numerous studies to gather existing information on the numbers of Subtitle D facilities, facility design and operating characteristics, leachate and gas characteristics, and environmental and human health impacts associated with different types of facilities. EPA relied on several key sources of information on the number and design and operating characteristics of Subtitle D facilities for this proposal. The first major source was an EPA mail survey of State solid waste management programs conducted in 1985 to gather information on State Subtitle D programs and facilities. The final report on the survey, "Census of State and Territorial Subtitle D Nonhazardous Waste Programs" (State Census), was issued in 1986 (Ref. 46).

The State Census indicated that there are about 227,000 Subtitle D disposal facilities, excluding waste piles (which were not included in the survey). This total includes approximately 16,500 landfills, 191,500 surface impoundments, and 19,000 land application units. In addition, the State Census indicated that there are more than 145,000 oil and gas waste or mining waste facilities, which EPA is addressing in separate efforts.

The States estimated that roughly 37,000 Subtitle D facilities (or 16 percent of all the facilities) may receive hazardous wastes from households or from small quantity generators. The States' estimate of 16,500 landfills included approximately 9,300 MSWLFs; however, the States subsequently identified errors in the numbers reported for MSWLFs and submitted revised figures. These revised State figures and the results from EPA's 1986 municipal solid waste landfill survey, which was a random sample of approximately 1,250 MSWLFs nationwide, indicate that there are a total of 6,034 MSWLFs (as of 1986). The MSWLF survey also provided detailed information on MSWLF design and operation.

In developing this rule, EPA also utilized the results of an industrial facility screening survey, which involved a telephone screening of nearly 30,000 establishments in 22 industries. The primary purpose of this screening survey was to provide EPA with basic information on the universe and characteristics of industrial solid waste disposal facilities.

In general, information on Subtitle D disposal facilities is limited, except for MSWLFs. While new MSWLFs are expected to be better located, designed, and operated, the following observations can be made regarding the universe of existing MSWLFs. According to the State Census, MSWLFs are distributed throughout the country, occurring in virtually every hydrogeologic setting, and generally concentrated near more populated areas; they are owned predominantly by local governments (80 percent), with the remainder owned by private entities (15 percent), the Federal Government (4 percent), and State governments (1 percent). Approximately 42 percent are

small (less than 10 acres) and 52 percent dispose of small amounts of waste (less than 17.5 tons per day); only 15 percent are designed with liners (natural or synthetic) and only 5 percent have leachate collection systems. Current data also indicate that only 25 to 30 percent of MSWLFs have some type of ground-water monitoring system. Results from the 1986 MSWLF survey generally are consistent with these results.

1. Assessment of Impacts

Impacts associated with MSWLFs and industrial Subtitle D facilities are described below. Existing data indicate that some MSWLFs are adversely affecting the environment and could harm human health. Industrial solid waste facilities need to be examined more closely to determine their impacts.

a. Municipal Solid Waste Landfills. State inspection data, case study evidence, risk characterization studies, waste and leachate characteristics, and the current limited use of design controls indicate that some MSWLFs have degraded the environment and that this degradation could continue. Older landfills are of most concern because they may have received large volumes of hazardous waste and, in general, their use of design controls was very limited; however, existing data are not sufficient to conclusively demonstrate that MSWLFs currently are harming human health, other than data indicating acute impacts associated with methane releases. Current human health impacts from past exposure to contaminant releases from MSWLFs are difficult to isolate due to the complex interaction of factors that affect human health. However, the Agency's recently completed risk assessments indicate that MSWLFs present future potential risks to human health.

More than 500 MSWLFs, or about 25 percent of MSWLFs with ground-water monitoring systems, were reported by States to be violating a State ground-water protection standard, although the nature and extent of these violations are unknown. In some States, any detectable degradation of the ground water is considered a violation. Most facilities do not monitor for organic hazardous constituents in ground water, so these violations represent analyses for a limited set of pollutants. States also reported that 845 MSWLFs were cited for air-related violations (many of which are likely to be odor-related incidents), and 660 MSWLFs were cited for surface water contamination. Some of these violations may have been reported at sites established before existing State and Federal regulations were in place.

EPA has summarized case study information documenting ground-water and surface water contamination incidents (Ref. 7). Evaluation of 163 MSWLF case studies revealed ground-water contamination at 146 facilities and surface water contamination at 73 facilities. For most of these landfills, information on the waste received either was not available or was incomplete, although a limited number are known to have received hazardous waste before the Subtitle C regulations were issued. At about 50% of the facilities with ground-water contamination, specific contaminants were identified. The most common constituents were iron, chloride, manganese, trichloroethylene, benzene, and toluene. At several sites, drinking water sources were contaminated. Ground-water contaminant plumes characterized at three of the sites extended to (or nearly to) the base of an aquifer at depths of approximately 70 feet (at two sites) and 300 feet (at one site).

The plume from one site migrated one-half mile downgradient of the landfill, while the plume at another site migrated almost one and one-half miles downgradient.

Typically, those facilities causing ground-water contamination were more than 10 years older than facilities reporting no impacts. Ground-water impacts appeared to be more severe in locations characterized by high net infiltration rates and high ground-water flow rates. Most facilities that had contaminated ground water were located close to the ground-water table, underlain by highly permeable soils, or had no or very limited engineering controls. The case study information identifies several factors that may be related to failure at a particular facility, specifically the landfill's age, location, and engineering design; however, it is unknown whether this sample is representative of the universe of MSWLFs, and it is not possible to isolate the specific factors responsible for each failure.

Analysis of damage cases involving methane indicates that methane must be controlled to protect human health. Methane is produced in MSWLFs through anaerobic decomposition of organic waste and is explosive at sufficiently high concentrations (the lower explosive limit). Existing Federal regulations require that the concentration of explosive gases should not exceed 25 percent of the lower explosive limit in facility structures and should not exceed the lower explosive limit at the facility boundary. Methane is produced in such abundance that methane collection projects are in place at approximately 100 landfills for the primary purpose of resource recovery and energy production. Where methane is not controlled, fires and explosions have occurred. In 23 of 29 damage cases studied, methane has been measured in concentrations above the lower explosive limit at distances up to 1,000 feet off site. Explosions and fires, both on site and off site, have occurred in 20 of the 29 cases, loss of life has been documented in five instances, and injuries have been reported in several others. Most of these sites where injuries or death occurred did not have a landfill gas control system.

EPA also examined the characteristics of landfills on the Superfund National Priorities List (NPL) in May 1986 (Ref. 26). Of the 850 sites listed or proposed for listing on the NPL (in May 1986), 184 sites (22 percent) were identified as MSWLFs. In addition, of the 27,000 sites in the Superfund data base, almost one fourth are MSWLFs. In general, the MSWLFs on the NPL were poorly located and designed. Because most of the NPL sites were in operation before 1980 (the effective date of EPA's hazardous waste rules) and may have received hazardous wastes in addition to Subtitle D wastes, they are not representative of newer, better designed and operated MSWLFs; however, these sites indicate the extent to which older and poorly located, designed, and managed landfills can harm the environment. Current data indicate that 70 percent of existing MSWLFs were in operation prior to 1980.

The State data, case study information, and NPL study were supplemented by a risk assessment of MSWLFs (Ref. 10). The risk assessment was completed using the Subtitle D Risk Model, which was developed to evaluate the risks and resource damage associated with ground-water contamination at MSWLFs and to identify the factors that affect the nature, extent, and severity of environmental impacts from these facilities. The model simulates pollutant release, fate, and transport; exposure; impacts; and corrective action. The model is described in more detail in Section XI of this preamble.

Caveats to the risk and resource damage analysis results presented in the risk assessment need to be recognized. First, the risk and resource damage modeling includes considerable uncertainty. The model components that introduce the most uncertainty are those that predict leachate quality for trace

organics, the probability and consequences of containment system failure, and the human health risk resulting from exposure to toxic substances (e.g., the dose-response models). Second, the model estimates effects from new landfills, but does not analyze the risk and resource damage impacts from existing facilities.

The risk analysis estimates the human health risk for the maximum exposed individual (i.e., the mean of the average lifetime risk over the 300-year modeling period of the facility) and the total population using ground water as a drinking water source within one mile of the facility. Current data indicate that 54 percent of existing MSWLFs have no downgradient drinking water wells within one mile, a finding that strongly influences model results because current data and model limitations do not allow the risk to be estimated at facilities with drinking water wells beyond one mile. Thus, under this model, such facilities are considered to pose no risk.

Using the well distribution indicated by the MSWLF survey (i.e., no drinking water wells located within one mile of 54 percent of the landfills), the risk model estimates that, in the baseline, fewer than 1 percent of MSWLFs pose risk greater than 1×10^{-4} (i.e., an exposed individual would have a greater than one in ten thousand chance of contracting cancer in his or her lifetime as a result of the exposure), 5.5 percent pose risk in the 1×10^{-5} to 1×10^{-4} range, and 11.6 percent pose risk in the 1×10^{-6} to 1×10^{-5} range. Overall, approximately 17 percent of MSWLFs pose risks greater than $110\times^{-6}$. Out of the eight leachate constituents modeled, the three principal constituents contributing to human health risk are vinyl chloride, 1,1,2,2-tetrachloroethane, and dichloromethane.

For landfills located within one mile of a drinking water well (46 percent of all landfills), 14 percent pose risk exceeding 1×10^{-5}, and nearly 40 percent pose risk greater than 1×10^{-6}. If future wells are located near existing MSWLFs (or new sites are located near current wells), the overall risk distribution may be closer to the estimates for this subgroup. The overall risk distribution changes significantly if it is assumed that all drinking water wells are located at the facility boundary (assumed to be 10 meters from the landfill unit). Using this conservative scenario, it is estimated that approximately 35 percent would pose risk greater than 1×10^{-5}, and about 67 percent of MSWLFs would pose risk exceeding 1×10^{-6}.

Because risk is the result of a complex interaction among many factors (some of which have not been accounted for in this analysis), no single factor is responsible for most of the variation. Thus, in addition to well distance, the results of the analysis identified other risk-contributing factors, which include infiltration rate, facility size, and aquifer characteristics. These factors are similar to those identified in the case studies discussed above. More detailed discussion of EPA's risk assessment is provided later in this preamble.

b. Sewage Sludge Disposal in MSWLFs. EPA estimates that approximately 6,800 POTWs dispose of their sludge in MSWLFs. This represents the sludge disposal practice used by 44 percent of all POTWs. The total volume of co-disposed sewage sludge is slightly under 3 million tons per year, which is approximately 40 percent of the volume generated annually by POTWs.

EPA has not performed a separate risk assessment addressing the sludge component of municipal solid waste landfills. Sludge typically is a small component of the landfill (i.e., 5 percent). It is not technically feasible to monitor separately the fate and transport of the sludge and its constituents from the fate and transport of other wastes in the landfill and their constituents. Moreover, while there has been some research on the interaction of sludge and other wastes in a co-disposal situation, there are as yet no definitive results from such work. Therefore, the discussion above on the practices and risks associated with MSWLFs constitutes the best current information on those landfills that receive sludge together with the other wastes.

c. Industrial Subtitle D Facilities. In 1985, about 28,000 industrial solid waste land disposal facilities handled approximately 7.6 billion tons of waste. Although few data on specific health and environmental impacts of these facilities are available, the large volume of waste and number of facilities present concerns about actual and potential threats from these facilities. More than half of these facilities are surface impoundments, which create concerns because of the mobility and physical driving force of liquids in impoundments and the current limited use of design controls. Current data are insufficient, however, to determine the extent of potential problems.

Study results indicate only sporadic use of design and operating controls at industrial solid waste landfills and surface impoundments, with only 12 percent and 22 percent, respectively, employing any type of liner system. Study findings also revealed that few of these facilities have monitoring systems and only 35 percent were inspected by States in 1984, the latest year for which data are available.

Limited data on violations of State requirements, coupled with these statistics on design and operating controls, suggest that releases may be occurring, but more data are needed to determine the impacts of industrial Subtitle D facilities. The notification and exposure information requirements in Part 257 proposed today are a first step toward gathering this information.

B. State Controls on Solid Waste Management

Through the State Census, EPA gathered information on State Subtitle D programs in areas such as organization and resources, regulations and permit programs, and enforcement. In addition, EPA completed a detailed review of State regulations in 1984 (Ref. 25) and a supplemental review in 1987 (Ref. 9). The following is a brief overview of State solid waste regulatory programs.

MSWLFs are the Subtitle D facilities most closely regulated by the States. Most States and Territories impose some set of overall facility performance standards; however, among the States and Territories, specific design and operating standards vary greatly. For example, the 1987 regulatory review determined that 24 States and Territories require liners and 27 States and Territories require leachate collection systems. As of 1984, 28 States and Territories required gas control systems, and 38 specified some sort of run-on/run-off controls. Nearly all allow case-by-case exemptions and variances.

Many States and Territories impose some location standards or restrictions on MSWLFs. These usually include floodplain siting restrictions, which range from prohibitions on siting in the 100-year floodplain to specific design or performance standards for operations within the floodplain to a general directive to avoid sites subject to flooding. Although minimum distances from surface and ground waters and from airports and utility lines sometimes are specified, they too vary widely. For example, prescribed distances from habitable residences vary from 200 feet to three-quarters of a mile and required distances from community water supplies range from 400 feet to one mile.

Thirty-eight States and Territories specifically require ground-water monitoring systems, and an additional 12 States have general authority to impose ground-water monitoring on a site-specific basis. With regard to corrective action, 21 States have requirements in their regulations, while 22 others have general authority to

impose corrective action. Approximately half of the States and Territories require methane gas monitoring and/or surface water monitoring. While most States and Territories have general guidelines or requirements for facility closure and post-closure maintenance requirements, these requirements vary widely in stringency. Finally, some form of financial assurance for closure and post-closure care is required in about half of the States and Territories.

As can be seen from the above information, there are certain gaps in some State and Territorial regulatory programs, which may result in inadequate protection of human health and the environment in some parts of the country. In some cases, the gaps in State and Territorial programs may be linked both to the inadequate implementation of the existing Federal Criteria by certain States and Territories and to the absence of certain key regulatory provisions in the current Federal Subtitle D Criteria themselves. For example, the current Criteria do not require ground-water monitoring or monitoring for methane releases, so MSWLF owners and operators may choose not to install monitoring devices (if the State or Territory does not specifically require them) and thus may not detect problems before significant problems have occurred. The existing Criteria also do not require corrective measures in the event contamination above levels of concern occurs. Furthermore, MSWLF owners and operators are not required to provide continued protection of human health and the environment through effective closure procedures and post-closure care. Agency experience since 1979 in both the hazardous waste regulatory program and response actions under Superfund has confirmed the importance of such preventive measures for long-term protection of human health and the environment.

C. Need for Revisions to the Part 257 Criteria

The evidence briefly described above indicates that MSWLFs, when improperly designed and operated, may present threats to human health and the environment. The evidence further indicates that the Federal Criteria are missing several key regulatory provisions. These provisions include location restrictions, ground-water monitoring, and corrective action, which all are mandated by HSWA. In addition, current data point to the need for the addition of methane monitoring, closure and post-closure care, and financial assurance requirements. The Agency believes that the available data clearly indicate that the current Federal Criteria have not proved adequate to protect human health and the environment and must be revised to ensure such protection.

These revisions to the Subtitle D Criteria come at a time when heightened concern is directed at issues of solid waste management. This concern derives from State, Territorial, and local government difficulties in ensuring adequate capability for municipal solid waste management as well as public concern regarding potential hazards presented by waste disposal facilities. EPA is aware of the crisis in solid waste management and believes that these proposed Criteria revisions should be a major step toward alleviating public concern with respect to inadequate controls on solid waste disposal. In addition, EPA believes these proposed revisions provide States and Territories with the flexibility needed to address the practicable capacity of the regulated community.

IV. Public Participation in This Rulemaking

Given the number and diversity of MSWLFs and the potentially significant impacts that the revised Criteria may have on them, EPA involved the public and private sector in the rulemaking process. This effort included public meetings and outreach activities aimed at encouraging participation in the process.

Since the spring of 1985, EPA has hosted or participated in a series of public meetings, workshops, conferences, and other activities focusing on issues in the Subtitle D program. In August 1985, EPA sponsored a conference explaining the major provisions of the Hazardous and Solid Waste Amendments of 1984 that affected three key RCRA programs—Subtitle D, small quantity generators, and underground storage tanks. During the conference, EPA held workshops on the following Subtitle D issues: 1) Identification of available information and case studies, 2) ground-water monitoring and protection requirements, 3) closure and post-closure care and financial responsibility requirements, 4) waste restrictions and liquids management requirements, and 5) liner and location requirements. The workshops provided a forum for EPA and the participating State and local governments, public interest groups, industry, and trade associations to exchange information and discuss significant regulatory issues.

On June 27, 1986, EPA hosted a public meeting in Washington, DC, on the issues and options being considered for the revisions to the Subtitle D Criteria. At that time, EPA presented the Agency's initial thinking on the revised Criteria, solicited comments, and responded to questions from representatives of States, local governments, public interest groups, and private organizations.

On November 18 to 20, 1986, EPA held a three-day conference in Arlington, Virginia, on solid waste disposal facilities and HHW collection programs. At this conference, EPA presented interim results of the Subtitle D Study, reported on the status of the Subtitle D Criteria revisions, and discussed issues associated with HHW collection programs. Conference participants also made presentations on State regulatory perspectives and public- and private-sector views.

EPA also sponsored a series of policy discussion meetings in 1986 involving high-level representatives of the principal interest groups affected by the Subtitle D program, including State and local governments, citizen and environmental groups, and industry and trade associations. The broad objectives of these meetings, which were coordinated for EPA by the Conservation Foundation, were to examine the effectiveness of the Subtitle D program, identify issues likely to affect implementation of the revised Criteria, and suggest innovative strategies to address problems identified.

V. Scope and Structure of Today's Proposal

The revised Criteria EPA is proposing today vary considerably in scope and content from the current Criteria in Part 257. This section explains the basis for EPA's decisions with respect to the scope and structure of today's proposal.

A. Scope of the Existing Part 257

The existing Part 257 Criteria are applicable to all solid waste disposal facilities and practices regulated under Subtitle D of RCRA. With certain exceptions listed in § 257.1(c), the Criteria apply to all types of facilities (i.e., landfills, surface impoundments, land application units, and waste piles) used for disposal of solid waste, as well as all types of solid wastes (i.e., municipal, industrial, commercial, agricultural, mining, and oil and gas waste) regulated under Subtitle D of RCRA.

Part 257 also applies to the disposal of sewage sludges from POTWs, but the Agency currently is developing specific standards for managing POTW sewage sludge under section 405(d) of the CWA.

These standards will establish pollutant concentration limits and management practices for sludge monofills, land application units, (including distribution and marketing), incineration, and ocean dumping. The Agency plans to propose these standards in 1989. At that time, EPA will propose amending Part 257 to exclude POTW sewage sludge from its requirements. As previously discussed, today's revised Criteria proposal governs the co-disposal of sewage sludge with household wastes.

B. Scope of Today's Proposal

HSWA directs EPA to develop revisions to the Part 257 Criteria for the subset of solid waste disposal facilities that "may receive hazardous household wastes or hazardous wastes from small quantity generators." Congress thus identified for EPA the scope of the revised Criteria. Based on the studies performed to date, EPA has found that the HSWA-mandated scope includes all MSWLFs, which may receive HHW and SQG hazardous waste, and some industrial solid waste disposal facilities and certain other Subtitle D facilities, which may receive SQG hazardous waste. However, as noted above, EPA has obtained extensive information on only the characteristics of MSWLFs and the risks they may pose to human health and the environment. Neither EPA nor the States have comparable information on industrial solid waste disposal facilities at this time. For this reason, EPA has decided to undertake the revisions to the Part 257 Criteria in phases.

The first phase will apply to MSWLFs (landfills that receive household waste) and is the subject of today's proposal. A second phase will apply to industrial solid waste disposal facilities (disposal facilities that receive solid waste generated by manufacturing or industrial processes), including those that receive SQG hazardous waste, and will be proposed at such time as EPA has adequate data on which to base its decisions. Because of EPA's concern about industrial solid waste disposal facilities (including landfills, surface impoundments, waste piles, and land application units), however, EPA already has initiated data collection, described later in this preamble, to determine the potential impacts of certain of these facilities. In addition, EPA today is taking the first regulatory step in addressing industrial facilities by proposing to require notification and exposure information from owners and operators of certain of these facilities. The Agency recognizes that additional regulatory efforts will be necessary to regulate other disposal facilities not included in the first two phases.

C. Structure of Today's Proposal

Because today's proposal is substantially different in scope and content from the Part 257 Criteria, EPA has chosen to create a new Part 258 for the revised Criteria the Agency is proposing today. EPA considered simply amending Part 257 to include the revised Criteria for MSWLFs, but decided against that option because of the confusion that might be created by having Criteria of general applicability alongside revised Criteria applicable only to MSWLFs. Placing the revised Criteria in a separate Part 258 tracks the distinction made by Congress, which indicated that the revisions only apply to facilities that may receive HHW or SQG hazardous waste. It also leaves the Part 257 Criteria in place for all other solid waste disposal facilities besides MSWLFs.

D. Scope and Effect of Today's Proposal on MSWLFs That Co-dispose of Sludge

The regulations proposed today would apply, under the authority of section 405 (d) and (e) of the Clean Water Act, to all MSWLFs that co-dispose of sludge. Section 405(d) requires EPA to promulgate regulations providing guidelines for the use and disposal of sludge. In general, these regulations must identify numerical limitations and management practices that are adequate to protect public health and the environment from reasonably anticipated adverse effects; however, if, in EPA's judgment, it is not feasible to prescribe or enforce a numerical limitation for a pollutant, EPA may instead promulgate a design, equipment, management practice, or operational standard, or combination thereof, that in EPA's judgment is adequate to protect public health and the environment from reasonably anticipated adverse effects.

Today's proposal reflects EPA's tentative determination that it is not feasible to prescribe concentrations of pollutants in co-disposed sludge that are protective of public health and the environment. Sludge typically is a minor portion of a co-disposal MSWLF (e.g., 5 percent). It is not feasible to separately evaluate the fate, transport, and health and environmental effects of the sludge as distinguished from the remaining majority of wastes in the landfill. Nor does it make sense to try to regulate this small portion of a landfill's waste on a concentration basis, while regulating the entire landfill on a comprehensive management basis. EPA has concluded that today's proposal, which establishes a variety of management and operation requirements (including numerical limitations in the form of ground-water protection standards), will protect public health and the environment from reasonably anticipated adverse effects.

A significant effect of the promulgation of these regulations under section 405(d) of the CWA would be the renewed eligibility of certain POTWs to grant removal credits to their industrial users under section 307(b) of the CWA. Section 307(b) requires EPA to promulgate pretreatment standards for industrial users of POTWs. Section 307(b) also allows an individual POTW to relax these standards for its industrial users by giving them a "removal credit" reflecting the POTW's removal capability, provided that the credit will not prevent the POTW from using or disposing of its sludge in accordance with section 405(d) of the CWA. EPA has promulgated removal credit regulations in 40 CFR Part 403. On April 30, 1986, the United States Court of Appeals for the Third Circuit invalidated the version of the removal credits regulations promulgated in 1984. (*Natural Resources Defense Council* v. *EPA*, 790 F.2d 289 (3d Cir. 1986).) EPA has amended the regulations to respond to all but one of the Third Circuit's four holdings (52 FR 42434, November 5, 1987).

The Third Circuit's fourth holding was that EPA may not authorize POTWs to grant removal credits to their industrial users until EPA promulgates the sludge regulations required by section 405(d) of the CWA. EPA considers the regulations proposed today to respond adequately to the Third Circuit's decision with respect to POTWs that dispose of all their sewage sludge through co-disposal in MSWLFs. These regulations would comprehensively regulate this sludge disposal practice; no further regulation of this practice is required by law or contemplated by the Agency. Thus, upon promulgation of today's regulations, the POTWs that dispose of all their sludge in co-disposal MSWLFs may apply to EPA for removal credits authority, and EPA may grant such authority to any POTW that complies with the procedural and substantive requirements of the removal credits regulations.

VI. General Approach to Today's Proposal

EPA's primary goals in developing today's proposal were to develop standards that are protective of human health and the environment, that are within the practicable capability of the regulated community, and that provide State flexibility in implementation. In

order to meet these goals, EPA considered four options for the approach to today's proposal. First, EPA considered uniform design and operating standards for application to all MSWLFs. Second, EPA considered a performance standards approach that defines goals for the design and operation of MSWLFs. The third and fourth options are methodology-based decision frameworks for determining design and operating requirements. In the third option, facility requirements are specified for facilities in various location categories. The fourth option utilizes a risk assessment algorithm to delineate the necessary design and operating controls. These options are not necessarily mutually exclusive; given that this proposal contains many facets, different options could be employed for different parts of the rule (e.g., performance standards for location requirements and a methodological approach to design requirements). However, in general, EPA chose the performance standards approach for today's proposal.

The uniform national design and operating standards option would impose specific design standards and operating requirements on all units regardless of location and other relevant factors. The Agency believes that such an approach would not adequately account for variability across the country. For instance, this approach would require EPA to assume that all facility locations are "poor" and impose comprehensive design standards on all facilities based on what is necessary to protect human health and the environment in the "poorest" of locations. A rule that does not take into account site-specific location characteristics would likely over-regulate MSWLFs in "good" locations; however, a uniform standards approach may be easier to implement and enforce by States because of the specificity of the standard.

The Agency also considered adopting the uniform national standards option with variances, in order to account for site-specific characteristics. Under this option, variances would be granted if the owner or operator could demonstrate that equivalent protection is provided by site-specific location, design, and operating characteristics. This approach parallels the one adopted for hazardous waste facilities under Subtitle C of RCRA, which imposes virtually identical requirements (e.g., double liners and leachate collection systems) at all new hazardous waste landfills. Variances are then allowed, under Subtitle C, based on an adequate demonstration by the owner or operator that the specific standard is not necessary. While variances add some flexibility, EPA has two concerns about this approach. First, variance demonstrations often require substantial resources on the part of the owner and operator and the States. Second, EPA is concerned that public pressure would limit State or local flexibility in granting variances, even though they may be warranted for a specific site. While this option might provide a high assurance of protection of human health and the environment, it could over-regulate some facilities by requiring unnecessary controls. In addition, this approach does not fully take into account the practicable capability of the regulated community.

The second approach considered was to impose overall performance standards for each facility requirement. These performance goals or standards would require site-specific analyses to determine appropriate controls. EPA chose this approach for this rulemaking because it allows the greatest flexibility for the State to consider numerous location-specific factors in tailoring facility requirements. In addition, performance standards are less disruptive of existing State programs and give facilities some needed latitude to meet requirements within the bounds of their practicable capability. Finally, a performance standard, as opposed to a strict design standard, allows for the consideration of innovative technologies that may be developed in the future.

The third approach, a methodological one, was to impose a decision framework based on location categories to determine the applicable requirements for a specific facility. This approach would categorize all locations on the basis of certain characteristics, then set individual requirements for each category. Under this approach, appropriate requirements could be matched to specific categories of locations. Methods of establishing location categories and their corresponding requirements would be specified in the revised Criteria; then States, using information submitted by the owner or operator, could determine the category and apply the associated requirements to a given facility. A key advantage to the categorical rule approach is that it establishes uniform criteria for matching requirements to potential problems. For example, facilities in areas of the country characterized by abundant rainfall could be required to collect generated leachate. Conversely, facilities in the more arid areas of the country do not necessarily generate leachate in quantities sufficient to warrant leachate control systems, and could be regulated accordingly.

The Agency believes this categorical requirements approach would provide protection without over-regulation; however, a complex, sophisticated scheme would be necessary to address every location consideration and to match appropriate requirements. Furthermore, it would be difficult to develop a technically defensible approach for all requirements for MSWLFs, particularly those requirements that necessitate site-specific analyses (e.g., ground-water monitoring). In addition, this approach would restrict State flexibility because it would specify which designs are necessary for each location.

The fourth option, also a methodological approach, is based on a risk assessment algorithm. This approach would require the use of a predictive equation to determine the necessary facility requirements. The predictive equation would include some simplifying assumptions, but would utilize site-specific values for some of the parameters. Like the categorical approach, this option has the advantages of employing a uniform national standards approach that could be easy to implement; however, it would be difficult to develop a technically sound risk algorithm and could restrict State flexibility.

EPA intends to provide guidance on how to design MSWLFs to meet the proposed performance standards. The agency believes the categorical approach is one viable method for determining landfill design, and is considering developing this method as guidance along with the risk algorithm method. Both of these approaches to design requirements are discussed in more detail in section IX.D of this preamble. The Agency requests comments on the approach proposed today and on the alternatives presented.

VII. Major Issues

A. Ground-Water Resource Value

Resource value refers to the current and future importance of ground water as a water supply and as an ecological resource. Highly saline ground water or ground water with very low yield may have a low resource value. Pristine ground water or ground water in high demand that cannot easily be replaced or restored similarly may have a high resource value. As EPA was developing the framework for the revised Criteria, the Agency considered at length the

subject of differential protection of ground water based on its resource value. Specifically, EPA considered applying different engineering controls, monitoring, and corrective action requirements according to the resource value of the ground water.

In 1984 EPA issued the Ground-water Protection Strategy, which established the concept of differential protection of ground water depending on its resource value. Accordingly, three classes of ground water were identified. Class I ground waters are defined as special ground waters that are highly vulnerable to contamination and that are either irreplaceable sources of drinking water or are ecologically vital. Class II ground waters are defined as current and potential sources of drinking water and those having other beneficial uses. Class III ground waters are defined as heavily saline ground water or ground water otherwise contaminated beyond the level allowing cleanup through methods commonly used by public water supply treatments. The Agency expects to issue final Guidelines for Ground-Water Classification during 1988. States then may use this document for reference in making ground-water classification and resource evaluation decisions.

With respect to facility design for MSWLFs, today's proposal would establish facility design Criteria that give States the flexibility to address the value of ground-water resources in setting facility-specific design requirements. Section IX.D of today's preamble describes the Agency's approach for incorporating resource value considerations into facility design decisions. EPA is not mandating use of the ground-water classification system set forth in EPA's Ground-water Protection Strategy. Rather, under this proposal, States would have the discretion to assess the value of ground-water resources. In developing Subtitle D guidance in the future, however, the Agency may draw upon the Guidelines for Ground-Water Classification to provide examples of appropriate resource evaluation and classification decisions.

The Agency also is proposing to allow consideration of resource value in the corrective action and, to a lesser extent, the ground-water monitoring components of today's rule. Specifically, today's proposal would allow the ground-water protection standards to be adjusted by States in situations where MSWLFs are located over aquifers that meet certain conditions (see section IX.E of today's preamble). These conditions include the following: (1) The aquifer is not a current or potential source of drinking water; and (2) the aquifer is not interconnected with waters to which the hazardous constituents are migrating or are likely to migrate in a concentration(s) that represents a statistically significant increase over background concentrations. Adjustments made to the ground-water protection standard or cleanup standard would be made on a site-specific basis by the State after determining that the above conditions are met. Furthermore, the time allowed for corrective action could vary based on the value placed on the ground water.

In addition, EPA is proposing that any frequency of ground-water monitoring (above the minimum required) be specified by the State based on site-specific factors, including the resource value of the ground water. The proposed approach, however, would not allow exemptions from all ground-water monitoring for facilities located over low value ground water. The Agency believes that at least minimal ground-water monitoring is necessary at all MSWLFs to evaluate the performance of facility design and operation and to identify potential threats to human health and the environment. Furthermore, HSWA specifically mandates that the revised Criteria require ground-water monitoring as necessary to detect contamination at facilities that may receive HHW or SQG waste. The Agency requests comment on whether ground-water monitoring should be waived for MSWLFs located over ground water of low resource value.

Finally, EPA believes ground-water resource value already plays an important role in local and State decisions regarding the siting of MSWLFs. In this proposal EPA has not established Federal siting Criteria specifically based on resource value because EPA recognizes that resource value considerations in facility siting are more appropriately made at the State and local levels.

The Agency also recognizes that many States are implementing various ground-water protection strategies, including wellhead protection programs. EPA believes today's proposal provides the States the flexibility to implement these programs and encourages them to increase certain requirements, as necessary, to meet the objectives of their wellhead protection programs. These requirements could range from more stringent design controls for mimimizing migration out of a unit to establishing certain location restrictions, such as minimum setback distances from vulnerable municipal well fields.

Comments are requested specifically on how the resource value of ground water should be accounted for in setting the various requirements proposed today for MSWLFs.

B. Exclusion of Closed MSWLFs

EPA considered whether to apply the requirements proposed in Part 258 to MSWLF units that close prior to the effective date of the final rule. Closed units are defined in § 258.2 as those units that no longer receive wastes and have a final layer of cover material. EPA believes that inclusion of closed facilities in this rulemaking would raise numerous technical, legal, and implementation complexities that could not be resolved within the time frame of this rule. For example, inclusion of closed units could overtax State implementation capabilities because identification of closed facilities would be difficult and time consuming and complicated by issues such as changes in ownership. Thus, EPA proposes that closed units be excluded from regulation at this time. The Agency is in the process of examining questions regarding closed facilities, however, and will consider further action once this effort has been completed.

According to the State Census, a reported 32,000 closed solid waste disposal facilities are located across the U.S., but EPA does not know how many of these are closed MSWLFs. In the absence of closed MSWLF regulations, these facilities, which represent potential threats to human health and the environment because of their number and because many were poorly designed and managed, may be addressed under EPA's Superfund program or by RCRA enforcement provisions for imminent hazards.

Because the Agency is concerned about closed MSWLFs, EPA today encourages each State to develop a long-term regulatory strategy to deal with these closed facilities. EPA believes that developing a closed MSWLF strategy should include at least the following steps: 1) Review of the State's legal authority to address closed facilities; 2) an inventory of closed facilities to identify the location of these facilities and to gather available information on facility age and size, waste types disposed of, and known local ground-water usage; 3) ranking of sites by the present danger to human health and the environment; 4) determination of the adequacy of the existing regulatory controls for closed sites and their ability to respond to any problems; and 5) use of the available legislative and regulatory authorities to address

problems identified with closed sites. EPA specifically is interested in comments on Federal and State strategies that may be used in addressing these closed MSWLFs.

C. Practicable Capability

The Congressional directive to revise the existing Criteria (§ 4010 of RCRA as amended) states that EPA may consider the "practicable capability" of owners and operators of facilities that may receive HHW or SQG waste in determining what these revisions should entail. Congress recongnized that the universe of owners and operators of solid waste disposal facilities included many with limited economic and technical capabilities. For example, many MSWLFs are owned and operated by small local governments with limited resources. Development of today's proposal, therefore, included an analysis of how the "practicable capability" of owners and operators should be taken into account when setting appropriate controls for protection of human health and the environment.

The Agency believes that practicable capability encompasses both technical and economic components. The technical component includes both the availability of technology for addressing a particular problem (i.e., technical feasibility), as well as the technical capability of the owner or operator to implement that technology. The economic component refers to the economic resources available to the owner or operator to implement the revised standards.

To assist in characterizing the practicable capability of MSWLFs, EPA collected data on waste disposal, demographics, landfill size, and landfill ownership. These data indicate that most MSWLFs handle relatively small volumes of municipal solid waste (measured in tons per day). EPA estimates that 52 percent of all landfills manage less than 17.5 tons per day (TPD) and account for less than 2 percent of the waste handled by all MSWLFs. However, the largest landfills (2.6 percent of all MSWLFs) handle more than 1,125 TPD and manage 40 percent of all municipal landfill waste.

These data also clearly indicate that most MSWLFs are located in rural areas and these MSWLFs typically serve a limited number of communities relative to landfills located in more urban areas. EPA matched 1982 Census data with geographic location data (longitude and latitude coordinates) to determine whether landfills are located in low- (rural) or high- (urban) density counties. EPA estimates that 69 percent of existing landfills are in counties with population densities of fewer than 100 people per square mile, supporting the conclusion that most landfills are located in "rural" areas. In addition, EPA Facility Survey data (Ref. 36) show that, on average, only 1.8 communities share a landfill at the village or town level, but that at the city level, there are 3.8 communities per landfill.

To address the economic component of practicable capability, EPA assessed the financial capability and current spending practices of municipal governments. EPA assembled financial and demographic data from the "1982 Census of Governments" and the "1983 County and City Data Book." Based on the 1982 Census data, EPA estimates that communities typically spend less than 1 percent of their budgets on solid waste disposal. In comparison with other municipal services, costs at this level represent a very small obligation. For example, as an average percentage of total community expenditures, communities spend 36 percent on education, 5 percent on police protection, and 3 percent on sewage disposal. The 1982 Census data also were used to develop a composite score of nine various financial and economic vitality measures. This score categorizes communities' financial capabilities as weak, average, or strong. EPA used the score to assess the baseline financial condition of governments and the economic impact of various regulatory scenarios. The development and categorization of the composite score and the economic impact analysis is described in detail in Section XI of this preamble and in the draft regulatory impact analysis for today's proposal.

EPA believes that significant disruptions of solid waste management could result unless these technical and economic factors are taken into account where necessary. The Agency, therefore, examined the range of MSWLFs to determine which, if any, might be especially susceptible to technical difficulties or economic hardship. Owners and operators of two classes of MSWLFs were identified as possible candidates for consideration of practicable capability—existing MSWLF units and small MSWLFs.

EPA estimates that there are more than 6,000 MSWLFs currently in operation. Of these existing facilities, about 20 percent are expected to close before 1990 and almost 75 percent are expected to close within 15 years (Ref. 10). EPA evaluated whether requirements should be the same for these facilities as for new MSWLF units.

Regulating new and existing MSWLF units differently allows consideration of practicable capability of the existing MSWLF, although some problems at existing facilities may not be addressed if these units face less stringent requirements. Regulating new and existing units the same way, while conceptually offering greater assurance of protection, could impose very high costs, creating implementation difficulties and posing the prospect of solid waste management disruptions. Comments that EPA received prior to proposal from States, industry groups, and private firms favored different requirements for new and existing units.

Based on these considerations, EPA is proposing today to vary some requirements for new and existing landfill units. These differences fall in three major areas. First, the majority of the location restrictions proposed today would be applicable only to new landfill units (that is, units that have not received wastes prior to the effective date of the rule). EPA believes the application of today's location restrictions to existing units would result in significant disruption of solid waste management in certain areas of the country. However, existing units would be required to comply with the unstable area restrictions (§ 258.15) because the Agency believes these areas pose particular concerns for protection of human health and the environment.

Second, today's proposal does not require that existing units be retrofitted with liners and leachate collection systems. EPA believes that such a requirement would: (1) Exceed the economic capabilities of the majority of owners and operators of existing facilities, (2) present additional public health problems from the excavation of waste, and (3) disrupt existing solid waste management activities.

Third, today's proposal provides a phase-in period of 18 months for all requirements not only to allow States to put in place revised regulations, but also to provide lead time for owners and operators to comply with the new requirements. Furthermore, additional phase-in time is provided for ground-water monitoring due to the resources needed by States and owners and operators to implement this provision. Detailed discussion of the ground-water monitoring provision is provided in Section IX.E of this preamble.

In today's proposal, EPA has not varied requirements for new and existing units in cases where such requirements are equally feasible, technically and economically, at both new and existing landfill units, except existing facilities would have more time to comply with certain requirements. For

example, the operating criteria (Subpart C) and ground-water monitoring and corrective action requirements (Subpart E) are applicable equally to new and existing units, although new facilities must comply with Subpart E's ground-water monitoring requirements before they can accept wastes, while existing units may have up to five years to comply.

EPA also considered varying requirements for small MSWLFs. The Agency estimates that, of the approximately 6,000 active MSWLFs, just over half handle 17.5 TPD or less (Ref. 10). In contemplating whether to regulate small MSWLFs differently from large ones, EPA determined that practicable capability considerations did not outweigh potential health and environmental threats. Specifically, the Agency believes that size represents only one factor in determining potential risk, and that other variables, such as design and operating controls, location and climate characteristics, and waste streams, can be significant determinants of risk regardless of MSWLF size. Based on the risk assessment for this rulemaking, EPA concluded that no single factor factor is responsible for most of the variability in risk across MSWLFs; rather, there is a complex interaction among the factors that govern leachate flux and flow through the underlying aquifer (Ref. 10). As a result, EPA is not proposing any special exceptions for small MSWLFs. However, the Agency believes that today's proposal provides States adequate flexibility to address particular site-specific conditions present at MSWLFs, including small MSWLFs. In addition, the 18-month phase-in period, along with a State-specified ground-water monitoring compliance schedule, should provide owners and operators of small MSWLFs adequate time to comply with the requirements proposed today or to make other arrangements for solid waste disposal.

D. Extent of the Criteria Revisions

HSWA directs that, at a minimum the Criteria revisions require "groundwater monitoring as necessary to detect contamination, establish criteria for the acceptable location of new or existing facilities, and provide for corrective action as appropriate." The statute further specifies that the revised Criteria shall be "those necessary to protect human health and the environment and may take into account the practicable capability of solid waste disposal facilities." Because of EPA's mandate to protect human health and the environment, the Agency was not confined to these minimum statutory requirements (i.e., location restrictions, ground-water monitoring, and corrective action requirements) in developing today's proposal. Limiting the Criteria revisions to the statutory minimum would omit important preventive measures (e.g., gas controls) necessary for long-term protection of human health and the environment. Moreover, exceeding the miminum reduces the reliance on detection systems for protecting human health and the environment and thus results in a higher level of protection.

Furthermore, going beyond the statutory minimum allows the Agency to consider other requirements that can prevent failures and corrective actions, even though these additional requirements may add costs for preventive measures at facilities that would not have failed and thus did not need the preventive measures; however, the Agency has taken into account the practicable capability of municipal solid waste landfills in specifying the required level of environmental controls.

During the development of these Criteria revisions, EPA received comments on whether or not the revised Criteria should exceed the statutory minimum. In general, industry advocated confining the scope of the rule to the statutory minimum. Several industry associations, however, supported an expanded scope as long as flexibility was built into the rule and site-specific factors could be considered in determining what controls should be imposed. State views were divided. Some preferred requiring the statutory minimum only, while others suggested varying subsets of additional requirements, and still others wanted comprehensive controls.

In today's action, EPA has proposed revisions that go beyond those minimally required by HSWA (i.e., location restrictions, ground-water monitoring, and corrective action). In addition to the statutory minimum, today's proposal includes an update of the design and operating criteria in the existing Part 257 Criteria, and adds new requirements for closure and post-closure care and financial responsibility. The rationale for each of these new provisions, which the Agency believes are necessary for the protection of human health and the environment, is discussed in detail later in this preamble. The Agency seeks comments on the extent of the revisions proposed today.

E. Requirements for Facilities Other Than MSWLFs

EPA is concerned about the estimated 28,000 industrial solid waste disposal facilities and 2,600 construction/demolition waste landfills, as discussed previously. However, today's proposal would limit the applicability of the revised Criteria to MSWLFs because there are insufficient data currently available to develop requirements for these other facilities. For this reason, the Agency considered the information-reporting requirements that might be appropriate for identifying and assessing the risks associated with industrial waste disposal facilities and construction/demolition waste landfills, and for determining the need for additional controls on these facilities.

EPA contemplated three information-reporting options for these facilities. The first option was a notification requirement. Notification could provide information on these solid waste disposal facilities, including data on their locations, ownership, and waste management practices. This information could be used to answer basic questions about these facilities without placing significant resource demands on the owners and operators of these affected facilities or the States. This option, however, provides no specific data on the potential environmental or human health impacts posed by these facilities.

A notification requirement with an exposure information component was the second option. Facilities would be required to supply exposure information, such as distance to the property boundary and available data on the population that could readily be exposed. This information could help EPA and the States roughly assess the potential risks currently posed by these facilities and use this information to select facilities that need more careful examination and analysis. States should use this information especially to help set priorities; however, information defining potential exposed population may be of limited utility if not backed by monitoring results indicating the extent of any releases that may be occurring.

A ground-water monitoring requirement was the third option considered by the Agency. Comprehensive ground-water monitoring data could provide a strong foundation on which to base analyses in support of rulemaking applicable to facilities other than MSWLFs. However, this effort would be resource-intensive for States and much more costly to the regulated community then simpler options. Given the diversity and size of

this universe of facilities, ground-water monitoring may not be necessary for all facilities. While ground-water monitoring could generate substantial data, EPA believes there are more cost-effective ways of establishing a data base for rulemaking. EPA believes that the risks posed by these facilities should be evaluated more closely before taking the significant step of requiring ground-water monitoring at all 28,000 industrial solid waste disposal facilities and construction/demolition waste landfills nationwide. The advantage of a strong information base is offset by the added costs and burden imposed on these facilities for monitoring and the resulting potential for exceeding the practicable capability of marginally profitable operations. Moreover, most States would have difficulty implementing the program due to the extensive resources it would require and the fact that even the basic data (e.g., location) on these facilities are very limited in many States.

Instead, EPA is contemplating a phased approach to data collection. The proposed amendment to Part 257, which is described in more detail in section VIII of this preamble, calls for a notification requirement with a limited amount of exposure information. Once these basic data are compiled and analyzed, the Agency can determine what further information requirements or regulatory controls should be pursued for industrial solid waste disposal facilities and construction/demolition waste landfills.

VIII. Amendments to Part 257

Today's proposal includes amendments to 40 CFR Part 257. These amendments include: (1) Conforming changes to Part 257 that would make it consistent with the proposed Part 258; (2) an update to the MCLs listed in Appendix I of Part 257; and (3) a notification requirement for certain types of facilities.

A. §§ 257.1–2 Conforming Changes to Part 257

Today's proposal adds municipal solid waste landfills to the list of exceptions to the Part 257 Criteria contained in § 257.1(c). Because MSWLFs would be covered by the proposed Part 258 Criteria, they would no longer be subject to the Part 257 Criteria that are generally applicable to solid waste disposal facilities and practices. The Part 257 Criteria would otherwise be unchanged with respect to their applicability, and would remain in full effect for all other facilities and practices.

Today's proposal also would add certain facility definitions to Part 257. Included are definitions of the four types of solid waste disposal facilities that would be regulated by the Part 257 Criteria: Landfills, surface impoundments, land application units, and waste piles. These new definitions would clarify that these types of solid waste disposal facilities are subject to the Part 257 Criteria.

B. §§ 257.3–4 Revisions to Ground-Water Requirements

EPA is proposing to update the MCLs, which are used as ground-water protection criteria in Part 257, to include any MCLs that have been established by EPA since the promulgation of Part 257 in 1979. Currently, Part 257 imposes basic environmental criteria for the protection of human health and the environment. At the time Part 257 was promulgated, the available interim MCLs for the protection of human drinking water were included as ground-water protection criteria. MCLs are developed by EPA under section 1412 of the Safe Drinking Water Act (SDWA), which was amended in 1986. Under the 1986 Amendments to the SDWA, EPA is mandated to promulgate drinking water regulations for a large number of constituents; these regulations generally include MCLs. Accordingly, this notice would revise the Part 257 regulations to include any new MCLs as ground-water protection criteria (including the MCLs for eight volatile organics that were promulgated on July 8, 1987; see 52 FR 25690). Because the development of MCLs is an ongoing process, EPA is proposing to simply reference the MCL regulations (40 CFR Part 141) directly, rather than update Appendix I, which now includes only the MCLs promulgated prior to 1979. Therefore, today's action proposes to eliminate Appendix I and to incorporate the MCLs by reference to 40 CFR Part 141. Using this approach, the Agency avoids the need to update the Part 257 Criteria every time EPA issues a new MCL. The public would have the opportunity to comment on whether it would be appropriate to use each new MCL as a ground-water protection standard under Part 257.

C. § 257.5 Notification and Exposure Information Requirements

The proposed amendments to Part 257 also include a notification and exposure information requirement for certain solid waste disposal facilities (§ 257.5). As discussed above, under this requirement, EPA intends to obtain notification and exposure information from a set of solid waste disposal facilities of particular concern: Industrial landfills, surface impoundments, land application units, and waste piles, as well as construction/demolition waste landfills.

As explained earlier, these facilities are of concern to the Agency because they represent a large and diverse set of solid waste disposal facilities, and little information is available on these facilities at either the State or Federal level. In addition, some of these sites may be used for disposal of SQG hazardous waste and may pose unknown risks to human health and the environment. EPA plans to undertake data collection efforts on these facilities to establish the basis for future rulemaking. Today's proposed requirement for notification and exposure information from these facilities is a first major step toward revising the current regulatory program for these facilities.

The information EPA is proposing to require from these facilities consists of two parts: Basic notification information for facility identification purposes and limited exposure information to be used to estimate potential risks posed by these facilities. The notification information is necessary because neither EPA nor the State have adequate information on these facilities to support fully revised Criteria for these facilities at this time. EPA's recent survey of the States clearly indicates the scarcity of data on industrial solid waste disposal facilities and construction/demolition waste landfills. The proposed notification requirement would provide EPA and the States the mechanism to identify the universe of facilities and, at the same time, indicate to the facilities that they are subject to Subtitle D.

The notification also would request very basic data for determining the potential risks the facilities present to human health and the environment. For example, in addition to seeking general facility information, the proposed notification includes two questions relating to the potential risks posed by the facility: The number of households within one mile of the facility, and the number of on-site monitoring wells. Information submitted in response to these risk-based questions could be used by the States in setting priorities for inspections and other activities. EPA requests comments on whether to include other risk-related questions in the proposed notification, such as questions concerning the use of local waters (ground and surface), the number of local drinking water wells, and the number of municipal water intakes downstream from the facility. In addition, EPA requests comments generally on the appropriate questions

to be included on the notification form, and whether the form should be sent to both EPA and the State.

The proposed notification and exposure information requirement is only one part of EPA's data collection efforts with respect to industrial solid waste disposal facilities. The Agency recently has completed a major telephone survey, and other efforts are under consideration, such as an in-depth mail survey, a closer examination of State regulatory programs, and collection of available ground-water monitoring data. The Agency intends to develop revised Criteria for these facilities as soon as adequate data are available to support rulemaking.

IX. Section-by-Section Analysis of Part 258

A. Subpart A—General

Subpart A discusses the purpose, scope, and applicability of the proposed Part 258. It provides definitions necessary for the proper interpretation and implementation of the rule and identifies what Federal laws are to be considered in complying with these rules.

1. § 258.1 Purpose, Scope, and Applicability

Part 258 sets forth minimum national criteria for the location, design, operation, cleanup, and closure of municipal solid waste landfills. An MSWLF that does not meet these criteria would be considered an open dump for purposes of State solid waste management planning under RCRA. Open dumping is prohibited under section 4005 of RCRA.

Part 258 would apply to all new and existing municipal solid waste landfills, as defined in § 258.2, except MSWLF units that closed prior to the effective date of the rule. As specified in § 258.2, a closed unit is any solid waste disposal unit that no longer receives solid waste and has received a final layer of cover material. As discussed in more detail later, the Agency believes that final covers are essential for closure of MSWLF units. This definition would ensure that the owner or operator cannot escape these regulations by simply refusing to accept additional waste and abandoning the MSWLF. Part 258 requirements do not apply to units that are created within the area of contamination during Superfund actions. In addition, Part 258 would not apply to other landfills, or surface impoundments, waste piles, or land application units used for solid waste disposal; these facilities will continue to be covered under Part 257.

Landfills that receive municipal waste combustion (MWC) ash regulated under Subtitle D of RCRA, including MWC ash monofills, would be considered municipal solid waste landfills for the purposes of this rule (see section IX.A.2 of today's preamble). Therefore, today's proposal applies to any Subtitle D landfill that receives MWC ash. However, legislation is currently pending in Congress which, if enacted, would require specific standards for the design of MWC ash disposal facilities which differ from today's proposed design requirements. In addition, the Agency is concerned that certain requirements proposed today may not be adequate or appropriate for MWC ash disposal facilities. For example, today's proposed air criteria do not specifically require fugitive dust controls during MWC ash transportation. Also, certain ground-water monitoring parameters (e.g., volatile organic constituents) and the methane gas controls proposed today for MSWLFs may not be appropriate for MWC ash monofills due to the characteristics of MWC ash. In addition, the proposed daily cover requirements may not be necessary at MWC ash monofills that utilize operating controls, such as the periodic application of moisture to the landfill surface. The Agency specifically requests comments on the adequacy and appropriateness of today's proposed requirements for MWC ash disposal.

In a separate effort, the Agency is developing guidance on MWC ash disposal. This guidance will provide additional information regarding the proper location, design, and operation of MWC ash disposal facilities.

2. Section 258.2 Definitions

Aquifer. EPA has defined aquifer for this proposal as a geologic formation, group of formations, or portion of a formation capable of yielding significant quantities of ground water to wells or springs. This definition is the same one currently used in EPA's hazardous waste program and differs from the original Criteria definition (40 CFR 257.3–4(c)(1)) only in that it substitutes the term "significant" for "usable." The Agency has selected this definition for two reasons: First, because of several comments received on the ambiguity of the word "usable," especially with respect to resource value, and second, because the delineation of the aquifer is a site-specific determination. Some concern has been expressed, however, that this new definition also is vague and that the rule should define "significant." One possible approach would be to define "significant" as a minimum sustained yield of a certain amount (e.g., one gallon per minute); however, EPA does not have sufficient information to determine the amount of ground water that must be produced to be considered "significant" in all cases and believes, therefore, that such a determination at this time would be arbitrary. EPA believes such a determination should be site-specific and has structured the definition of aquifer accordingly. The Agency specifically requests comments on this approach to defining "aquifer."

Household Waste. Any solid waste, including garbage, trash, and sanitary waste in septic tanks, derived from households is defined as a household waste. Household include single and multiple residences, hotels and motels, bunkhouses, ranger stations, crew quarters, campgounds, picnic grounds, and day-use recreation areas. This definition is consistent with the RCRA Subtitle C regulations found at 40 CFR 261.4.

Lateral Expansion. The Agency has defined this term to mean any horizontal expansion of the waste boundary of an existing landfill unit. Under this proposal, lateral expansions are treated as new units and must meet the requirements applicable to new units. Under this proposed definition, any area of any existing unit that has not received waste by the effective date of this rule and later receives waste, is a lateral expansion.

Liquid Waste. Liquid waste, either bulk or containerized, is defined under proposed § 258.28(c)(2) as any waste that is determined to contain free liquids according to Method 9095 (Paint Filter Liquids Test) (Ref. 42). This method has been adopted by the Subtitle C program in 40 CFR Parts 264 and 265. Because the solids content of sewage sludge is readily determined, the Agency considered using a different definition of liquids for sewage sludge from publicly owned treatment works. Under this alternative, sludges that have a solids content of 20 percent or greater would not be considered liquid. That alternative was considered inferior to the Paint Filter Liquids Test for two reasons. First, the variability of sludges may result in certain sludges meeting the 20-percent criterion and still behave in a liquid state or containing free liquids. Second, the Agency believes that the Paint Filter Liquids Test is adequate to ensure that "dry" sludges will not be eliminated from disposal at MSWLFs. However, the Agency recognizes that using a solids content measure would allow easier implementation because it is a measure commonly used by POTWs. EPA currently is conducting

research to determine if a solids content measure would be an acceptable substitute for the Paint Filter Liquids Test for municipal sewage sludges. EPA specifically requests any data that will assist in evaluating the use of a solids content measure for purposes of this rule.

Municipal Solid Waste Landfill. A municipal solid waste landfill is defined as any new or existing landfill or landfill unit that receives household waste. These may be publicly or privately owned. Landfills owned by municipalities that do not accept household waste are not MSWLFs. MSWLFs also may accept other types of Subtitle D wastes, such as commerical waste, nonhazardous POTW sewage sludge, construction/demolition waste, and industrial solid waste. (Units that accept only these wastes will be addressed in future rulemaking activities.) For example, a unit that receives primarily construction/demolition waste, but also receives some household waste, is an MSWLF under this rule. This definition does not include landfills regulated as hazardous waste units under Subtitle C of RCRA and is not meant to capture industrial solid wate landfills that may receive office, sanitary, or cafeteria wastes generated at the site. Finally, the definition of MSWLFs includes any landfill that receives MWC ash including ash monofills (i.e., landfills that receive only ash from MWC facilities) to the extent that MWC ash is generated from the combustion of household waste alone or in combination with other nonhazardous wastes.

3. § 253.3 Consideration of Other Federal Laws

Section 258.3 provides that the owner or operator of an MSWLF unit must comply with any other applicable Federal laws, regulations or requirements. There are numerous other Federal laws that must be considered in siting, designing, and operating MSWLFs. The owner or operator is responsible for ensuring that the requirements of all applicable statutes and regulations, as well as any other requirements, are met. Applicable statutes include, but are not limited to, the following:

- National Historical Preservation Act of 1966, as amended.
- Endangered Species Act.
- Coastal Zone Management Act.
- Wild and Scenic Rivers Act.
- Fish and Wildlife Coordination Act.
- Clean Water Act.
- Clean Air Act.
- Toxic Substances Control Act.

B. Subpart B—Location Restrictions

EPA has identified six types of locations that require special restrictions: sites in the vicinity of airports, 100-year floodplains, wetlands, fault areas, seismic impact zones, and unstable areas. Restrictions for sites near airports and floodplains are included in the original Part 257 Criteria. EPA is proposing to add to the revised Criteria restrictions on siting in wetlands, fault areas, unstable areas, and seismic impact zones because, as discussed below, EPA believes that the additional information that has been developed and reviewed since promulgation of the current Part 257 Criteria supports the need for additional controls in these locations. References to "new MSWLFs" in this section and throughout this preamble refer to new units, as well as to lateral expansions of existing units.

1. Section 258.10 Airport Safety

Under today's proposal, new and existing MSWLFs located within the distance limits specified in Federal Aviation Administration (FAA) Order 5200.5 (10,000 feet for airports handling turbojets and 5,000 feet for airports handling piston-type aircraft) may not pose a bird hazard to aircraft. The proposed requirement is identical to the current § 257.3–8 and is included because MSWLFs receive putrescible wastes that can attract birds despite controls such as daily cover. When solid wastes are disposed of near airports, the birds attracted to the area can present a significant risk of collisions with aircraft. The FAA Order 5200.05, "FAA Guidance Concerning Sanitary Landfills on or Near Airports" (October 16, 1974) states that solid waste disposal facilities have been found by study and observation to be attractive to birds and, therefore, "may be incompatible with safe flight operations" when located near an airport. The background document relevant to this section (Ref. 2) discusses instances of damage resulting from bird strikes that have occurred near landfills.

The distances derived from Order 5200.5 are based on the fact that over 62 percent of all bird strikes occur below altitudes of 500 feet (150 meters) and that aircraft generally are below this altitude within the distances specified.

EPA wishes to make it clear that the "bird hazard" of concern is "an increase in the likelihood of bird/aircraft collisions." Thus, EPA expects that solid waste disposal within the specified distances would occur only if the operation can be managed in such a way as to not increase the risk of collision within the specified distances. EPA recommends that owners and operators of MSWLFs consult with the Fish and Wildlife Service to determine whether specific facilities pose a bird hazard to aircraft. Where appropriate, this determination should be made in consultation with FAA, as well as with the owners and operators of the airports of concern.

2. Section 258.11 Floodplains

EPA proposes to include a floodplain requirement in Part 258 that is identical to the requirement in the current Part 257 Criteria. Thus, EPA is proposing that new and existing MSWLFs located in the 100-year floodplain shall not restrict the flow of the 100-year flood, reduce the temporary water storage capacity of the floodplain, or result in the washout of solid waste so as to pose a hazard to human health and the environment. The Agency's thinking today is consistent with the rationale for the original Criteria, as discussed in 44 FR 53438, dated September 13, 1979. Namely, disposal of solid waste in floodplains may have significant adverse impacts: (1) If not adequately protected from washout, wastes may be carried by flood waters and flow from the site, affecting downstream water quality; (2) filling in the floodplains may restrict the flow of flood waters, causing greater flooding upstream; and (3) filling in the floodplain my reduce the size and effectiveness of the temporary water storage capacity of the floodplain, which may cause a more rapid movement of flood waters downstream, resulting in higher flood levels and greater flood damages downstream. For these reasons, EPA believes that it is desirable to locate disposal facilities outside floodplains. EPA estimates that 14 percent of all existing MSWLFs are located in 100-year floodplains. The Agency made this estimate by mapping MSWLFs nationwide and determining how many MSWLFs fell in areas mapped as floodplains. Case studies, discussed in the background document for this section (Ref. 2), indicate that landfills are subject to design and operational failures as a result of flooding.

Today's proposal would require that new and existing MSWLFs, if located in a 100-year floodplain, be designed and operated to prevent the adverse effects described above. EPA recognizes that locating MSWLFs in floodplains can be expected to have some impact on the flow of the 100-year flood and water storage capacity, regardless of precautions taken. The intent of today's proposed requirement is to require that

MSWLFs not cause significant impacts on the 100-year flood flow and water storage capacity. Site-specific information should be used to evalute whether a facility has met this standard.

Consistent with the original Criteria, Part 258 as proposed today would define the floodplain using the 100-year flood level. This criterion would limit the chance for site inundation and increased flood levels and damages. The intent of this criterion is the same for Part 258 as it was for the original Criteria: (1) To require an assessment of any new or existing disposal site or expansion of any existing site in a floodplain to determine the potential impact of the disposal site on downstream and upstream waters and land; (2) to prohibit such disposal activities if the site, as designed, may cause increased flooding during the 100-year flood; and (3) if the disposal site is located in a floodplain, to require the use of available technologies and methods to protect against inundation by the base flood and minimize potential for adverse effects on water quality and on the flood-flow capacity of the floodplain.

This approach conforms with the intent of Executive Order 11988, dated May 24, 1977, concerning floodplain management. Federal agencies are required to comply with this Executive Order, and State agencies are encouraged to develop and apply similar policies and to consider the provisions of the Unified National Program for Floodplain Management of the Water Resources Council in formulating and applying State policies.

In order to determine whether a unit is located in the 100-year floodplain, owners and operators should use flood insurance rate maps (FIRMs) developed by the Federal Emergency Management Agency (FEMA) under the Federal Insurance Administration (FIA) pursuant to the National Flood Insurance Act of 1986. FEMA has developed FIRMs for approximately 99 percent of the flood-prone communities in the United States. FIRMs can be obtained at no cost from the FEMA Flood Map Distribution Center, 6930 (A-F) San Tomas Road, Baltimore, Maryland, 21227-6227. In areas of the country where FIRMs are not available, there are numerous other sources of floodplains maps, which include: The U.S. Army Corps of Engineers, the Soil Conservation Service, the National Oceanic and Atmospheric Administration, the U.S. Geologic Survey, the Bureau of Land Management, the Bureau of Reclamation, the Tennessee Valley Authority, and State and local flood control agencies or other departments. When floodplains maps cannot be obtained from any of these sources, the owner or operator, with the assistance of a qualified professional firm, can determine flood-flow frequency using Water Resources Council Bulletin Number 17A (1977), Guidelines for Determining Flood-Flow Frequency.

EPA is requesting information on the problems associated with locating facilities in areas subject to frequent flooding (e.g., in five- or ten-year floodplains). The Agency is concerned about locating facilities in such areas because EPA believes that frequent flooding may result in erosion, undermining, and eventual washout of the facility. Engineered systems for preventing such occurrences, therefore, would be subject to frequent maintenance. EPA's existing Subtitle C regulations allow facilities in a 100-year floodplain if precautions to prevent washout have been taken similar to today's proposal. However, the Agency currently is considering revisions to its Subtitle C requirements for locating hazardous waste facilities in floodplains. A ban on MSWLFs in areas subject to frequent flooding could affect large portions of the nation, including the majority of some States, and, thus, could strain the regulated community's ability to provide adequate disposal capacity for municipal solid waste in those areas. Therefore, a total ban on siting in floodplains for Subtitle D is not deemed appropriate. The Agency is requesting comment on locating facilities in areas of frequent flooding.

3. Section 258.12 Wetlands

Today's proposal includes provisions that no new MSWLF units can be placed in wetlands unless the owner or operator makes specific demonstrations to the State that the new unit: (1) Will not result in "significant degradation" of the wetlands as defined in the CWA section 404(b)(1) guidelines, published at 40 CFR Part 230, and (2) will meet other requirements derived from the section 404(b)(1) guidelines. Existing facilities that are located in wetlands could continue to operate.

EPA believes that these stringent restrictions are necessary to protect human health and the environment because of the potential damage caused by siting MSWLFs in wetlands. The background document to the rule describes the threats posed when MSWLFs are located in wetlands (Ref. 2). Moreover, within recent years the Agency has identified wetlands protection as a top priority, specifying aggressive implementation of the Clean Water Act section 404 program, increased coordination with and consistency of Federal and State policies, and other measures as may be necessary. To this end, the Agency considers today's proposed action as essential measure for protecting wetland resources.

Today's proposed action is based on existing Agency wetland policy as expressed in the 40 CFR Part 230 guidelines; Executive Order No. 11990, Protection of Wetlands; and the January 23, 1986, Memorandum of Agreement (MOA) between EPA and the Army Corps of Engineers, which addresses the disposal of solid waste in wetlands under RCRA. The 1986 MOA represents an interim arrangement for controlling solid waste disposal in waters of the U.S., including wetlands. In the long term, the expanded RCRA solid waste regulations proposed herein will help play a key role in protecting wetlands from the unregulated disposal of waste materials.

EPA's Part 230 guidelines are the regulations that specify the analytical tools and environmental criteria to be used when determining whether to issue Clean Water Act section 404 permits for proposed discharges of dredged or fill material in waters of the United States which include most wetlands. To be consistent with the Act, the provision proposed today in § 258.12 adopt the definition of wetlands contained in the Army Corps of Engineers (the Corps) section 404 implementing regulations (33 CFR Parts 320 through 330) and the EPA section 404(b)(1) guidelines (40 CFR Part 230). EPA believes that consistency with this definition will aid in implementing the MSWLF provisions. As defined by EPA and the Corps, wetlands are those "areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalance of vegetation typically adapted for life in saturated soil conditions. Wetlands include, but are not limited to, swamps, marshes, bogs, and similar areas."

Today's proposed action adopts the four major requirements of the guidelines: (1) The practicable alternatives test, (2) lack of significant degradation; (3) compliance with other applicable laws, and (4) minimization of adverse effects. The guiding precept of the guidelines is that discharges into wetlands should not be allowed unless the owner or operator can demonstrate that such discharges: (1) Are unavoidable, i.e., there are no practicable alternatives to discharging in wetlands; and (2) will not cause or contribute to significant degradation of

wetlands. In particular, the guidelines identify filling operations in wetlands as among the most severe environmental impacts covered. For this reason, EPA believes that these guidelines should be used to provide the basis for today's proposal. Moreover, these guidelines are in keeping with Agency policy of maintaining consistency among different EPA programs.

The guidelines in § 230.10(a) state that "no discharge of dredged or fill material shall be permitted if there is a practicable alternative to the proposed discharge would less adversely impact on the aquatic ecosystem, so long as the alternative does not have other significant adverse environmental consequences." An alternative is practicable if it is: (1) Available and (2) feasible, i.e., capable of satisfying the basic or overall purpose of the proposed project, taking cost, logistics, and technology into consideration. For activities that are not water-dependent, i.e., do not require access or proximity to wetlands to fulfill their basic purpose, the guidelines further provide that: (1) Practicable alternatives that do not involve wetlands are presumed to be available, unless clearly demonstrated otherwise; and (2) where a discharge is proposed for a wetland, all practicable alternatives that do not involve a discharge to a wetland are presumed to have a less adverse impact on the aquatic ecosystem, unless clearly demonstrated otherwise. Both of these rebuttable presumptions place a burden on the permit applicant to demonstrate that no practicable alternatives exist.

In addition to the practicable alternatives test, the guidelines also require that "no discharge of dredged or fill material shall be permitted which would cause or contribute to significant degradation of the waters of the United States," including wetlands (40 CFR 230.10(c)). Under the guidelines, effects contributing to significant degradation considered individually or cumulatively include significant adverse effect on: (1) Human health or welfare; (2) life stages of aquatic life and other wetland-dependent wildlife; (3) aquatic ecosystem diversity, productivity, and stability, e.g., a wetland's capacity to assimilate nutrients, purify water, or reduce wave energy, and (4) recreational, aesthetic, and economic values.

Third, § 230.109(c) of the guidelines states that a discharge of dredged or fill material shall not be permitted if it: (1) Causes or contributes to violations of any State water quality standards; (2) violates applicable toxic effluent standards or other Clean Water Act Section 307 standards; (3) jeopardizes species or habitat protected under the Endangered Species Act; or (4) violates any requirement imposed by the Secretary of Commerce to protect marine sanctuaries under the Marine Protection, Research, and Sanctuaries Act.

Moreover, the guidelines provide that a permit should not be issued unless appropriate and practicable steps have been taken to minimize potential adverse impacts of the discharge into wetlands (40 CFR 230.10(d)). Subpart H of the guidelines lists examples of the many types of actions that can be undertaken to minimize the adverse effects of discharges of dredged or fill material.

Because construction of a new landfill essentially is a filling operation, it destroys the wetland, which generally cannot be restored due to the complexities and fragility of the ecosystem. EPA also believes that it is essential to preserve the ecological function of the remaining wetland at an existing facility. Thus, unless the owner or operator can make the demonstration specified in § 258.12(a), new facilities and lateral expansions of existing facilities into wetlands are banned. This demonstration is similar to those established by EPA in the section 404(b)(1) guidelines at 40 CFR 230.10. The importance of these demonstrations is discussed below.

With regard to an owner or operator who wishes to site a new facility or expand an existing facility in wetlands, today's proposal essentially adopts the restrictions on discharges contained in § 230.10 of the guidelines and requires them in the form of prior demonstrations to be made to the State. Failure to make any of the following demonstrations will bar the MSWLF from being sited in a wetlands.

First, the MSWLF owner or operator must consider and evaluate alternative sites outside of wetlands and demonstrate that no environmentally acceptable "practicable alternative" is available. As discussed above, § 230.10(a) of the guidelines provides guidance on the meaning of the term "practicable alternatives." Since a landfill is not a water-dependent activity, the guidelines presume that: (1) Alternatives that do not involve locating MSWLFs in wetlands are available, and (2) such alternatives have a less adverse impact on the aquatic ecosystem. These presumptions make the alternatives analysis a rigorous test for the MSWLF owner or operator to meet.

Second, the MSWLF owner or operator must demonstrate that siting the landfill in the wetland will not cause or contribute to "significant degradation" of the wetlands, as defined in 40 CFR 230.10(b). Third, the owner or operator must ensure that siting in the wetlands does not violate any provisions of the applicable laws specified in § 230.10(c).

Fourth, the MSWLF owner or operator must demonstrate that, if the MSWLF is sited in the wetland after satisfying 40 CFR 230.10 (a), (b), and (c), appropriate and practicable steps have been taken to minimize potential adverse impacts of the MSWLF on the wetlands. These may include careful decisions with respect to the solid waste to be disposed of, any protective technology employed, attention to plant and animal populations, and measures that mitigate unavoidable impacts on wetland values. The guidelines identify a number of possible measures.

Finally, the owner or operator must show that sufficient information is available for making reasonable determinations with respect to these demonstrations; otherwise, the owner or operator cannot make the demonstrations necessary to qualify for the waiver to the ban. This last requirement places the burden for making the required demonstrations squarely on the MSWLF owner or operator.

EPA recognizes the burden that these requirements place on the MSWLF owner or operator who wishes to site a new facility, or expand an existing one, in wetlands. EPA believes, however, that the nation's wetlands are sensitive ecosystems that merit the protection afforded by these requirements. For this reason, the Agency proposes that no new MSWLFs (including internal expansions of existing MSWLFs) should be located in wetlands unless the MSWLFs meet the stringent waiver requirements. Comments are requested on the proposed ban and on the demonstration Criteria for the waiver.

Since the EPA section 404(b)(1) guidelines are prospective in nature, they do not address, or apply to, the question of existing facilities located in wetlands. The issue is whether, and to what extent, the revised Criteria should prohibit or otherwise restrict the operation of existing MSWLFs.

EPA recognizes that requiring existing MSWLFs in wetlands to close would not generally restore the ecological function of the wetland. Further, requiring existing units in wetlands to close would adversely imapct waste disposal capacity. EPA estimates that approximately 6 percent of all MSWLFs are in wetlands. This estimate was

developed by correlating maps of wetland areas with MSWLF locations. The Agency welcomes additional data that commenters may wish to supply concerning the number of MSWLFs sited in wetlands.

In developing the wetlands requirements for this proposal, EPA sought to balance the need to protect the fragile ecosystem with the practicable capability of owners and operators of MSWLFs. EPA recognizes that in some parts of the country, large areas fall within the definition of wetland. In these areas, a ban on the maintenance of existing facilities in wetlands could have great detrimental effects on waste management in communities and could possibly encourage inadequate alternatives to be implemented.

For existing facilities, EPA is not proposing to require closure and/or removal of waste. The existing Subtitle C standards do not specifically address wetlands, but the Agency intends to propose revisions to these standards in the future. The Agency believes that closure and/or removal of waste is not viable for MSWLFs located in or adjacent to wetlands because this approach would result in significant impacts on disposal capacity and cause major disruptions in current municipal solid waste management. There would be reduced capacity if MSWLFs located in wetlands were required to close and siting of MSWLFs in those States where large areas are included under the definition of wetlands would be substantially hindered. The Agency believes the approach proposed today for existing MSWLFs in wetlands properly considers disposal capacity concerns and the practicable capability of MSWLF owners and operators.

4. Section 258.13 Fault Areas

EPA proposes to ban the siting of new units of MSWLFs in locations within 60 meters (200 feet) of faults that have had displacement in Holocene time. (The Holocene is a geologic time unit, known as an epoch, that extends from the end of the Pleistocene to the present and includes approximately the last 11,000 years.) This requirement would be consistent with the existing location standard for hazardous waste facilities under Subtitle C; EPA has concluded that it is appropriate to impose the same requirement on MSWLFs because EPA believes that faults also may adversely affect the structural integrity of MSWLFs.

Earthquakes present a threat to public safety and welfare in a significant portion of the United States. Damage and loss of life in earthquakes occur as a result of surface displacement along faults (surface faulting) and ground motion (shaking), as well as secondary effects of the shaking such as ground or soil failure. Today's proposed standard is designed to protect facilities from deformation (i.e., bending and warping of the earth's surface) and displacement (i.e., the relative movement of any two sides of a fault measured in any direction) of the earth's surface that occur when the fault moves. The best protection for MSWLFs is to avoid faults subject to displacement and the zone of deformation.

The Agency is not proposing a standard for existing MSWLFs located over faults. EPA considered requiring existing units located over faults to close over a period of time; however, insufficient information exists that would justify the closure of these units. EPA requests comment on this issue.

The effects of deformation drop off rapidly as distance from the fault increases. Since the greatest degree of deformation occurs along the fault with the greatest displacement (usually the main fault), the farther away the MSWLF is from the main fault, the less likely it will be affected by deformation. Studies of main fault traces (i.e., faults that had most displacement in an area) suggest that most deformation occurs within 60 to 90 meters of faults that have had displacement in Holocene time. Since the 60-meter setback is measured from any fault, not just the main fault trace, EPA believes that a 60-meter distance from any Holocene fault (surface or subsurface) would provide ample protection against the effects of deformation. If a facility is located near a fault, containment structures (liners, leachate collection systems, and final covers) may be inadequate to prevent release of solid waste and hazardous constituents during an earthquake. Outside of this zone, ground motion will be less severe, and containment structures designed to withstand ground motion, as specified in § 258.14 (described below), should be adequate to protect human health and the environment.

Holocene faults are faults that either were created or experienced displacement in Holocene time. The faults are a concern because the geologic evidence indicates that faults that have been moved in recent times, i.e., during Holocene time, are the ones most likely to move in the future. Faults that have had displacement in Holocene time are easier to identify and date in the field than older faults because this epoch produced recognizable geological deposits, and erosion and deposition surfaces. These faults are identifiable by fault scarps, offset streams, mole tracks, furrows, and fault traces on young surfaces with ground-water barriers marked by spring alignments and vegetation contrasts.

EPA's definition of "fault" is intended to include main, branch, or secondary faults. This definition would include both faults that appear at the surface and those that do not have surface expression (including the small fault planes associated with surface faults). Because only faults that have experienced displacement in Holocene time are of concern in this standard, a subsurface or surface fault that has not disturbed the Holocene deposits is not included in the definition.

In some areas of the country, Holocene deposits and landforms are scarce, such as areas where glacial activity has stripped the surficial ground cover and left highly resistant rock, so inspection of Holocene deposits and landforms will not yield enough evidence to conclusively determine whether there has been recent faulting activity. In these situations, reference to seismic epicenter plots and historic records may be needed, and identification and close examination of possible fault-related features expressed in Pleistocene and older deposits may be necessary as well.

In 1978, the U.S. Geological Survey mapped the location of Holocene faults in the United States (Ref. 2). Maps of identified Holocene faults in the United States also are available from the States of California and Nevada. Based on these maps and maps of MSWLFs, EPA estimates that 35 percent of all MSWLFs are in counties that contain faults that have been active in the Holocene, putting a large number of MSWLFs in potentially threatened areas. However, the Agency does not have data showing how close landfills located in these counties are to the active faults.

The current Subtitle C regulations for hazardous waste facilities have the same location restriction being proposed in today's rulemaking. The Agency believes that this standard also is appropriate for MSWLFs because faults also present concerns relating to failure of containment structures for MSWLFs. In addition, the Agency believes that a similar ban is within the practicable capability of new MSWLFs because the area of the nation within 60 meters from a Holocene fault, i.e., the banned area, is limited. EPA requests comment on both the general concept of a location restriction based on fault areas and the specific 60-meter setback requirement.

5. Section 258.14 Seismic Impact Zones

Today's proposal would require the owner or operator of a new MSWLF unit in a seismic impact zone to design the unit to resist the maximum horizontal acceleration in hard rock at the site. Seismic impact zones are defined as areas having a 10 percent or greater probability that the maximum expected horizontal acceleration in hard rock, expressed as a percentage of the earth's gravitational pull (g), will exceed 0.10g in 250 years.

The National Oceanic and Atmospheric Administration and others have documented structural damages resulting from earthquakes. The potential for damage to MSWLFs from earthquakes can be deduced from similar structures damaged by earthquakes. Such damage includes cracks in foundations and complete collapse of structures. EPA believes that the adverse impact of siting MSWLFs in seismic areas justifies the need for a comprehensive standard to prevent releases from these facilities. Types of failure that may result from ground motion are: (1) Failure of structures from ground shaking; (2) failure of unit components due to soil liquefaction, liquefaction-induced settlement and landsliding, and soil slope failure in foundations and embankments; and (3) landsliding and collapse of surrounding structures. The background document supporting this section of the rule (Ref. 2) provides examples of the potential adverse effects on MSWLFs that may occur in seismic impact zones. The Agency believes that these failures may result in contamination of air, ground water, surface water, and soil. Therefore, in order to protect human health and the environment, all containment structures, including any liners, leachate collection systems, and surface water control systems at new MSWLFs, must be designed to withstand the stresses created by peak ground acceleration at the site from the maximum earthquake based on regional studies and site-specific analyses.

The Agency's proposed requirement translates to a 4-percent probability of exceeding the maximum horizontal acceleration in 100 years. The Agency believes that the areas affected by the proposed "seismic impact zone" requirement represent the areas of the United States with the greatest seismic risk, and, therefore, this proposal would be protective of human health and the environment.

The proposed performance requirement would minimize the risk of slope and liner failure due to seismic activity. By minimizing the risk of failure of the landfill slopes, the potential for exposure of solid waste to the atmosphere and the possible contamination of run-off by contacting exposed solid waste also would be reduced. The Agency further believes that today's proposal would reduce the potential for contamination of ground water beneath the landfill resulting from failure of a liner.

Although § 258.13 of today's proposal would prohibit siting new units on or adjacent to active Holocene faults (faults that have had displacement in Holocene time) to protect against releases of wastes from facility failure due to fault rupture, this standard does not address damage that may occur as a result of earthquake-induced ground motion. Studies indicate that ground motion is more important as a failure mechanism than fault rupture, and not all earthquakes are manifested by surface faulting (Ref. 2). Ground motion resulting from earthquakes without associated surface faulting has been found in some cases to be two or three times that associated with quakes with faulting.

Maps depicting the potential seismic activity across the United States at a constant-probability level have been prepared (U.S. Geological Survey Open-File Report 82–1033). The maps indicate that certain portions of the country are at a higher level of seismic hazard than other areas. For example, portions of the eastern U.S., although not subject to frequent earthquakes, are at a higher level of seismic hazard than portions of the western U.S.

The process of designing earthquake-resistant components may be divided into three steps: (1) Determining expected peak ground acceleration at the site from the maximum quake, based on regional studies and site-specific seismic risk analysis; (2) determining site-specific seismic hazards (e.g., soil liquefaction); and (3) designing the facility to withstand peak ground accelerations. Various methods for accomplishing the above steps are available. Methods appropriate to individual MSWLFs should be selected by the owner or operator, subject to State approval.

While the existing Part 257 Criteria and current Subtitle C requirements do not address seismic impact zones, additional location restrictions for hazardous waste disposal facilities under Subtitle C of RCRA are being developed, and a standard consistent with today's proposal is being considered. The Agency believes that this standard is appropriate for MSWLFs because the concerns relating to failure of containment structures are the same for any landfill regardless of waste type. The Agency requests comment on the approach proposed today.

6. Section 258.15 Unstable Areas

EPA is proposing to require owners and operators of new and existing MSWLF units located in unstable areas to demonstrate to the State the structural stability of the unit. This demonstration must show that engineering measures have been incorporated into the design of the unit to mitigate the potential adverse impacts on the structural components of the unit that may result from destabilizing events.

Structural components include liners, leachate collection systems, final covers, and run-on and run-off collection systems. Facilities located in unstable areas may require extensive repairs and/or corrective action following the occurrence of a natural or human-induced destabilizing event. EPA has reviewed documented events that illustrate the problems of locating waste management units in unstable areas (Ref. 2). The impacts resulting from natural or human-induced destabilizing events observed include rapid dispersion of contaminants over a large area, contamination of municipal water supplies, and seepage of contaminants into basements.

EPA is proposing to define an unstable area as a location that is susceptible to natural or human-induced events or forces capable of impairing the integrity of the landfill structural components responsible for preventing releases. These areas could include: (1) Subsidence-prone areas, such as areas subject to the lowering or collapse of the land surface either locally or over broad regional areas; (2) areas susceptible to mass movement where the downslope movement of soil and rock under gravitational influence occurs; (3) weak and unstable soils, such as soils that lose their ability to support foundations as a result of expansion or shrinkage; and (4) Karst terrains, which are areas where solution cavities and caverns develop in limestone or dolomitic materials.

National maps are available that locate Karst terrains and landslide-susceptible areas, but weak and unstable soils and subsidence-prone areas appear to be mapped only individually or at the local level. Thus, identification of existing MSWLFs in these unstable areas, and determination of whether the proposed site of a new MSWLF is in an unstable area, would

take place on a case-by-case basis where geographic delineation of these areas is not available on a national scale.

A detailed description and discussion of each of the types of unstable areas identified is contained in a background document (Ref. 2) and a brief summary of each type and the potential threats to MSWLFs follow.

Subsidence-prone areas are those subject to surface subsidence because of natural subsurface conditions, such as Karst formations, or human-made subsurface activities, such as fluid withdrawal or mining. Subsidence at a facility can result in rupture, deformation, or other damage to liners or final covers that may release waste directly into the environment.

Areas susceptible to mass movements include areas with evidence of ongoing slope failure; areas where a small increase in shear stress or a small decrease in shear strength might cause slope failure; areas where geologically similar locations in the same general areas have failed; and areas in the vicinity of pre-existing slope failures. Susceptibility to mass movement is determined from geotechnical and geologic studies.

"Mass movement" covers a variety of slope failures and rapid movement of materials downslope by gravitational influences including landslides, avalanches, flows, creeps, solifluction, block sliding, or a combination of these. Mass movements are caused by imbalances between the forces of gravity (shear stress) acting on the mass of soil or rock composing the slope and the shear strength of the mass. Human activity and natural events can increase the shear stress acting on the mass and/or reduce the mass' shear strength, thereby causing failure. Human-induced causes of mass movement include, but are not limited to, construction operations, seepage from human-made sources of water, and stormwater drainage. Naturally occurring slope failures may be caused by large volumes of water from intense rains or melting snows, vibrations and shock waves generated by earthquakes, frost and freeze/thaw cycles, or intense drying of soils. Mass movements, whether naturally occurring or induced, can carry a facility downslope, rupture a facility in place, or destroy facility control and monitoring systems.

Weak and unstable soils include unconsolidated deposits subject to differential and excessive settlement. This movement under and around a facility can tear liners, rupture dikes, render leachate collection systems inoperable, and possibly alter the ground-water flow.

Karst terrains are areas underlain by limestone and dolomite and often are characterized by extensive solution cavities, sinkholes, and fractures. Sinkhole formation, which may occur in certain types of Karst terrains, can cause rupture of unit liners and covers and can result in collapse of the facility. Karst terrains also promote more rapid movement of leachate from the landfill due to extensive fractures and secondary porosity. Based on map overlays of Karst areas and MSWLF locations, EPA estimates that 4-percent of all existing MSWLFs are in Karst terrain; however, not all Karst terrains would be considered unstable under today's proposal.

Under the proposed requirement, the owner or operator of a new MSWLF must determine, and demonstrate to the State, that the proposed site is not subject to any of these destabilizing events. This demonstration should be maintained in the facility file by the owner or operator as part of the permit application. The following factors should be considered in determining whether an area is unstable: (1) Soil conditions that may result in significant differential settling resulting in damage and failure of dikes, berms, or containment structures (for example, the presence of expansive clays that expand when wet and shrink when dry); (2) geologic or geomorphologic features such as mass-movement-prone areas, Karst terrains, or fissures that may result in sudden or nonsudden ground movement and subsequent failure of dikes, berms, or containment structures; (3) human-induced features or events (both surface and subsurface) such as areas of extensive withdrawal of oil, gas, or water from subsurface formations or construction operations that may result in sudden or nonsudden ground movement and subsequent failure of dikes, berms, or containment structures; and (4) any other features that historically indicate that a natural or human-induced event may impair the engineered structures of the unit and for which protective measures cannot be designed to withstand the event, such as volcanic activity areas.

EPA is proposing to require this case-by-case determination of instability because of the difficulty of clearly delineating unstable areas on a broad scale. EPA believes that case-by-case decisionmaking allows the soundest analysis under the circumstances. Subtitle C currently does not address unstable areas; however, the Subtitle C rules are being reviewed and standards consistent with today's proposal are being considered. EPA believes that today's standard is appropriate for MSWLFs because the concerns relating to failure of containment structures are the same for any landfill regardless of waste type.

Because failure of existing units as a result of destabilizing events in unstable areas poses potential threats to human health and the environment, the Agency is proposing that units that cannot make the structural stability demonstration be closed over time. In EPA's view, continued operation of such units would only increase the possible contaminant loading on the environment in the event of failure. In recognition of the practicable capability of the owner or operator to secure a replacement site, EPA is proposing that existing units in unstable areas close within five years of the effective date of the rule. Upon closure, the owner or operator of these facilities would not be required to remove the waste from the unit because removal of the wastes involves certain risks, and EPA believes removal of the wastes would be a great burden and expense to owners and operators and would exceed the practicable capability of the regulated community.

EPA has selected five years as a phase-out period based upon the belief that five years is adequate time for proper facility closure and for siting and construction of a new facility in an acceptable location. The activities that EPA expects to occur during this period include hydrogeologic investigations and site selection, land acquisition, and design, permitting, and construction of the new facility. The Agency is unable to estimate the number of facilities that would be affected by this requirement. EPA requests comments on the concept of a phase-out period, the appropriate length of the phase-out period, and the number of facilities affected.

EPA recognizes that, in some cases, it may not be possible to find a suitable site and construct a replacement MSWLF within five years. To address this situation, EPA also is proposing a variance to the required phase-out that would allow the State to extend (but not waive) the five-year period if no "practicable alternative" is available and if the existing MSWLF unit will not pose a substantial risk to human health and the environment. The Agency believes this variance is appropriate and justifiable under section 4010 of RCRA, which allows EPA to consider the "practicable capability" of facilities to comply with the Criteria. The variance would allow for State flexibility to determine the length of the time extension and to require any interim

controls necessary to protect human health and the environment. During the extension period, the owner or operator would be responsible for meeting all other applicable requirements in today's proposal.

In deciding whether to grant a variance, EPA would expect the State to consider whether (1) it currently is not economically feasible to find, develop, and operate a new site; (2) it currently is not logistically feasible to locate a new MSWLF in a more suitable area (e.g., the only suitable property is already developed or is located too far from collection centers); or (3) legal barriers exist to the siting, acquisition, or operation of the landfill in suitable areas (e.g., jurisdictional restrictions do not allow wastes from one municipality to be disposed of in the jurisdiction of another). If such conditions exist, and the risks associated with continued operation during the extended period of time do not pose undue threats to human health and the environment, a variance may be appropriate. A specific risk level is not being proposed because the Agency believes that such a decision is best left to the States, who must weigh the various alternatives.

The Agency recognizes that States may interpret the above criteria in various ways, and that decisions may be based on site-specific conditions. The Agency believes that this is appropriate, since the States are in a better position than EPA to determine whether a specific facility should be granted an extension.

Although it may be difficult to site a new MSWLF within the proposed five-year period, EPA does not intend that States grant unlimited time extensions to units located in unstable areas. Various alternatives, such as regionalization of disposal facilities, recycling and source reduction, municipal waste combustion (i.e., incineration), and the use of transfer stations, are available to manage wastes. These alternatives can be used to overcome environmental, logistical, legal, or economic barriers to siting new landfills.

EPA requests comments on whether other location restrictions such as these or others in addition to those proposed today should be imposed for MSWLFs.

C. Subpart C—Operating Criteria

The requirements of this Subpart would apply to all new and existing MSWLFs. These requirements address day-to-day activities, such as application of daily cover (necessary to reduce immediate threats to public health), and long-term activities, such as post-closure care (necessary to minimize or eliminate the possibility of the release of contaminants to the environment).

1. Section 258.20 Procedures for Excluding the Receipt of Hazardous Waste

Section 258.20 of today's proposal would require the owner or operator of an MSWLF to implement a program to detect and prevent attempts to dispose of hazardous wastes (regulated under Subtitle C of RCRA) and PCB wastes at the facility (regulated under the Toxic Substances Control Act). EPA does not intend for this regulation to limit the legal disposal in MSWLFs of very small quantity generator (VSQG) hazardous waste (hazardous waste generated at a rate of less than 100 kg per month), certain wastes containing PCBs at concentrations less than 50 ppm, and empty pesticide containers that have been properly rinsed in accordance with the label instructions as specified under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and regulations in 40 CFR Part 165. Today's proposal also does not restrict the disposal in MSWLFs of HHW, which is exempt from EPA's hazardous waste rules; however, the Agency strongly endorses HHW collection programs and recommends the management of collected HHW in hazardous waste management facilities.

With regard to the disposal of PCBs, regulations promulgated under the Toxic Substance Control Act (TSCA) specify MSWLF disposal as proper for limited categories of PCB materials. Such materials include drained PCB-contaminated electrical equipment (i.e., equipment that formerly contained 50 to 500 ppm of PCBs in dielectric fluids), drained hydraulic and heat transfer equipment, and "PCB articles" (see 40 CFR 761.3 and 761.60(b)(5)) that previously contained 50 to 500 ppm of PCBs and that have been drained of free-flowing liquids. Most significantly, TSCA disposal regulations generally allow the disposal in MSWLFs of "small capacitors" that contain less than three pounds of PCB dielectric. These small capacitors frequently are found in fluorescent light ballasts, high-intensity discharge lighting power supplies, and a variety of consumer appliances, such as microwave ovens and air conditioners.

Measures that MSWLF owners and operators must incorporate in their programs to exclude receipt of hazardous waste include, at a minimum, random inspections of incoming loads, inspection of suspicious loads, recordkeeping of inspection results, training of personnel to recognize hazardous waste, and procedures for notifying the proper State authorities if a regulated hazardous waste is found at the facility. The State may require additional program elements.

The random load checking program is a crucial deterrent to illegal disposal. Such a program might include designation of an inspector to examine several random loads throughout facility operations. The loads could be discharged at a designated location separate from landfilling operations, broken down with hand tools, and visually inspected for indications that suspicious containers may hold Subtitle C hazardous wastes. The rule could require that records be kept of each load inspection. The records should include the date, time, name of the hauling firm, driver, source of the waste, vehicle identification numbers, and all observations made by the inspector.

Each MSWLF would be required to train all necessary personnel to identify potential sources of Subtitle C hazardous wastes. At a minimum, this should include supervisors, spotters, designated inspectors, equipment operators, and weigh station attendants. The training should emphasize familiarity with containers and labels typically used for hazardous wastes and other hazardous materials. If Subtitle C hazardous waste is found in any load inspected, or otherwise found at the facility, the owner or operator should promptly notify the State. The owner or operator should cordon off the area where the material was deposited and make efforts to carry out proper cleanup, transport, and disposal of the material at a permitted hazardous waste management facility.

In developing this proposal, EPA considered specifying the program in detail, delineating all activities and procedures needed to exclude hazardous waste. The Agency decided against a strictly defined program because each landfill will receive different amounts of waste that could contain questionable material. Today's proposal gives States and MSWLF owners and operators flexibility in implementing this requirement.

2. Section 258.21 Cover Material Requirements

EPA proposes to strengthen the cover material criterion imposed under § 257.3–6 of the existing Subtitle D Criteria to require the application of suitable cover material at the end of each operating day, or at more frequent intervals, if necessary, to control disease vectors, fires, odors, blowing litter, and scavenging. MSWLFs receive wastes that consist of a wide variety of materials. In particular, such facilities

receive wastes that contain putrescible materials. As discussed in the background document for this section of the proposal (Ref. 3), the disposal of such materials in MSWLFs results in conditions conducive to the harborage of rodents and other disease vectors. EPA is proposing this requirement because problems associated with putrescible waste at MSWLFs are alleviated in part by cover material. In addition, 45 States and Territories require daily cover, suggesting that this is an effective procedure and that, by not requiring daily cover, the current Criteria are not sufficient.

Cover material serves several specific purposes for protecting human health and the environment: (1) It helps in disease vector and rodent control; (2) it helps contain odor, litter, and air emissions, which may threaten human health and environment and/or be aesthetically displeasing; (3) it lessens the risk and spread of fires; and (4) it reduces infiltration of rainwater by increasing run-off and thereby decreases leachate generation and surface and ground-water contamination. As an additional benefit, cover enhances the site appearance and utilization after completion.

EPA has not specified the type or amount of cover material to be used, leaving the determination of "suitable material" and minimum depth up to the State; however, EPA recommends that a six-inch depth of compacted earthen material be used as cover material. Tests have shown that 6 inches of compacted sandy loam prevent fly emergence; daily (or more frequent) cover has been shown to reduce the attraction of birds and to discourage rodents from burrowing into the waste. In addition, 45 States and Territories already specifically require 6 inches of daily cover and it is considered an accepted practice at most MSWLFs. This and other aspects of cover material are discussed in the background document for this section (Ref. 3).

Today's proposal allows the States to temporarily waive the daily cover requirement on a case-by-case basis in the event of extreme seasonal climate conditions, such as heavy snow or severe freezing, that make meeting the requirement impractical. This provision would allow the State to consider the practicable capability of the regulated community. EPA requests comments on the appropriateness of the frequency and depth of cover application and on whether there are other reasons for exempting daily cover. EPA also is requesting comments on the acceptability of cover materials other than earthen materials (e.g., foams).

3. Section 258.22 Disease Vector Control

Today's proposal would require that each owner or operator of an MSWLF prevent or control on-site disease vector populations using appropriate techniques to protect human health and the environment. This requirement is consistent with existing § 257.3–6, which states that "[t]he facility or practice shall not exist or occur unless the on-site population of disease vectors is minimized through the periodic application of cover material or other techniques as appropriate so as to protect public health."

Municipal wastes are known to contain pathogenic bacteria, parasites, and viruses that can infect humans and animals. These wastes also provide food and harborage from rodents, flies, and mosquitoes that then transmit disease organisms to humans and animals.

The performance criterion set forth in this section would provide States and MSWLF owners and operators flexibility in meeting this requirement to accommodate site-specific differences in vectors and in appropriate control technologies and mechanisms. Today's proposed standard to control disease vectors is intended to prevent the facility from being a breeding ground, habitat, or a feeding area for disease vector populations. The requirements for vector control are to be undertaken in conjunction with the cover material requirements in § 258.21. Cover material applied at the end of each operating day reduces the availability of food and harborage for rodents and other vectors and thus may be adequate in most cases to meet the performance criterion for disease vector control; however, if cover material requirements prove insufficient to ensure vector control, this criterion would require that other steps be taken by the owner or operator to ensure such control. The background document for this section discusses various methods for minimizing disease vectors (Ref. 3).

4. Section 258.23 Explosive Gases Control

The decomposition of solid waste (in particular, household waste) produces methane, an explosive gas. The accumulation of methane gas in MSWLF structures or nearby off-site structures can result in fire and explosions, potentially injuring or killing employees, users of the disposal site, and occupants of nearby structures, in addition to damaging containment structures resulting in the emission of toxic fumes. Several incidents resulting in deaths are discussed in the background document (Ref. 3).

For this reason, EPA established an explosive gas criterion in § 257.3–8 of the original Subtitle D Criteria to regulate the concentration of methane in facility structures and at the property boundary. This requirement is expanded in today's proposal. The lower explosive limit (LEL) of a gas is the lowest percent, by volume, of that gas in a mixture of explosive gases that will propagate a flame in air at 25°C and atmospheric pressure at sea level. Today's proposal would require that the concentration of methane generated by the MSWLFs not exceed 25 percent of the LEL in facility structures (excluding gas control or recovery system components) and the LEL itself at the property boundary. EPA based its selection of the 25 percent figure for the Criteria on a safety factor recognized by other Federal agencies as being appropriate for similar situations (Ref. 3); however, the Agency concluded that a 25 percent criterion was unnecessary at the property boundary because gases at or below the LEL at the property boundary will become somewhat diffused before passing into a structure beyond the property boundary. For these reasons, EPA continues to believe that the LEL standard would provide an adequate safety margin against off-site explosions. The Agency believes that these limits are protective of human health and the environment while not being unduly restrictive.

Further, the proposal includes routine subsurface and facility structure gas monitoring requirements and a requirement that, if methane exceeds the limits specified, the owner or operator must take necessary steps to ensure protection of human health and immediately notify the State of the level detected and the steps taken to protect human health. Such steps could include evacuation and ventilation of affected buildings. In addition, the Agency is proposing that the owner or operator submit a remediation plan to the State within 14 days of limits having been exceeded. This remediation plan must describe the nature and extent of the problem and the proposed remedy. Examples of appropriate remedies include installation of interceptor gas collection trenches, venting in structures, and subsurface gas withdrawal. The owner or operator would be required to implement the plan after State approval.

In reviewing damage cases that have occurred as a result of methane migration from landfills, the Agency has noted that many of these incidents have occurred since promulgation in 1979 of

the existing Criteria, which do not require routine gas monitoring. The Agency believes many of these instances could have been prevented if routine monitoring had been conducted to detect the dangerous levels prior to the incident. This issue is further discussed in the background document (Ref. 3). Early warning would allow the owner or operator to take action to prevent catastrophic events.

Because methane has been the principal source of explosions associated with solid waste disposal, EPA proposes to require monitoring only for methane at this time. EPA may require monitoring for other gases if new information develops at a later time indicating that there are other gases that pose problems; however, EPA currently does not have sufficient information on other gases generated to justify requiring owners and operators to monitor for them.

EPA is proposing that methane monitoring be conducted at least quarterly. As mentioned earlier, monitoring would provide early warning of potential methane build-up that may lead to explosions. The Agency believes that quarterly monitoring is a reasonable minimum frequency that accounts for the seasonal variations in subsurface gas migration patterns. The Agency recognizes that site-specific conditions may require more frequent monitoring, e.g., when facilities are near residential areas or enclosed in structures, and encourages States to require additional monitoring as necessary. There also may be limited situations (e.g., in very remote areas) where less frequent monitoring may be sufficient. EPA requests comment on these situations and the appropriateness of the minimum monitoring frequency specified in today's proposal.

Monitoring is intended to ensure that the performance standard is being met at the MSWLF. EPA considered specifying the type of monitoring and monitoring devices, but such an approach would not allow the consideration of site-specific factors in establishing the appropriate monitoring system. The proposal would allow State flexibility in determining the appropriate monitoring requirements on a case-by-case basis.

Site-specific factors to be considered when determining the type and frequency of monitoring are discussed in an Agency guidance manual (Ref. 12). Factors to be considered in determining the type and frequency of monitoring include: soil conditions, hydrogeologic conditions surrounding the disposal site, hydraulic conditions surrounding the disposal site, and the location of facility structures and relative to property boundaries. These factors control the rate and extent of gas migration and are discussed further in the guidance manual (Ref. 12).

Monitoring in a facility structure normally should be performed after the building has been closed overnight or for a weekend because these are the times when the most dangerous conditions are likely to exist. Sampling should be done in confined areas where gas may accumulate, such as in basements, crawl spaces, attics near floor cracks, and ground subsurface utility connections. Gas recovery and gas control equipment, however, need not be sampled. If all the readings are less than 25 percent LEL, the MSWLF would be in compliance; however, the presence of any methane in a facility structure, even in concentrations below 25 percent LEL, should be considered a problem that deserves attention and steps should be taken to ensure that the level of methane does not reach explosive levels. EPA recommends that continuous monitoring devices be used in facility structures at the landfill site.

For monitoring along property boundaries, at least two monitoring points should be located along the property boundaries closest to residences or other potentially affected structures. The exact location of these points should take into account any gas-permeable seams. In selecting the sampling points, some of the factors to consider include dry sand or gravel pockets, alignment with an off-site point of concern, proximity of the waste deposit, areas where there is dead or unhealthy vegetation that might be due to gas migration, and areas where underground construction may have created a natural path for gas flow (e.g., utility lines).

Monitoring should be conducted at the property boundaries ideally when the soil surface has been wet or frozen for several days because this is when levels are expected to be greatest (Ref. 12). The results, location, date, and time of monitoring should be recorded. If any of the readings are equal to or greater than the LEL, the facility would not be in compliance. It may be necessary to repeat the tests at a later date or under different climatic conditions to verify the readings. Where active control systems are being used, samples should be taken when all pumps have been shut down for their maximum time during normal operation.

Monitoring at the property boundary could be accomplished by using a permanent well or a portable monitoring device. The device should be determined by the State on a case-by-case basis. EPA has provided additional guidance on types of monitoring devices that could be used (Ref. 12). The Agency suggests that methane at a concentration just below the LEL at a monitoring point may indicate a major problem and should not be ignored. The appropriate action would depend on the proximity of off-site structures, possible pathways, and other factors. In all cases, an evaluation should be made so that the danger of explosion is minimized.

5. Section 258.24 Air Criteria

The existing Criteria in Part 257 prohibit the open burning of solid waste but allow infrequent burning of agricultural wastes, silvicultural wastes, land clearing debris, diseased trees, debris from emergency cleanup operations, and ordnance. Today's proposal under § 258.24 maintains this standard. Requirements for compliance with State Implementation Plans (SIPs) under section 110 of the Clean Air Act (CAA) would remain unchanged from the Part 257 Criteria.

The Agency believes that any infrequent burning of the waste types listed above should be conducted in areas dedicated for that purpose and at a distance away from the landfill unit so as to preclude the accidental burning of other solid waste. For the purposes of this proposal, agricultural waste does not include empty pesticide containers or waste pesticides.

Open burning, which is the uncontrolled or unconfined combustion of solid wastes, is a potential health hazard, damages property, and can be a threat to public safety. For example, smoke from open burning can reduce aircraft and automobile visibility and has been linked to automobile accidents and death on expressways. The air emissions associated with open burning are much higher than those associated with incinerators equipped with air pollution control devices. Combustion in a trench or pit incinerator is considered the equivalent of open burning because particulate emissions from trench and pit incinerators equal or exceed those from open burning.

As stated earlier, EPA originally established the ban on open burning in the 1979 Criteria. Commenters on the proposal to the 1979 Criteria questioned the necessity for that ban, stating that open burning reduces the volume of solid waste and helps control disease vectors. The Agency recognized that some volume reduction is achieved, but no data were provided that disease vectors were significantly reduced. EPA established the ban on open burning of

these wastes because the hazards posed to human health (e.g., increase in particulate emissions, decreased safety) outweighed any benefits derived from the practice. Since the promulgation of the current Part 257 Criteria, the Agency has not received any new data that would contradict this conclusion. Therefore, EPA is retaining the open burning prohibition in today's proposal.

The Agency is aware that some States allow certain communities to open burn routinely municipal solid waste under certain circumstances. Such communities usually generate small amounts of waste and are in remote areas. The major advantage claimed is substantial volume reduction in the waste to be disposed of, thus extending landfill life. These communities assert that disposal costs would increase dramatically if there were strict enforcement of the Federal ban on open burning; however, these communities have not addressed the impacts on human health and the environment resulting from the practice on open burning, and, because health and environmental concerns are the underlying reason for the ban, the Agency does not intend to change the requirement from the 1979 Criteria. However, because EPA has received these comments stating that open burning is a necessary disposal practice, the Agency is specifically requesting comment on this issue.

This proposal retains the requirement that new and existing MSWLFs not violate applicable requirements developed under a SIP approved or promulgated by the Administrator under the CAA Section 110, as amended. EPA originally instituted this requirement because regional health concerns addressed through the SIPs clearly are of concern under RCRA as well as the CAA. Obviously, RCRA regulations should not undermine the provisions that implement the CAA.

Recent studies conducted by the Agency indicate that MSWLFs also appear to be a source of air pollutants. Gases of decomposition originate within the landfill and vent to the atmosphere by vertical migration and/or lateral migration. Landfill gas is generated by chemical reactions and by microbial degradation of refuse materials into a variety of simpler compounds. Typically, landfill gas consists of approximately 50 percent methane, 50 percent carbon dioxide, and trace constitutents of volatile organic compounds (VOCs) and other toxic constituents. Pollutants commonly found in MSWLF gas include vinyl chloride, benzene, trichloroethylene, and methylene chloride. It is estimated that approximately 200,000 metric tons of nonmethane organics per year are emitted nationwide from existing MSWLFs. Some of these compounds can create an odor nuisance while the VOCs and other toxic emissions can constitute a health hazard. This is in addition to the dangers from the explosion potential of methane (as described above).

Air emissions from MSWLFs can be controlled by collecting and controlling (or recovering) the extracted landfill gas. At approximately 100 landfills, gas is collected and used as recovered energy. Control systems can be economically attractive due to the energy recovery benefits, especially at larger landfills. There are sites controlling or recovering landfill gas in many States, including California, Maryland, New Jersey, New York, Ohio, Oregon, Texas, Wisconsin, and Washington.

EPA has decided to regulate MSWLF air emissions under the CAA Section 111(b) for new landfills and Section 111(d) for existing landfills. Under Section 111(d), EPA is preparing air emission guidelines that are to be adopted by States; they will prepare plans for controlling existing sources of MSWLF air emissions according to the EPA guidelines. The regulations will be based on both collecting and controlling landfill gas. EPA plans to propose air emission standards for MSWLFs in the near future.

6. Section 258.25 Access Requirements

EPA is proposing to require control of public access at new and existing MSWLFs to prevent illegal dumping of wastes and public exposure to hazards at MSWLFs as well as to prevent unauthorized vehicular traffic. Access control is a key element in preventing injury or death at these facilities. Because EPA also is concerned with the unauthorized dumping of hazardous waste, the proposed requirement expands on the existing 257.3–8 health and safety criteria, which prohibit uncontrolled public access, by adding requirements to control illegal dumping of wastes and unauthorized vehicular traffic.

EPA proposes that MSWLF owners or operators control public access, illegal dumping, and unauthorized vehicular traffic using natural and/or artificial barriers, as appropriate, to protect human health and the environment. Steps needed to comply with this standard would be determined by the State on a site-specific basis. At some facilities, it may not be necessary to construct any artificial barriers, such as fences, in order to comply with this criterion. Such facilities include, for example, those located in remote areas away from the general public or in areas with mountainous terrain or cliffs that would make access by the general public difficult. Posting signs and gates across access roads may be sufficient in remote areas to prevent public access that could lead to injuries; however, facilities that are located near residential areas or other public areas may be required to construct fences in order to control access. Unauthorized vehicular traffic and illegal dumping could be prevented by placing gates with locks at all entrances to a remote site. Other provisions may be necessary on a site-by-site basis.

Under the Subtitle C regulations, the owner or operator must prevent unknowing entry, and minimize the possibility for unauthorized entry, onto the active portions of the facility. At a minimum, a hazardous waste facility must have a 24-hour surveillance system or an artificial or natural barrier, such as a fence in good repair or a fence in combination with a cliff that completely surrounds the active portion of the facility, and a means to control entry at all times. The requirements may be waived under Subtitle C if it can be demonstrated that physical contact with the waste or equipment will not injure unauthorized persons or livestock and disturbance of the waste or equipment will not threaten human health and the environment.

These Subtitle C requirements are considered unnecessary for MSWLFs because EPA believes the risks associated with direct contact with municipal solid wastes are less than those associated with hazardous waste. Today's proposal allows greater consideration of site-specific conditions in establishing the appropriate controls than the Subtitle C regulations do. For example, as discussed above, the remoteness of a site may serve as an adequate "natural barrier" to facility access. EPA believes that simply requiring owners or operators to control public access allows the owner or operator to implement a system tailored to site-specific characteristics.

7. Section 258.26 Run-on/Run-off Control Systems

EPA is proposing run-on and run-off control requirements. These requirements are interrelated in that diversion of run-on reduces the amount of run-off that needs to be collected. The proposal would require that the owner or operator of an MSWLF design, construct, and maintain a run-on control system to prevent flow onto the active portion of the MSWLF during the peak

discharge of a 25-year storm. The purpose of the run-on standard is to minimize the amount of surface water entering the landfill facility. Run-on controls prevent: (1) Erosion, which may damage the physical structure of the landfill (2) the surface discharge of wastes in solution or suspension, and (3) the downward percolation of run-on through wastes, creating leachate. Control is accomplished by constructing diversion structures to prevent surface water run-on from entering the active portion of the facility. Diversion structures help prevent liquids, which will eventually generate leachate or leave the site as contaminated run-off, from coming into contact with the waste.

The Agency believes that the main area of concern, with respect to run-on, is the active portion of the landfill, not the landfill facility as a whole. In this proposal, that part of the facility or unit that has received or is receiving wastes and has not been closed as required in § 258.30 is defined as the active portion. It is at active portions that run-on is most likely to: (1) Seep into the exposed waste, contributing to the formation of leachate, or (2) erode wastes, or constituents of them, and carry them away in surface water run-off. Seepage and erosion would not be a problem at inactive portions that have been closed in accordance with the closure Criteria specified in § 258.30. The Agency proposes that surface water run-on be diverted from active portions. Diversion of run-on may be accomplished by locating the active portion in areas where the topography naturally prevents run-on, by sloping or contouring the land, or by constructing ditches, culverts, or dikes. The capacity of diversion structures should be determined by the owner or operator considering site topography, size of the drainage area, and size of the active portions. The Agency chose the 25-year storm as the design parameter to be consistent with the standard in 40 CFR Part 264, which requires active portions of hazardous waste landfills to be protected from the peak discharge of a 25-year storm.

The quantity of run-off from active portions of landfills can be minimized by (1) minimizing run-on, (2) preventing disposal of liquid wastes in the landfill, and (3) minimizing the size of the active portion of the landfill. To address run-off that is generated, the Agency proposes to require that the owner or operator of an MSWLF design, construct, and maintain a run-off control system from the active portion of the landfill to collect and control at least the water volume resulting from a 24-hour, 25-year storm. Run-off from the active portion of the unit must be handled in accordance with § 258.27 of this proposal in order to ensure that the CWA NPDES requirements and CWA Section 208 and 319 requirements are not violated. Again, the Agency chose the 24-hour, 25-year storm design parameter to be consistent with the standards for Subtitle C facilities in 40 CFR Part 264.

By design, almost all trench and area fills in depressions or pits control most run-off because of surface contours. Owners and operators having area fills that do not use depressions can control run-off by building a berm or dike on the low elevation side; however, when landfills using either the trench or area methods become large or substantially above grade, both run-off and leachate seeps, which often occur on the outer slopes of the fill, need to be collected. Run-off that does emerg from active portions may be collected by ditches, berms, dikes, or culverts, which direct it (sometimes by sump pump) to surface impoundments, basins, tanks, or treatment facilities. These collection devices may consist of temporary structures around active portions, because run-off usually has been in contact with waste or leachete seeps from active portions and sometimes is collected via a leachate collection system, it probably will be contaminated. It is difficult to differentiate between rainwater run-off and leachate run-off at the active portion of a landfill unless an elaborate or expensive sampling program is conducted. Once collected, a number of options exist for treating and disposing of run-off. These include land treatment, treatment in surface impoundments (e.g., evaporation), or discharge to a sewer, other treatment facility, or surface waters (if permitted). The background document supporting this section of the rule (Ref. 3) discusses in further detail 25-year storm events and run-on and run-off control requirements.

8. Section 258.27 Surface Water Requirements

Today's proposal would prohibit any MSWLF unit from (1) causing a discharge of pollutants into waters of the U.S., including wetlands, that violates any requirements of the CWA, including, but not limited to, NPDES requirements; and (2) causing a nonpoint source of polution to the waters of the U.S., including wetlands, that violates any requirements of a State-wide or area-wide water quality management plan under Section 208 or Section 319 of the CWA. The surface water criterion currently in Part 257 was retained in today's proposal because EPA believes it provides necessary protection for human health and the environment.

EPA considers it essential that solid waste activities not adversely affect the quality of the nation's surface waters. Rivers, lakes, and streams are important sources of drinking water, recreational resources, and habitat for a wide variety of fish with other aquatic organisms. Solid waste disposal has led to surface water contamination from run-off of leachate, accidential spills, and drift of spray occurring at landfills. In the proposed Criteria, EPA seeks to coordinate its surface water requirements under RCRA, including programs developed under the CWA to restore and maintain the integrity of the waters of the United States.

Under Section 1006 of RCRA, EPA is required to integrate, to the maximum extent practicable, the provisions of RCRA with other statutes, including the CWA Under the CWA, EPA conducts programs designed "to restore and maintain the chemical, physical, and biological integrity of the nation's water." EPA believes that this goal also is a legitimate objective for its regulatory activity under RCRA and that the Agency should use its authority under RCRA to see that CWA goals are achieved. Thus, in establishing the surface water criteria, EPA employed concepts and approaches use under the CWA. The discharge of a nonpoint source of pollution from solid waste disposal activities would be required to conform with any established water quality management plan developed under Section 208 or Section 319 of the CWA. Not all portions of a Section 208 or Section 319 plan are applicable to solid waste disposal activities, and the State would determine which requirements under these plans apply. Similarly, the discharge of pollutants from solid waste disposal activities would be required to comply with other provisions of the CWA, including the NPDES requirements under Section 402.

The provision of § 257.3–3 of the current Criteria, which states that "a facility 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 CWA, as amended," has been included under the wetlands section of today's proposed Part 258 Criteria.

9. Section 258.28 Liquids Restrictions

EPA is proposing a new requirement for liquids restrictions because the intentional introduction of liquids into

landfills can be a significant source of leachate generation. Today's proposal would prohibit bulk or noncontainerized liquid waste that are not household waste (other than septic waste) from being disposed of in MSWLFs. Leachate and gas condensate that is derived from the MSWLF unit and recirculated would be exempt from this prohibition if the unit has been equipped with a composite liner and a leachate collection system designed and constructed to maintain less than 30cm of leachate over the liner in order to ensure that the recirculated liquids are managed properly. Containers of liquid waste could be placed in MSWLFs only when the containers: (1) Are small containers of the size typically found in household waste, (2) are designed to hold liquids for use other than storage, such as a battery or capacitor, or (3) hold household waste.

By restricting the introduction of liquids into landfills through a ban on the disposal of bulk and containerized liquid waste, EPA expects to minimize the leachate generation potential of the landfills, and thus minimize the risk of gound-water contamination. Twenty-one States and Territories already prohibit disposal of liquids and semiliquid wastes in MSWLFs. EPA believes, therefore, that this restriction is a sound MSWLF management practice.

The problems associated with the landfill disposal of containerized liquid wastes arise upon the eventual deterioration of the waste container. Liquids escaping from leaking containers will migrate to the bottom of the landfill, acting as a transport and leaching medium for the wastes contained in the landfill. Liquids accumulating on landfill liners can contribute to liner failure through increased hydraulic pressure and/or chemical interactions. Increased hydraulic head due to liquid accumulation can increase the amount and rate of contaminant movement from the landfill to the ground water. Additionally, when waste containers degrade, allowing their contents to escape, they collapse under the pressure of the landfill. This situation can create voids in the landfill, which can lead to slumping and subsidence of the final cover. Once the integrity of the landfill cover is lost, infiltration of precipitation will increase, contributing to the leachate generation in the landfill. Collapse of deteriorated waste containers and subsequent damage to the cover material could occur after the post-closure care period of the landfill, when ground-water monitoring systems are not maintained to detect ground-water contamination.

Disposal of bulk or noncontainerized liquids in landfills present the same problems that disposal of containerized liquids present once they have leaked from this containers, namely, increased mobility of wastes in the landfill, increased risk of loss of liner integrity through greater pressure and/or chemical interactions, and increased hydraulic head, which can increase the rate and quantity of movement of contaminants to the ground water.

EPA believes that the proposed ban on the disposal of bulk or noncontainerized liquids (except nonseptic waste from households and recirculated leachate and gas condensate at facilities with specific designs) will greatly reduce the quantity of free liquids to be managed in MSWLFs, which, in turn, will reduce the risk of liner failure and subsequent contamination of the ground water. The ban on containerized free liquids (except those from households) will achieve the same purposes as the ban on bulk liquids, and, in addition, will reduce the problem of subsidence and possible damage to the final cover upon eventual deterioration of the waste containers.

EPA recognizes that landfills are, in effect, biological systems that require moisture for decomposition to occur and that this moisture promotes decomposition of the wastes and stabilization of the landfill. Therefore, adding liquids may promote stabilization of the unit. Some concern has been expressed that the Agency requirements would effectively place landfills in a state of "suspended animation," impeding stabilization by minimizing introduction of liquids. EPA does not agree with this argument for several reasons. Wastes received at landfills already contain moisture (10 percent to 35 percent by volume). The Agency believes that this moisture is sufficient for decomposition to proceed. In addition, moisture is added from rainfall, and more moisture is generated during the decomposition process. Finally, although the Agency recognizes that moisture is necessary for waste decomposition, it does not have data that indicate that allowing the deliberate introduction of liquids into a unit for stabilization purposes is beneficial and outweighs the potential problems incurred from increased volumes of leachate.

The intent of today's proposal is to prohibit the disposal of bulk or noncontainerized liquid waste at new and existing MSWLFs units. Household waste (other than septic waste) is exempted because it is beyond the practicable capability of owners and operators to effectively restrict the disposal of all household liquid wastes. Furthermore, the primary purpose of today's liquids restrictions is to limit the disposal of large-volume liquids in the landfill. Septic wastes would not be exempted because they are easily identifiable and restricted if they do not pass the liquids test described below.

Certain small containers (e.g., paint cans) and other wastes (e.g., batteries) would be exempt from the containerized liquids ban because they are not likely to contribute substantial amounts of liquids at most landfills and the difficulty of opening and emptying them appears to outweigh the small benefit gained (Ref. 3). EPA believes that the 18-month period between the promulgation date and the effective date of the rule would allow liquid waste disposers adequate time to develop alternatives to liquids disposal in MSWLFs.

Under this proposal, the owner or operator would be required to determine if wastes (e.g., septic wastes, municipal wastewater sludge) are liquid waste by using the Paint Filter Liquids Test method. This test method (Method 9095) already has been adopted by the Subtitle C hazardous waste program (Ref. 34). As discussed earlier under the explanation for the proposed definition for "liquid waste," the Agency requests comments on the appropriateness of the solids content measure as an alternative to the Paint Filter Liquids Test for POTW sludges for defining liquid waste.

The Agency is proposing to allow leachate and gas condensate recirculation at MSWLF units that incorporate a composite liner and leachate collection system into their design. Studies have indicated that leachate recirculation has certain benefits, which include increasing the rate of waste stabilization, improving leachate quality, and increasing the quantity and quality of methane gas production. Leachate recirculation also provides a viable on-site leachate management method. Other methods for managing leachate include disposal in off-site POTWs or on-site treatment facilities. These other methods, however, may not be available or practical because of limited POTW capacity, institutional constraints, or costs. Recent studies conducted by EPA indicate that of those facilities collecting leachate (481 MSWLFs or 5 percent of total), 42 percent (205 MSWLFs) are recirculating leachate. The Agency expects that the number of MSWLFs collecting leachate would increase with

the implementation of today's proposed design Criteria (Subpart D of today's proposal).

The Agency recognizes that there are potential operational problems associated with leachate and gas condensate recirculation that may result in adverse impacts on human health and the environment. These problems include: (1) An increase in leachate production, (2) clogging of the leachate collection system (LCS), (3) buildup of hydraulic head within the unit, (4) an increase in air emissions and odor problems, and (5) an increase in the potential of leachate polluant releases due to drift and/or run-off. Therefore, EPA is proposing that only MSWLF units designed and equipped with composite liners and an LCS constructed to maintain less than a 30-cm depth of leachate over the liner be allowed to recirculate leachate and gas condensate.

A composite liner is a system consisting of two components. The upper component must contain a flexible membrane liner (FML), and the lower component must contain at least a three-foot layer of compacted soil with hydraulic conductivity of no more than 1×10^{-7} centimeters per second. The FML component must be installed in direct and uniform contact with the compacted soil component so as to minimize the migration of leachate through the FML if a break should occur. Because of the increased leachate generation due to the increased amounts of liquids and subsequent hydraulic head buildup, EPA believes that the added protection provided by a composite liner is necessary to ensure that contaminant migration to the aquifer is controlled. First, the FML portion of the liner will increase leachate collection efficiency and provide a more effective hydraulic barrier. Second, the soil portion will provide support for the FML and the leachate collection system and act as a back-up in the event of failure of the FML.

The standard for the LCS, i.e., the requirement that it be constructed to maintain less than 30 cm of leachate over the liner, is the same standard required for LCSs at Subtitle C hazardous waste units, and various technologies are available for meeting this requirement (Ref. 3). The appropriate technology depends on the size of the unit, waste permeability, and climatic conditions. LCS design normally consists of a permeable material placed on a sloping surface so as to allow the leachate to be removed and collected. For large units, a pipe drainage system also may be necessary.

The Agency believes that, because of the potential problems associated with leachate recirculation discussed earlier, the design requirements specified above generally are necessary to ensure protection of human health and the environment; however, because the data that EPA has collected on leachate recirculation are limited to laboratory studies (Ref. 24), the Agency is requesting aditional data on leachate recirculation, including pilot studies and field data.

Prior to selecting today's proposed approach, the Agency considered a wide range of options for leachate and gas condensate recirculation and is requesting comment on two additional options. EPA considered allowing waivers to the requirement that an MSWLF have a composite liner in order to recirculate leachate. For example, the waiver could be granted if the owner or operator could demonstrate that: (1) The unit is located over ground water that is not a potential or current underground source of drinking water, and such ground water is not interconnected to a potential or current drinking water source; or (2) recirculation of leachate or gas condensate in the absence of a composite liner or leachate collection system would not result in contamination of ground water; or (3) recirculation of leachate or gas condensate in an existing unit not equipped with a composite liner or leachate collection system would pose lower risks to human health and the environment than disposal of this leachate without recirculation.

Because of the previously mentioned operational problems associated with leachate and gas condensate recirculation and the limited data available, the Agency also is considering a ban on leachate and gas condensate recirculation as an alternative to today's proposal. Under this alternative, for new MSWLF units, the ban could be instituted on the effective date of the revised Criteria and could be phased in for existing units over a period of time, possibly five years, to allow for alternative leachate management practices to be implemented. The Agency recognizes that the area of leachate and gas condensate recirculation will be controversial and, therefore, is seeking comment on a number of issues. The Agency is seeking comment on the appropriateness of the proposed design requirements and whether other designs would provide adequate protection, and whether today's proposed requirement should be modified to allow the State greater flexibility in establishing appropriate design controls. The Agency is requesting comment on the above approaches to granting the waivers and is interested in receiving information on how to develop the necessary waiver demonstrations. Finally, EPA is specifically requesting comments on banning leachate and gas condensate recirculation.

10. Section 258.29 Recordkeeping Requirements

EPA has included a recordkeeping requirement in these proposed Criteria to ensure that a historical record of MSWLF performance is maintained. The owner or operator would be required to maintain the following records: Ground-water monitoring, testing, or analytical data as specified under Subpart E of today's proposal; gas monitoring results; inspection records, training procedures, and State notification procedures as specified under § 258.20 of today's proposal; and closure and post-closure care plans required under proposed §§ 258.30(b) and 258.31(c), respectively. The required information would be recorded as it becomes available, and maintained by the owner or operator of new and existing MSWLFs. This section consolidates the recordkeeping requirements of other sections of today's proposal.

EPA believes that this requirement would ensure the availability of basic types of information that demonstrates compliance with today's requirements. EPA has not defined the time period for retaining these records, required that reports should be submitted, nor specified in what form records should be maintained because the Agency believes it is more appropriate for these requirements to be specified by States, which are directly responsible for implementing these provisions. EPA believes this requirement is flexible enough to allow the States to establish specific requirements for recordkeeping and to determine if additional records should be maintained.

11. Section 258.30 Closure Criteria

Because of the potential threats to human health and the environment posed by MSWLFs, the Agency believes that is necessary to prescribe minimum standards for closing these landfills. Improperly closed landfills, as discussed in a background document (Ref. 3), have the potential for contaminating the environment due to inadequate controls to contain the wastes (e.g., a final cap that erodes and fails to protect the wastes from being exposed). For this

reason, the Agency is proposing criteria for closure of MSWLFs in § 258.30 of today's proposal to ensure that owners and operators prevent threats to human health and the environment caused by improper landfill closure.

The closure criteria proposed today specify a closure performance standard that the owner of operator must meet that will minimize the need for maintenance after closure and minimize the formation and release of leachate and explosive gases during the post-closure care period. Owners or operators must prepare a closure plan, to be approved by the State, that describes the activities to be undertaken at the landfill to close it in accordance with the closure performance standard. Because prompt closure of a landfill is important to minimize potential threats to human health and the environment, the Agency is proposing that closure must begin promptly after the final receipt of waste at each landfill unit. To further ensure that closure is conducted properly and in a timely manner, the owner or operator also would be required to submit a certification for each unit at which closure had been completed in accordance with the closure plan. Other details regarding closure (such as deadlines and procedures for submitting, approving, and modifying closure plans; schedules and deadlines for completing closure; and other procedural requirements) would be left to the States in order to allow maximum flexibility without compromising the intent of the closure criteria.

a. Closure Performance Standard. The closure performance standard proposed by the Agency § 258.30(a) of today's rule is designed to ensure that long-term protection of human health and the environment is achieved while providing States with the flexibility to require more specific technical closure requirements. The Agency is proposing a health-based performance standard for the final cover, which is discussed in Section IX. D of this preamble. States are encouraged to specify technical standards for satisfying the closure performance standard (e.g., final cover design and materials, cap permeability) and may wish to refer to technical guidance materials applicable to Subtitle C hazardous waste facilities.

The components of the proposed closure performance standard are consistent with the closure performance standard for Subtitle C hazardous waste treatment, storage, and disposal facilities. First, the MSWLF owner or operator must close each landfill unit (i.e., discrete cells or trenches in a manner that minimizes the need for further maintenance after operations cease. Second, closure activities must minimize the formation and release of leachate and explosive gases after the closure performance standard to the extent necessary to protect human health and the environment. This dual requirement establishes the standard for the closure applicable to all MSWLFs and, at the same time, allows owners or operators and the States to determine the site-specific technical requirements necessary to achieve these general goals of protecting human health and the environment.

The Agency recognizes that many owners and operators manage their landfills in phases and close units (e.g., discret cells or trenches) as they are filled. To ensure that the entire landfill is closed in an environmentall sound manner, the Agency is proposing that all units of the landfill be closed in a manner that satisfies the closure performance standard, including units closed prior to cessation of all operations at the landfill. This requirement also is consistent with the Subtitle C requirements applicable to hazardous waste facilities.

b. Closure Plan. To ensure that the activities and resources necessary to close MSWLFs in a way that will protect human health and the environment have been adequately considered, today's proposed § 258.30(b) would require the owner or operator of each new and existing MSWLF to prepare a written closure plan describing how all units of the landfill will be closed in accordance with the closure performance standard. The closure plan also would serve as a basis for enforcing the closure performance standard and other closure requirements under § 258.30. In addition, this plan would serve as the basis for determining site-specific cost estimates and the amount of financial assurance required under § 258.32. The proposed requirement for a detailed written closure plan is consistent with many State solid waste regulations. A survey of selected State programs indicated that many States currently require the owner or operator to demonstrate that it has prepared for closure of the facility.

Section 258.30(b) of today's proposal specifies the minimum information that must be provided in the closure plan. States are encouraged to supplement these requirements to ensure more complete and adequate closure plans. States may wish to refer to the regulatory and preamble language in 40 CFR Parts 264 and 265, Subpart G, applicable to closure and post-closure care standards for hazardous waste facilities, for guidance in developing more detailed closure plan requirements.

Today's proposal specifies that the closure plan must include (1) an overall description of the methods, procedures, and processes that will be used to close each unit to the landfill in accordance with the closure performance standard, including procedures for decontaminating the MSWLF, (2) an estimate of the maximum extent of operation that will be open 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 landfill, (4) description of the final cover designed in accordance with § 258.40(b) and § 258.40(c), and (5) a schedule for competing all activities necessary to satisfy the closure performance standard.

The closure plan should provide enough detail to allow the State to evaluate its adequacy. For example, the description of the activities necessary to complete all closure activities should address removing, transporting, treating, or disposing of any waste inventory remaining at the landfill; monitoring the ground-water and managing gas and leachate during the closure period; controlling run-on an run-off; and decontaminating or removing contaminated structures, equipment, and soils. Decontamination procedures include the methods for decontaminating the MSWLF, sampling and testing procedures, and criteria to be used for evaluating contamination levels. The estimate of the maximum extent of operation of the landfill should account for the largest portion of the landfill ever open at any time over the active life of the MSWLF. An area of a landfill is considered open if it has not been closed in accordance with the technical closure requirements in §§ 258.30 and 258.40 (i.e., final cover). Therefore, areas that receive daily cover but are not otherwise closed in accordance with today's provisions would be included in the estimate of the maximum extent of operation. The active life of the facility is defined in § 258.2 as the period from the initial receipt of wastes until certification of closure in accordance with the requirements in § 258.30(e) has been submitted and approved by the State. The estimate of the maximum amount of waste inventory ever handled at the MSWLF at any time over the landfill's active life should be included all wastes awaiting landfilling as well as run-off in trenches, ditches, or collection ponds. The requirements to provide an estimate of the maximum extent of landfill

operation and an estimate of the maximum amount of waste on site over the active life of the landfill are important to accurately estimate the cost of closure. Financial assurance for closure must be based on the maximum cost of closing the landfill based on site-specific factors. Knowing the maximum cost of closure ensures that adequate funds for closure are available even if closure takes place earlier than expected.

The description of the final cover should include the design of the final cover, the types of materials to be used, and how the final cover will achieve the objectives of the closure performance standard. Finally, the closure schedule should include the total time required to close each landfill unit and the time for intervening closure activities that will allow the progress of closure to be tracked (e.g., estimates of the time required to decontaminate the MSWLF and to place a final cover).

Because today's rule applies only to MSWLFs, the estimate of the maximum extent of operation, maximum amount of inventory, and the corresponding description of procedures for handling these wastes refer only to those wastes and units that are integrally a part of the operation of the MSWLF (e.g., run-off collection ponds). These regulations are not intended to address closure of other structures or units at the facility that may not be part of the landfill operation (e.g., a surface impoundment used as a sludge drying bed).

c. Closure Plan Deadline and Approval. EPA is proposing in § 258.30(c) to require that the closure plan be prepared as of the effective date of the rule or by the initial receipt of solid waste at the landfill, whichever is later. Based on experience with hazardous waste facilities under Subtitle C, the Agency believes that the proposed deadline for preparing the closure plan is sufficient. A responsible owner or operator already should have considered many of the types of activities required at closure as part of routine operations, especially if the landfill is operated on a cell-by-cell basis and cells are filled and closed successively. The owner or operator of an existing MSWLF may be able to rely extensively on records of closure activities of areas no longer active in preparing the plans (e.g., in developing an appropriate final cover or in determining the type of final cover used).

The Agency also is proposing in § 258.30(c) that the closure plan, and any subsequent modifications to the plan, must be approved by the State to ensure that the plan adequately addresses all of the required activities. This proposal is particularly important because the closure cost estimate and the amount of financial responsibility required are based directly on the activities described in the closure plan. To allow the States maximum flexibility in developing procedures for implementing these rules, the Agency is not proposing specific deadlines and procedures for submitting, approving, and modifying closure plans. The Agency recognizes that many States already have approval procedures in place, making specific Federal requirements unnecessary and potentially burdensome. For example, most of the States surveyed approve closure plans as part of the permitting process and require that subsequent modifications to the plans be subject to State approval. Other States require that owners or operators apply for closure permits prior to closure. In developing an approval process, States may wish to review the procedures included in Subpart G of 40 CFR Parts 264 and 265, and the permitting requirements in 40 CFR Parts 124 and 270 that apply to hazardous waste facilities.

For recordkeeping purposes, the Agency is proposing in § 258.30(c) that the owner or operator maintain a copy of the most recently approved closure plan at the MSWLF facility, or at some other place designated by the owner or operator, until the owner or operator has been notified by the State that it has been released from financial assurance for closure of the entire landfill under § 258.32(f).

d. Triggers for Closure. To ensure that MSWLF units are closed in a timely manner after operations at the unit have ceased and to protect against threats to human health or the environment posed by open but inactive landfills, the Agency is proposing in § 258.30(d) that the owner or operator begin closure activities at each unit, in accordance with the approved closure plan, no later than 30 days after the final receipt of wastes at each landfill unit. Thus, if the MSWLF is operated on an individual cell or trench basis, closure of each cell or trench must begin within 30 days following the final receipt of waste at that unit. Extensions may be granted at the discretion of the State, if the owner or operator of the MSWLF demonstrates that the open landfill unit will not pose a threat to human health or the environment. These closure trigger provisions in § 258.30(d) are consistent with the closure trigger mechanisms for hazardous waste facilities under Subtitle C. States may wish to refer to the language in 40 CFR Parts 264 and 265, Subpart G as guidance for developing more detailed provisions.

The Agency encourages States to define "final receipt of wastes" to preclude MSWLF units from remaining inactive for an indefinite period of time without closing. For example, States may wish to adopt the provisions applicable to hazardous waste facilities that specify that closure of each unit must begin no later than 30 days after the final receipt of hazardous wastes, no later than one year after the most recent receipt of hazardous wastes at that unit. Furthermore, States are encouraged to establish specific criteria for granting extensions of the deadline for beginning closure. For example, the Subtitle C regulations for hazardous waste facilities specify that an extension will be granted only if the owner or operator demonstrates, among other requirements, that (1) the facility has remaining capacity, and (2) the owner or operator is operating in compliance with all applicable regulations and will continue to do so.

As noted above, the Agency is allowing the States to develop their own procedural requirements, imcluding provisions for owners or operators to notify the States of their intent to close their landfill units. States are encouraged to establish notification requirements that provide them with sufficient advance notice to inspect the facility and to ensure that the approved closure plan is still applicable to the facility's current conditions. States may wish to adopt the notification provisions included in the Subtitle C regulations that require advance notice prior to closure of each unit of the landfill. If the State allows the owner or operator to gradually fund a trust fund as demonstration of financial assurance, notice of closure is particularly important to ensure that the trust fund is fully funded at the tme of closure. For example, Subtitle C requires an estimate of the expected year of closure to be included in the closure plan if the owner or operator expects to close the landfill prior to the end of the required trust fund pay-in period.

While today's proposal specifies when closure must begin, the Agency is not proposing deadlines for completing closure of an MSWLF unit. However, the Agency is concerned that the completion of closure not be delayed unnecessarily and is encouraging States to specify deadlines and interim milestones. For example, the Subtitle C regulations for hazardous waste facilities specify a six-month deadline for completing closure and an interim milestone of three months for managing all inventory at the site. Extensions to these deadlines may be granted if (1) the closure activities

will take longer than six months to complete or (2) there is a reasonable likelihood that the owner or operator or a person other than the owner or operator will recommence operation of the facility, the landfill has additional capacity to receive waste, and closure would be incompatible with continued operation of the facility. In all cases, if an extension for completing closure is granted, the owner or operator of a Subtitle C facility remains subject to all applicable permit requirements and must take all the necessary steps to ensure protection of human health and the environment. The Agency requests comment on the extent to which the revised Criteria should specify deadlines for completing closure.

e. Closure Certification. The Agency is proposing in § 258.30(e) that following closure of each MSWLF unit, the owner or operator must submit to the State a certification that closure of that unit has been completed in accordance with the approved closure plan. The closure certification must objectively verify that closure has been performed in accordance with the closure requirements, based on a review of the landfill unit by a qualified party. State approval of closure certification will trigger the release of the owner and operator from closure financial responsibility requirements under § 258.32(f) (see Section 13.e below.)

The Agency is leaving to the discretion of the State the types of certifications that satisfy the regulations; in all cases, however, the certification must provide an objective evaluation of site closure, based on a direct review of the MSWLF unit by a party qualified to make such an assessment. Certifications that may satisfy the criteria in today's proposal include written verification by an independent qualified party (e.g., an independent registered professional engineer) or a qualified in-house registered professional engineer at the MSWLF with knowledge about the facility's operations who can objectively evaluate the closure activities, or an on-site review by State inspection officials. While this certification requirement allows the States more discretion than under Subtitle C, the intent of today's proposed rule is consistent with the Subtitle C regulations, which require a hazardous waste facility owner or operator to submit a certification signed by himself and an independent registered professional engineer that closure has been conducted in accordance with the approved plan.

The Agency also is leaving to the States the discretion to specify a deadline for submitting the certification. States may wish to adopt the Subtitle C regulations that require the certifications to be submitted no later than 60 days after the completion of closure of each unit.

12. Section 258.31 Post-Closure Care Requirements

The closure performance standard requires the owner or operator of an MSWLF to close each landfill unit in a manner that minimizes the need for further maintenance and minimizes leachate and gas formation. Even when properly carried out, however, closure cannot guarantee against long-term environmental problems at landfills. For this reason, the Agency is proposing that the owner or operator conduct post-closure monitoring and maintenance as necessary to minimize future threats to human health and the environment following closure of each landfill unit. The post-closure care requirements proposed in § 258.31 of today's rule specify the minimum activities necessary to minimize deterioration of the final cover and to detect problems before they pose a threat to human health and the environment. These activities must be described in the post-closure care plan under proposed § 258.31(c).

An owner or operator must begin post-closure care activities following closure of each landfill unit. The Agency is proposing that this post-closure care period comprise two phases. In the first phase, the owner or operator must perform the post-closure care activities specified in § 258.31(a) for a minimum of 30 years; during the second phase, the owner or operator must continue to conduct certain post-closure care activities specified in § 258.31(b). The length of this second phase would be specified by the State. The post-closure care plan must describe the activities in both phases of post-closure care.

a. Post-Closure Care Activities. During the first 30 years of the post-closure care period, the Agency is proposing that the owner or operator conduct routine maintenance of any final cover, and continue any leachate collection, ground-water monitoring, and gas monitoring requirements as necessary to control the formation and release of leachate and explosive gases into the environment and maintain the integrity of these monitoring systems. Routine maintenance of the integrity and effectiveness of the final cover, proposed in § 258.31(a)(1), is necessary to prevent liquids from penetrating into the closed landfill and creating the potential for leachate migration. Required activities include repairs to the final cover to correct the effects of settling, subsidence, erosion, or other events, and preventing run-on and run-off from eroding or damaging the cover. Cover maintenance also includes periodic cap replacement, which is necessary to remediate the effects of routine deterioration. These activities are intended to promote the Agency's overall goal of minimizing liquids in landfills and are the minimum steps the Agency believes are necessary to protect human health and the environment in the long term. The Agency believes that these requirements also should provide an incentive to properly manage solid wastes (e.g., ensuring proper compaction of wastes) during the active life of the landfill.

The Agency is proposing in § 258.31(a)(2) that owners or operators of MSWLFs designed with liner(s) and leachate collection systems continue to operate and maintain the leachate collection system during the post-closure care period in accordance with the requirements of § 258.40(b). Experience has shown that leachate generation in landfills continues long after closure. Therefore, to avoid leachate collecting on top of the liner and causing the "bathtub effect," the owner or operator must continue to remove leachate from the collection system during the post-closure care period until leachate no longer is collected in the system.

Proposed § 258.31(a)(3) would require the owner or operator to conduct ground-water monitoring during the first 30-year post-closure care period in accordance with the requirements in § 258.50 and maintain the ground-water monitoring system. The fundamental purpose of monitoring during the post-closure care period is to detect ground-water contamination in a timely fashion should the waste containment structures fail and to trigger corrective action as soon as contamination occurs. Long-term monitoring is essential to detect releases due to design or operating errors (e.g., tearing of liners or disposing of wastes that are incompatible with the liner) and routine deterioration of liner. Particularly for landfills designed with advanced containment systems (e.g., liners, leachate collection systems, or synthetic final caps), ground-water contamination may be delayed for many years, thus increasing the need for long-term monitoring. Because ground-water monitoring wells are subject to routine deterioration, post-closure activities also should include the periodic replacement of these wells as needed.

Finally, § 258.31(a)(4) proposes to require the owner or operator to monitor

for methane in accordance with § 258.23. That section requires the owner or operator to ensure that methane generated by the landfill unit does not accumulate in landfill structures (excluding gas control or recovery system components) in concentrations in excess of 25 percent of the lower explosive limit for methane. The concentration of methane gas at the MSWLF facility property boundary also must not exceed the LEL.

Following completion of the first phase of post-closure care at each landfill unit, today's proposal would require the owner or operator to conduct a second, less-intensive phase of care. The purpose of this second phase is to ensure that a minimum level of care is continued to detect any release that might occur at an MSWLF in the long term, while at the same time minimizing the burden on the owner or operator of continuing extensive post-closure care activities for an extended period of time. Therefore, the Agency is proposing under § 258.31(b) that the owner or operator must continue, at a minimum, ground-water monitoring and gas monitoring in order to detect any contamination that might occur beyond the first 30 years of post-closure care. States would have the responsibility of specifying the duration of this second phase.

The Agency is proposing this second phase of post-closure care for a number of reasons. First, even the best liner and leachate collection systems will ultimately fail due to natural deterioration, and recent improvements in MSWLF containment technologies suggest that releases may be delayed by many decades at some landfills. For this reason, the Agency is concerned that while corrective action may have already been triggered at many facilities, 30 years may be insufficient to detect releases at other landfills. The Agency, therefore, wants to ensure that any potential release will be detected regardless of when it occurs. Finally, in the absence of sufficient data to follow the Agency to predict with certainty when containment systems are likely to fail, a second phase of reduced post-closure care ensures that releases will be detected while minimizing costs to the regulated community.

The Agency is proposing minimum requirements for this second phase of care to allow States maximum flexibility in tailoring the scope of the requirements and the duration of this period to site-specific circumstances. For example, if a release is detected at an MSWLF during the second phase of care, the State may specify increased post-closure activities to be carried out as necessary. For facilities located in vulnerable environmental settings, the State may wish to require the owner or operator to continue during this second phase of care many of the activities conducted during the first phase. In addition, for vulnerable or high hazard settings, the Agency expects States to specify extended second-phase care periods. In those cases in which corrective action is still underway at the end of the first phase of post-closure care, the Agency expects States to require the second phase of post-closure care to extend for the duration of the corrective action period, at a minimum.

In addition to the minimum post-closure activities specified in today's proposal, the Agency encourages States to specify more detailed post-closure care requirements, such as maintaining the vegetative cover through periodic mowing, replanting, and regrading to preclude erosion that occurs naturally over time and as a result of servere storms, and repairing the cap when necessary to prevent the cap from becoming permeable. Other post-closure care requirements could include security measures if access to the MSWLF facility could pose a health hazard. In addition, the Agency encourages the States to specify deadlines for submitting monitoring data and other recordkeeping requirements to facilitate the detection of potential problems at the site in a timely manner. The Agency requests comment on the appropriateness of incorporating these and other post-closure care requirements.

The types of post-closure care requirements proposed today closely parallel those applicable to Subtitle C facilities. In addition, the post-closure care activities proposed in today's rule are consistent with existing State solid waste management requirements based on the Agency's review of several States' solid waste regulations (Ref. 21). All of the State programs reviewed require, at a minimum, post-closure site maintenance, leachate control, and ground-water monitoring. In addition to these activities, many States surveyed require additional post-closure activities such as surface water monitoring. The Agency in no way means to preclude States from requiring such activities.

b. Length of Post-Closure Care Period. As noted above, the Agency is proposing that, following closure of each MSWLF unit, the owner or operator must conduct two phases of post-closure. In the first phase of post-closure care, the owner or operator must conduct all of the post-closure care activities specified under ¶ 258.31(a) for a minimum of 30 years. The State has the discretion to extend the period beyond 30 years. Subtitle C establishes a 30-year post-closure period and allows the Regional Administrator to either reduce or extend the length of the period based on site-specific demonstrations. As discussed above, the Agency is concerned that releases may not occur until after 30 years. In fact, the Agency currently is considering extending the length of the post-closure care period well beyond 30 years for hazardous waste facilities located in certain environments likely to pose significant threats to human health and the environment. Therefore, today's rule proposes that the first phase of post-closure care must continue for a minimum of 30 years, with the option for States to require a longer period if deemed appropriate.

Section 258.31(b) proposes a second, less intensive phase of post-closure care designed to ensure the detection of releases, but leaves to the States the flexibility to specify the appropriate length of this period. States may specify a standard period of care for all landfill units, or determine an appropriate period on a case-by-case basis (e.g., at the time the MSWLF is applying for a permit or within a specified period after the effective date of the regulations). While the first option would reduce the burden on the States, the second option could allow for better protection against releases of hazardous constituents to the environment by adapting the post-closure care period to site-specific circumstances.

The Agency considered requiring an extended post-closure care period for MSWLFs with an option to reduce the period only if the owner or operator could demonstrate that a reduction in the period would not pose any threat to human health and the environment; however, the Agency was concerned that this approach could be overly stringent and potentially burdensome to the owner or operator and to the State to establish the criteria for terminating the post-closure care period. The Agency also considered allowing the State the discretion of reducing the 30-year post-closure care period based on cause, consistent with the Subtitle C requirement for hazardous waste facilities. As discussed above, however, because improvements in containment technology may delay the detection of releases, the Agency is concerned that reducing the period to less than 30 years could result in future releases not being detected. Finally, the Agency considered requiring periods consistent with some

of the State post-closure care periods (e.g., 5, 10, or 20 years). In the absence of empirical data from the States, however, the Agency is not convinced that these shorter periods are adequate to ensure the protection of human health and the environment.

EPA is not proposing criteria and procedures for determining the length of the second phase of the post-closure care period although States are encouraged to do so. States may wish to consider several criteria when evaluating the appropriate length of the second phase of the post-closure period. For instance, the liner and cover design, age, stability, and operating record (including ground-water monitoring results that show changes in constituent concentrations over time) of existing landfills are useful factors in estimating the potential for leachate and gas release. Other factors include leachate quality (e.g., volume and physical characteristics), hydrogeologic characteristics of the site, the potential for human exposure, and the expected future use of the facility and surrounding land. The State also may wish to list in the regulation the types of demonstrations that owners or operators must make to terminate the post-closure care period.

The Agency is requesting comments on the appropriate length of the post-closure care period for MSWLFs. In particular, the Agency is requesting comments on the two-phased approach and information on the frequency and timing of releases from MSWLFs, criteria that should be used to evaluate the length of the post-closure care periods, appropriate demonstrations for terminating the post-closure care period, and other information based on experiences with closed landfills.

c. Post-Closure Plan. EPA is proposing in § 258.31(c) to require the owner or operator of an MSWLF to prepare a written post-closure plan that includes descriptions of the monitoring and maintenance activities required in § 258.31(a) and (b) for each MSWLF unit and the frequency with which these activities will be performed during both phases of post-closure care. The fundamental objective of monitoring is to ensure that any migration of contaminants is detected in a timely fashion. In many instances, post-closure monitoring will be a continuation of the monitoring activities conducted during the landfill's active life. The description of maintenance activities necessary to ensure the integrity of the waste containment systems should include routine maintenance that reasonably can be expected to be required after closure of each unit (e.g., mowing, fertilization, erosion control, and rodent control) and the frequency with which these activities will be performed. These monitoring and maintenance requirements are consistent with State regulations examined by the Agency.

EPA is proposing in § 258.31(c)(2) that the post-closure plan also include the name, address, and telephone number of the person or office to contact about the MSWLF during both phases of the post-closure care period. This requirement would ensure that, if emergency measures or long-term corrective measures are necessary after closure, a person familiar with the landfill design, the types of wastes handled, past operating problems, etc., will be available.

The Agency also is proposing under § 258.31(c)(3) that the post-closure plan include a description of the planned uses of the property during both phases of the post-closure care period. One example of an acceptable use of a closed landfill would be a recreational park, provided the park complies with the requirements of § 258.31(c)(3). Under the proposed § 258.31(c)(3), the post-closure use of the property must not disturb the integrity of the final cover, waste containment system, or function of the monitoring systems unless the State determines that the activities (1) will not increase the potential threat to human health or the environment or (2) are necessary to reduce a threat to human health or the environment. For example, a foundation structure installed in a closed MSWLF may disturb the integrity of the cap, present potential safety problems as result of migrating landfill gas, and result in structure failure. Interference with the operation of the monitoring systems could prevent timely detection of ground-water contamination or gas concentrations greater than the established health-based limit. Unmonitored access to the property after closure also could result in the release of hazardous constituents or actual exposure of buried wastes as a result of disturbances of the site. If an owner or operator wishes to remove any wastes, waste residues, the liner, or contaminated soils at any time during the post-closure care period, it must obtain approval from the State and demonstrate that disturbing the site will not increase the threat to human health and the environment. These requirements are consistent with the Subtitle C requirements for hazardous waste facilities.

d. Post-Closure Plan Deadline and Approval. Consistent with the closure plan requirements, the Agency is proposing to require under § 258.31(d) that the post-closure plan be prepared as of the effective date of the rule or by the initial receipt of solid waste at the MSWLF, whichever is later. This section also requires that the post-closure plan, and any subsequent modification to the plan, be approved by the State. As described above, the Agency is leaving specific procedural requirements such as deadlines and procedures for submitting, approving, and modifying post-closure care plans to the individual States. Finally, proposed § 258.31(d) requires the owner or operator to maintain a copy of the most recent approved post-closure plan at the MSWLF facility or at some other location designated by the owner of operator. The plan must be maintained from the onset of the post-closure care period until completion of the post-closure care period has been certified in accordance with § 258.31(f) (see Section 12.f below) and the owner or operator has been notified by the State that it has been released from financial assurance for post-closure care for the entire landfill under § 258.32(g).

e. Notation on the Deed to Property. The Agency is proposing in § 258.31(e) that, following closure of the entire MSWLF, the owner or operator must record a notation on the deed or some other instrument normally examined during a title search that will notify any potential purchaser that: (1) The land has been used as an MSWLF and (2) its use is restricted under § 258.31(c)(3). This notation on the deed is intended to assure that the land use is restricted in perpetuity. The owner or operator may ask permission to remove the notation on the deed if all wastes are removed in accordance with the provisions in § 258.31(c)(3). Under the Subtitle C requirements for hazardous waste disposal facilities, an owner or operator must record a notice on the deed following closure of the first unit and after final closure to provide additional assurance that all parties are aware of the use of the property. While today's proposed rule does not require that a notation to the deed by filed after closure of each landfill unit in order to minimize burdens on the owner or operator, States may wish to adopt this more stringent requirement.

According to the Agency's survey of State requirements, some States already have procedures for ensuring that the post-closure use of landfill property is restricted. Some States require a notation to be put on the property deed, other States require that proposed future

land use be subject to Agency review and approval.

States may wish to specify additional notification requirements for MSWLFs as required under Subtitle C. For example, submission of a survey plat indicating the location and dimension of landfill units, a record of waste including the type, location, and quantity of waste disposed of in each landfill unit, and a certification that the deed notation has been recorded are all required under Subtitle C regulations.

f. Post-Closure Care Certification. The Agency is proposing in § 258.31(f) that following the completion of the second phase of the post-closure care period for each unit, the owner or operator submit to the State, a certification that both phases of post-closure care have been conducted in accordance with the approved post-closure plan. Consistent with the closure certification, the post-closure care certification must objectively verify that post-closure care has been performed in accordance with the post-closure care requirements based on a review of the landfill unit by a qualified party. As discussed above for closure certifications, the Agency is proposing to leave to the State the discretion to specify the types of certfications that would provide such an objective assessment.

Today's proposal requires that the certification be submitted at the completion of the second phase of the post-closure care period for each unit. This requirement is consistent with these for hazardous waste facilities under Subtitle C. Because of the duration of the post-closure care period, the States may wish to require periodic interim certifications (e.g., every five or 10 years or at the time of the permit renewal, if applicable) to confirm that activities are being conducted properly. Alternatively, States may wish to consider requiring a certification after the end of each of the two phases of post-closure care.

13. Section 258.32 Financial Assurance Criteria

Under today's proposed rule, the owner or operator of a new or existing MSWLF would be required to demonstrate financial assurance for the costs of conducting closure, post-closure care, and, if applicable, corrective action for known releases. (Under proposed § 258.57, whenever the ground-water protection standard is exceeded, an owner or operator must conduct a corrective action program to treat in place or remove any Appendix II hazardous constituents exceeding the standard.) The purpose of financial assurance is to ensure that the owner or operator adequately plans for the future costs of closure, post-closure care, and corrective action for known releases, and to ensure that adequate funds will be available when needed to cover these costs if the owner or operator is unable or unwilling to do so. To demonstrate to the State that it has planned for future costs, the owner or operator must prepare written cost estimates. These cost estimates would serve as the basis for determining the amount of financial assurance that must be demonstrated.

Today's proposed financial assurance requirements for closure, post-closure care, and corrective action for known releases at MSWLFs are patterned after the financial assurance provisions for hazardous waste facilities under Subtitle C and proposed provisions for underground storage tanks under Subtitle I. Financial assurance for closure and post-closure care for MSWLFs is currently required in numerous States. Although financial assurance for corrective action is less frequently required by States, the Agency believes that provision of financial assurance to cover the costs of corrective action for known releases is important to ensure that funds for long-term remedial activities are provided by the owner or operator.

The Agency is not proposing at this time to require financial assurance for other than known releases due to the complexity of the analysis that would be required to estimate probable corrective action costs associated with releases from MSWLFs. For example, to require a facility with a high probability of a release to demonstrate financial assurance for corrective action costs in the event of a release would require a characterization of the risks posed by a facility as well as the potential size, impact, and costs to remedy such releases. Such facility risk analyses could require considerable time to complete and also could delay the adoption and implementation of regulations by States. The Agency requests comments on this decision and information concerning how such cost estimates could be derived in the event additional corrective action financial responsibility requirements are proposed in the future.

The Agency also considered requiring owners or operators of MSWLFs to demonstrate financial assurance for third-party liability to compensate injured third parties. For a number of reasons, however, the Agency has decided to defer proposing such liability requirements at this time. First, the Agency is concerned that it does not have sufficient data at this time to specify the amount of liability coverage that would be appropriate for an MSWLF. Unlike Subtitle I, which mandates a minimum level of coverage for underground storage tanks, the statute does not specify any minimum financial assurance requirements for MSWLFs. To date, few claims data exist concerning third-party awards resulting from releases at MSWLFs. While more data are available to assess potential claims from Subtitle C facilities, the Agency is reluctant to extrapolate from these data or to adopt directly the levels of coverage required for Subtitle C facilities without further analysis comparing the risks and resultant third-party claims from MSWLFs and Subtitle C hazardous waste facilities.

Second, RCRA Section 4010(c) allows the Agency discretion to take into account the practicable capability of MSWLFs when developing the new criteria. Today's proposal applies an extensive set of new regulations to a large universe of waste facilities. Therefore, in light of the costs associated with implementing today's proposed requirements, the lack of available data on awards for third-party damages, and the current constraints in the insurance market, the Agency has tentatively decided to defer any third-party liability requirements. Instead, the Agency has chosen to focus on financial assurance requirements for costs of activities that are certain to be incurred (i.e., closure, post-closure care, and corrective action for known releases). In deferring these requirements, the Agency hopes to provide more time for the liability insurance market to adjust to a new potential market. The Agency adopted a similar approach when promulgating liability coverage requirements for Subtitle C requirements when it phased in the requirements over a three-year period to allow the market to adjust to the demand for increased capacity.

Deferring third-party liability coverage requirements at the time, however, does not preclude the Agency from promulgating such a requirement for MSWLFs at a later date. Further, the Agency encourages States to consider requiring such coverage if they choose. This decision to defer these financial assurance requirements in no way relieves an owner or operator of liability should injury to third parties be shown to have resulted from the operation of MSWLFs.

The Agency requests comments on this decision to defer requirements for financial assurance for third-party liability costs at this time. In particular, the Agency requests information to

assist in setting appropriate levels of liability coverage for MSWLFs, including data on the number of claims filed, the size of settlements or awards resulting from injuries associated with releases from MSWLFs, the causes of such injuries, and the number of persons harmed. Data concerning the nature, size, probability of, and potential exposures to releases from MSWLFs could also be used in developing liability coverage requirements. EPA also requests information on the likely availability and cost of insurance coverage and other financial instruments for liability coverage, the factors that might affect the cost and availability coverage, the factors that might affect the cost and availability of financial assurance instruments, the potential burden on owners or operators of obtaining financial assurance, and the advisability of phasing in financial responsibility requirements for third-party liability as done under Subtitle C.

Today's rule proposes that the amount of financial assurance for closure, post-closure care, and corrective action for known releases be based on site-specific cost estimates. The Agency is not proposing in today's rule the types of mechanisms that may be used to demonstrate financial assurance. Rather, today's proposal establishes a performance standard that specifies a set of criteria that must be satisfied by any mechanism that is used. Regardless of the mechanism chosen, it must ensure that adequate funds are available in a timely manner whenever they are needed. This approach provides the regulatory community and the States the maximum flexibility in satisfying the financial assurance requirements.

a. Applicability. Today's proposal would apply to each owner and operator of an MSWLF except for an owner or operator who is a State or Federal government entity. Although these proposed requirements would apply to both the MSWLF owner and the operator, only one would be required to demonstrate financial assurance for the MSWLF. This requirement is consistent with those under Subtitles C and I. This option provides flexibility to the regulated community by allowing them to choose which party will demonstrate financial assurance while, at the same time, giving the State the additional assurance that funds will be available by holding both parties ultimately responsible. EPA considered, but rejected, the option of requiring both the owner and operator to demonstrate financial assurance. While such an approach might provide somewhat greater assurance that the costs of closure, post-closure care, and corrective action for known releases would be covered in the event that one party failed to provide adequate funds, the Agency believes that, in most cases, this "double" coverage would be unnecessary and would substantially increase the burden on owners and operators of MSWLFs.

EPA recognizes that because Federal and State government entities are permanent and stable institutions that exist to safeguard health and welfare, they have the requisite financial strength and incentives to cover the costs of closure, post-closure care, and corrective action for known releases. The Agency believes, therefore, that it is not necessary to impose financial assurance requirements on MSWLFs owned or operated by government entities whose debts and liabilities are the debts and liabilities of a State or the United States. This exemption also extends to cases in which an MSWLF is owned by a State or Federal government entity and operated by a private party (or operated by a State or Federal government entity while owned privately). A State or Federal owner may, of course, require the private operator by contractual agreement to provide financial assurance. The exemption for MSWLFs owned or operated by Federal or State governments is consistent with the approach adopted under both the Subtitle C regulations applicable to owners or operators of hazardous waste facilities and the proposed Subtitle I rules for underground storage tanks containing petroleum.

The Agency also is considering whether to treat Indian Tribes, having Federally recognized governing bodies that carry out substantial governmental duties and powers over any area, as States. If so, they would be considered exempt from financial assurance requirements. If Indian Tribes are not exempt, they would be required to demonstrate financial assurance similar to local governments. The Agency requests comment on whether to exempt Indian Tribes from financial responsibility requirements. Specifically, the Agency requests information on whether Indian Tribes have the requisite financial strength and incentives to cover the costs of closure, post-closure, and corrective action for known releases.

With regard to financial assurance requirements for local governments, EPA carefully considered whether to require municipal owners and operators of MSWLFs to demonstrate financial assurance for the costs of closure, post-closure care, and corrective action for known releases. While the Agency recognizes that many local governments, like Federal and State governments, are permanent entities and act to secure the well-being of their citizens, the Agency is concerned that local governments cannot provide the same guarantee that they will be able to access adequate funds to pay for environmental costs in a timely manner.

EPA has determined that, relative to Federal and State government entities, local government entities generally: (1) Have more limited financial resources and less flexibility in their annual budgets, making reallocation of a substantial amount of funds for a specific purpose in a given year extremely difficult; (2) cannot necessarily access the traditional sources of municipal financing (i.e., intergovernmental transfers, bond issues, and taxes) quickly enough to ensure funding in a timely manner; and (3) have been more prone to fiscal emergencies than Federal and State government entities. The Agency believes, therefore, that local government entities should be subject to financial assurance requirements as a tool to induce advanced planning for the future environmental costs of closure, post-closure care, and corrective action for known releases. Moreover, the Agency believes that requiring local governments to demonstrate financial assurance may help them to raise funds for these costs that they ultimately will have to cover.

b. Cost Estimates. EPA is proposing in § 258.32 (b), (c), and (d) that the owner or operator of each MSWLF develop written site-specific estimates of the costs of conducting closure, post-closure care, and corrective action for known releases that would be used to determine the amount of financial assurance required under § 258.32 (f), (g), and (h). These cost estimates must account for the costs, in current dollars, of a third party conducting the activities described in the closure and post-closure plans and in the corrective action program as specified in §§ 258.30, 258.31, and 258.58. The "third party" provision ensures that adequate funds will be available for the State to hire a third party to conduct closure, post-closure care, and corrective action in the event that the owner or operator fails to fulfill these obligations. These requirements parallel the requirements or proposed requirements under Subtitles C and I.

The closure cost estimate must be based on the cost of closing the MSWLF at the point in the landfill's active life

when the extent and manner of its operation would make closure (as described in the closure plan) the most expensive. For example, if an owner or operator operates the MSWLF on a cell-by-cell basis, the estimate should account for closing the maximum area of the landfill ever open at any time.

The Agency is proposing that the owner or operator develop estimates of the costs of hiring a third party to conduct post-closure care activities for each phase of the post-closure care period. The cost estimate for each phase must be based directly on the activities described in the post-closure care plan required under § 258.31(c) and account for the entire landfill. The estimate for each phase would be derived by multiplying the annual costs (in current dollars) of the activities by the number of years of care required in that phase. This approach is similar to the Subtitle C calculation of the post-closure care cost estimate, in which the cost estimate is determined by multiplying the annual post-closure cost estimate by the number of years of post-closure care. Because not all post-closure care activities are conducted on an annual basis (e.g., cap replacement or monitoring well replacement may only be required periodically), the total cost estimate must be adjusted to include these periodic costs as well as the annual costs. To ensure that adequate funds would be available for the entire post-closure care period, the Agency is requiring that the post-closure care cost estimates for each phase of post-closure care account for the most expensive costs of routine post-closure care. For example, the costs of monitoring during the first 30-year phase should account for the most extensive monitoring likely to be required.

As noted above, Subpart E of today's rule proposes to require that whenever the ground-water protection level at the MSWLF is exceeded, an owner or operator must conduct corrective action. Once a release has been detected, the owner or operator must prepare an estimate of the cost of the corrective action program, calculated by multiplying the annual costs of remedial actions and the number of years required to complete the corrective action program.

The proposed rule would require the closure and post-closure cost estimates to be adjusted annually for inflation until the entire landfill has been closed. The cost estimate for corrective action activities must be updated for inflation until the end of the corrective action period even if it extends beyond closure of the MSWLF. These requirements are consistent with the Subtitle C requirements. Also consistent with Subtitle C requirements, today's proposal would not require the owner or operator to update the post-closure cost estimate after the entire landfill has been closed; however, the Agency requests comment on the desirability of requiring annual adjustments of the post-closure cost estimate during the post-closure care period to prevent a significant shortfall in funds, which could result from not accounting for future inflation.

The Agency suggests that the States require the use of inflation factors that are readily available to owners and operators (e.g., Implicit Price Deflator for Gross National Product as published in the "Survey of Current Business," a Department of Commerce publication) or specify other inflation factors that must be used to adjust the estimates. States may wish to refer to the provisions in 40 CFR 264.142 and 264.144 and the accompanying guidance materials in developing these requirements.

In addition to updating estimates for inflation, today's proposed rule also would require that the owner or operator increase the closure and post-closure cost estimates when changes to the plans or changes at the facility during the active life increase the cost estimates (e.g., increase in design capacity, increase in the maximum area open, more extensive monitoring requirements). Similarly, today's rule proposes that an owner or operator must increase the corrective action cost estimate anytime a change in the corrective action program or in the facility conditions increases the cost estimate.

Whenever the cost estimates are increased, the owner or operator must increase the level of financial assurance required under § 258.32 (f), (g) and (h). If the owner or operator can demonstrate that changes in the facility result in a decrease in the maximum costs of closure over the active life of the landfill (e.g., reduction in size of the area to be used for the landfill), the owner or operator may submit a request to the State to reduce the closure cost estimate. The owner or operator may request a reduction in the amount of the post-closure care cost estimate if the owner or operator can demonstrate that the cost estimate exceeds the maximum cost of post-closure care over the remaining post-closure care period. Because the proposed rule would not require the post-closure cost estimate to be adjusted for inflation during the post-closure care period, the State should account for future inflation in determining if the estimate exceeds the remaining costs to be incurred over the length of the period. Because the corrective action cost estimate is adjusted for inflation until the completion of the program, the owner or operator may more easily be able to demonstrate that the original estimate exceeds the remaining costs to be incurred.

The Agency is not proposing procedures or deadlines for estimating and adjusting cost estimates. However, the Agency encourages States to do so and refers them to the Subtitle C provisions in 40 CFR 264.142 and 264.144 for guidance. In addition, the Agency strongly encourages States to consider carefully all requests for reductions in cost estimates to ensure that shortfalls in coverage do not result. The Agency asks for comments on whether the revised Criteria should include procedures or deadlines for estimating and adjusting cost estimates.

For recordkeeping purposes, the owner or operator must maintain copies of the most recent cost estimates for closure, post-closure care, and corrective action for known releases at the landfill unit until the owner or operator has been released from financial assurance for that activity under § 258.32 (f), (g), and (h). These provisions are consistent with requirements under Subtitle C.

c. Performance Standard for Financial Assurance. In order to minimize the number of specific procedural requirements applicable to demonstrating financial assurance and provide maximum flexibility to the States, the Agency is not specifying in the proposed regulation the types of financial assurance mechanisms that would be allowable; however, the Agency is concerned that the mechanisms allowed by the States (e.g., trust funds, letters of credit, State fund) satisfy the overall ojbectives of financial assurance, i.e., to ensure that adequate funds are readily available to cover the costs of conducting closure, post-closure care, and corrective action for known releases if the owner or operator fails to do so. Therefore, the Agency is proposing in § 258.32(e) of today's rule a performance standard for financial assurance that must be satisfied to demonstrate financial assurance under § 258.32 (f), (g), and (h).

Under the performance standard, financial assurance mechanisms allowed by a State must: (1) Ensure that the amount of funds assured is sufficient to cover the costs of closure, post-closure care, and corrective action for

known releases when needed; (2) ensure that funds will be available in a timely fashion when needed; (3) guarantee the availability of the required amount of coverage from the effective date of these requirements or prior to the initial receipt of solid waste, whichever is later, until the owner or operator is released from financial assurance requirements under § 253.32(f), (g), and (h); (4) provide flexibility to the owner or operator; and (5) be legally valid and binding and enforceable under State and Federal law.

The financial assurance mechanisms authorized under Subtitle C and proposed under Subtitle I, if properly drafted, satisfy these performance criteria. Subtitle C allows the use of a trust fund, letter of credit, surety bond, insurance, financial test, corporate guarantee, State-required mechanism, State assumption of responsibility, or a combination of certain mechanisms to demonstrate financial assurance for closure and post-closure. (Insurance was not proposed for corrective action financial assurance under Subtitle C because the Agency determined that it would not be available.) The proposed Subtitle I regulations (52 FR 12766, April 17, 1987) allow a similar set of instruments to demonstrate financial assurance for corrective action and liability coverage. States may wish to refer to the background document for closure and post-closure care and financial responsibility (Ref. 4) for more information on the use of these mechanisms in other EPA financial assurance programs and guidance on how these mechanisms could be structured to satisfy the performance standard discussed below.

The financial assurance performance standard in today's proposal would require States to adopt a program under which the selected range of financial assurance mechanisms ensures that sufficient funds will be available to cover the costs of conducting closure, post-closure care, and corrective action for known releases whenever such funds are needed. In most cases, the amount of funds assured should equal the full amount of the current site-specific cost estimates for closure, post-closure care, and corrective action at the time the mechanism is established. For example, if a letter of credit issued by a bank is an allowable mechanism, its face value must equal the site-specific cost estimate. To minimize the burdens on small owners or operators who may have to set aside funds in a trust to demonstrate financial assurance, States may wish to adopt the approach used under Subtitle C. Under Subtitle C, an owner or operator is allowed to build up the trust fund over the life of the facility or over 20 years (10 years for permitted facilities), whichever is shorter. To meet the performance standard criteria under today's proposal, if a build-up period is allowed for trust funds, the State must require the trust to be fully funded no later than the end of the landfill's active life. States may wish to adopt stricter trust fund requirements (e.g., shorter build-up period, accelerated payments into the trust in the earlier years of operations) to avoid potential shortfalls if the MSWLF is closed earlier than expected. If a State chooses to develop a State fund to be used for the costs of closure, post-closure care, and corrective action for known releases, the size of the fund must be commensurate with the expected costs likely to be incurred to satisfy the performance standard.

To ensure that funds will be available when needed, States also may need to take into account potential legal and political constraints on accessing funds guaranteed by financial mechanisms. For example, because the U.S. EPA Regional Administrator does not have the authority to directly receive funds from third-party financial assurance mechanisms (i.e., all monies received must be directed to the U.S. Treasury), under Subtitle C a standby trust fund must be established when certain instruments are used (e.g., letter of credit and surety bond) to serve as a depository for the funds if the Regional Administrator draws on the instrument. Some States may face similar constraints in accepting funds directly from third parties and may need to establish standby trust fund requirements for certain mechanisms (e.g., letters of credit) to ensure that the State has access to the funds whenever they are needed.

Because of the long period between the initial establishment of the financial assurance mechanism and the time that the costs are incurred, the performance standard requires that the mechanisms guarantee continued availability of coverage until the owner or operator establishes an alternate financial assurance mechanism or is released from financial assurance requirements to avoid potential gaps in coverage. To ensure reliability over time, States should establish provisions that address contingencies such as (1) bankruptcy or incapacity of the financial assurance provider or the landfill owner or operator and (2) cancellation or termination of mechanisms by the provider. To prevent gaps in coverage in the event of these contingencies, States must ensure that owners or operators establish alternate financial mechanisms in a timely manner. For example, States could require that only after obtaining alternate assurance could the present mechanism be cancelled or terminated. States also could specify notification requirements and time limits for providing alternate financial assurance, similar to provisions under Subtitle C. Furthermore, States may wish to adopt provisions similar to Subtitle C regulations that require certain mechanisms to be automatically renewed unless an alternate financial assurance mechanism has been established, or else the third party offering the instrument becomes liable for the obligation. Finally, States must ensure that owners or operators of MSWLFs cannot terminate financial assurance at will, which could jeopardize the availability of funds when necessary. For example, Subtitle C requires that financial assurance cannot be terminated until after the certifications of closure or post-closure care have been received and approved.

In authorizing financial assurance mechanisms for demonstrating financial assurance, States should provide a range of mechanisms to provide owners or operators of MSWLFs with flexibility for demonstrating compliance while at the same time ensuring that they meet the regulatory requirements. For example, the Agency would not consider a program sufficiently flexible if that program restricted owners or operators to using only a financial test or insurance because such restrictions would likely impose a significant burden on much of the regulated community.

Finally, under the performance standard, the financial assurance mechanisms must be legally valid and binding. The validity of such mechanisms will largely be a matter of State law. However, to be legally valid, a financial assurance mechanism must be issued by an institution that has the legal authority to issue the mechanism and that is legally acceptable and/or regulated by a Federal or State agency. Financial assurance mechanisms also must be enforceable under State and Federal law. To help ensure that the mechanisms are enforceable, States may wish to specify wording for the mechanisms consistent with the regulations found in 40 CR 264.151. These mechanisms are discussed in a background document to this proposed rule (Ref. 4).

In proposing a financial assurance performance standard rather than specific financial assurance

mechanisms, the Agency has sought to minimize inconsistencies with the approximately 20 States that already have financial assurance requirements for MSWLFs. The Agency recently conducted case studies of nine such programs (Ref. 19). The study found considerable variation among State programs both in the types of mechanisms allowed and in the procedural requirements for the financial assurance mechanisms. For additional detail on the results of the case studies, see the financial assurance background document to this rulemaking (Ref. 19). Today's proposal is, therefore, designed to accommodate the variations among existing State programs, while ensuring that all programs meet the performance standard for financial assurance. The Agency requests comments on the proposed financial assurance performance standard, including the use of this standard rather than identifying a list of acceptable financial assurance mechanisms.

d. Financial Assurance Provisions for Local Governments. As noted in the previous section, the Agency is not proposing specific financial mechanisms in today's rule in order to provide maximum flexibility to the States. The Agency believes that the Subtitle C provisions can be used as models for States in developing their rules. Unlike Subtitle C, however, the majority of MSWLFs are owned by local governments. While Subtitle C allows a financial test to be used to demonstrate financial assurance, the test in 40 CFR 264.143 and 264.145 is designed primarily for corporate firms and is not directly applicable to local governments. Therefore, because of the large number of MSWLFs owned by local governments, the Agency considered for today's rule the feasibility of developing a financial test that would exempt local governments able to pass the test from having to obtain a third-party financial assurance mechanism (or contribute to a State Fund, if applicable).

A financial test designed specifically for local governments was considered during the development of the Subtitle C regulations but was not included due to difficulties in interpreting and verifying municipal accounting information, concern over the use of bond ratings as a measure of fiscal strength, and concern over the accessibility of allocated tax revenues. However, since the promulgation of the Subtitle C requirements, many local governments have developed more sophisticated financial management practices. Because of these changes, the Agency is examining possible approaches a State might use in developing such a test specifically for local governments. For example, the Agency is examining the feasibility of developing a special test that takes into account fiscal, institutional, and other factors. Although the Agency is not proposing a financial test for local governments in today's rule, the financial assurance background document discusses a framework that States may wish to use in specifying criteria for a financial test for local governments (Ref. 4). If a State decides to allow a financial test for local governments, the framework should be useful in choosing appropriate measures of a local government's financial strength.

The Agency requests comments on the use of a financial test for local governments. Specifically, EPA requests information on standards that might be used to measure a local government's financial strength, the measures that might be taken to establish such a financial test, and whether any States currently allow a financial test for local governments.

e. Financial Assurance Requirements. As noted in Sections 13.b and c, site-specific cost estimates are used to determine the amount of financial assurance required. The mechanisms used to demonstrate this amount of coverage must satisfy the performance standard specified in § 258.32(e).

The amount of closure financial assurance must be based directly on the most recent closure cost estimate adjusted for inflation in accordance with § 258.32(b). Financial assurance for post-closure care must cover the costs of conducting both phases of the post-closure care period for the entire landfill. The amount of financial responsibility required for each phase of post-closure care is calculated by multiplying the most recent annual post-closure cost estimate for each phase of post-closure care by the number of years in that phase. The sum of these two estimates is the amount of financial assurance required for post-closure care. This approach is similar to the Subtitle C calculation of the post-closure care cost estimate, in which the cost estimate is determined by multiplying the annual post-closure cost estimate by the number of years of post-closure care.

EPA is proposing in § 258.32(h) to require corrective action financial assurance for known releases in an amount equal to the most recent annual corrective action cost estimate in § 258.32(d) times the number of years required to complete the corrective action program. The Agency is proposing that financial assurance for corrective action be demonstrated after the cost estimate has been prepared in accordance with § 258.32(d), consistent with Subtitle C. Before adopting this timing requirement, the Agency considered the feasibility of requiring some minimal level of financial responsibility for corrective action as soon as the need for corrective action was demonstrated but before the corrective action measures and costs were determined. This latter approach has been proposed for Subtitle I because the statute requires financial assurance for corrective action for a specified amount ($1 million) before there is any known contamination. The Agency concluded, however, that it still does not have the data sufficient to estimate the cost of corrective action in advance and is delaying the requirement until a release has been detected and the estimates of costs have been developed. States may wish to require some level of financial assurance to cover the costs of interim measures that may be taken prior to the completion of the corrective action plan and the approved cost estimate.

Release from financial assurance requirements for closure, post-closure care, and corrective action is triggered by State approval of the certifications submitted to the State under §§ 258.30(e), 258.31(f), and 258.32(h). Following the receipt of the certification from the owner or operator that verifies that closure, post-closure care, or corrective action have been completed in accordance with the approved plans, today's rule proposes in § 258.32 (f), (g), and (h) that the State notify the owner or operator in writing that he no longer is required to demonstrate financial responsibility for these activities. If the State has reason to believe that the activities have not been conducted in accordance with the approved plan, it must notify the owner or operator and include a detailed statement of reasons for not releasing the owner or operator from the financial assurance requirements.

D. Subpart D—Design Criteria

1. Overview of Proposed Standards

a. New Units. Section 258.40(a) of today's proposal would require that new MSWLF units be designed with liner systems, LCS, and final cover systems as necessary to meet the design goal in the aquifer at the waste management unit boundary or an alternative boundary specified by the State. The two key components of this performance standard are the design goal, which is a human health- and environmental-based

ground-water risk level, and the point of compliance (POC) in the aquifer (i.e., the waste management unit boundary or an alternative boundary specified by the State). Today's proposal provides States considerable flexibility in establishing both of these key components. As discussed below, the State establishes the design goal within the protective risk range and also may set an alternative boundary as the point of compliance; however, this boundary shall not exceed 150 meters from the waste management unit and shall be located on land owned by the owner or operator of the MSWLF.

In this proposal the Agency is considering three alternative risk ranges. These are 1×10^{-4} to 1×10^{-7}, a fixed level of 1×10^{-5}, or an upper bound risk level of 1×10^{-4} (with States having discretion to be more stringent). EPA is proposing to use the range of 1×10^{-4} to 1×10^{-7} because the Agency currently uses this range in clean-up activities at sites and because this will provide a margin for consideration of site specific factors in setting the risk level. A fixed risk level of 1×10^{-5} would provide a uniform level of protection across all States. On the other hand, setting an upper bond risk level of 1×10^{-4} would allow States greater flexibility in establishing more stringent risk levels based on site specific conditions.

In its regulatory actions EPA generally uses a case-by-case approach, depending on the surrounding issues, uncertainties, and information bases. Such a case-by-case approach allows flexibility in judging the variety of factors and uncertainties included in the risk assessments. For example, the following risk levels have been embraced by EPA since 1984:

- The Superfund Clean-up policy—10^{-4} to 10^{-7}.
- Alternate Concentration Limits (ACLs)—10^{-4} to 10^{-7} with 10^{-6} target.
- Drinking water standards/ Maximum Contaminant Level (MCL)—10^{-4} to 10^{-6}.
- Pesticides in groundwater strategy—10^{-6} trigger.
- National Emission Standards for Hazardous Air Pollutants (NESHAPS)—10^{-2} to 10^{-6}.

The Agency intends to examine closely the nature of the Subtitle D universe while keeping in mind the capability of State programs and feasibility of achieving lower risks. The Agency requests comment on these alternatives.

The design goal is an overall ground-water carcinogenic risk level that must be established by the State. At a minimum, the goal must lie within the protective risk range; however, the States would, under any option, have the discretion to select a risk level that is more protective than the proposal. The focus for the design goal is on carcinogenic risk. Results of EPA's Subtitle D risk model indicate that carcinogens drive the risks posed by releases to ground water by MSWLFs. Non-carcinogens, along with carcinogens, will be addressed by the ground-water monitoring and corrective action programs.

The design goal is consistent with the requirements proposed today for determining the ground-water trigger levels (see proposed 258.52) and the ground-water protection standards (GWPSs) (see proposed 258.57(e)). However, unlike the trigger levels and the GWPSs, the design goal is not constituent-specific. Rather, the design goal represents the overall ground-water risk level (i.e., the combined risk from all constituents) that the State believes is necessary to protect human health and the environment.

The possible use of the risk range for a design goal is meant to give the States the flexibility to consider the practicable capability of the owner or operator in establishing design requirements.

The design goal (in conjunction with the point of compliance) is used to determine what design is necessary for the facility. For example, if 1×10^{-5} were chosen by the State as the design goal, the facility must be designed to prevent releases to the ground water that would cause the overall risk posed by the ground water to exceed 1×10^{-5} at the waste management unit boundary or alternative State-specified boundary.

Section 258.40(d) specifies that the State could establish an alternative boundary as the compliance point for a new unit; however, this alternative boundary cannot go beyond the 150 meters from the waste management unit boundary and must be on land owned by the owner or operator of the MSWLF. The State must consider at least the following factors in establishing this alternative boundary: (1) The hydrogeologic characteristics of the facility and surrounding land; (2) volume and physical and chemical characteristics of the leachate; (3) the quantity, quality, and direction of ground-water flow; (4) the proximity and withdrawal rate of the ground-water users; (5) availability of alternative drinking water supplies; (6) the existing quality of the ground water, including other sources of contamination and their cumulative impacts on the ground water; and (7) public health, safety, and welfare effects. EPA's intent in allowing States to establish alternative boundaries is to allow site-specific characteristics to be considered in meeting the design goal. For example, the State may wish to set an alternative boundary in situations where the aquifer is of low quality and has little or no potential for future use.

In considering the various factors specified in § 258.40(d) for establishing this alternative boundary, States will determine which factors are the most important at each facility and are provided the flexibility to use a different ranking system at each facility. The consideration of these site-specific factors should ensure that establishing the alternative boundary would not result in contamination of ground water needed or used for human consumption that would result in adverse impacts on human health or the environment. Such adverse impacts include contamination of drinking water supplies, degradation of sensitive ecosystems, or degradation of recreational areas.

EPA considered setting the maximum alternative boundary at the property boundary without a distance limit. However, under such an approach, great expanses of ground water could be contaminated before detection. EPA believes that this practice would, in effect, circumvent the intent of today's proposal. EPA chose a distance of 150 meters as the maximum alternative boundary to allow for consideration of the practicable capability of owners and operators and to allow for greater State flexibility in setting design requirements. The 150-meter limit also is expected to have minimum impact on existing facilities. The 150-meter value represents the third quartile (75th percentile) from the distribution of distances between the unit and property boundary for MSWLFs determined from EPA's facility survey results (Ref. 30). EPA also is proposing to require that the alternative boundary be located on land owned by the owner or operator of the MSWLF to prevent contamination of ground water off-site.

The consequence of giving States the flexibility to use a POC at a distance greater than the unit boundary is that it allows contaminant concentrations to diminish (due to degradation, dispersion, and attenuation) over distance and, thus, potentially decrease the stringency of design criteria needed to meet the design goal. In this manner, the alternative boundary provides States the opportunity to take into account the practicable capability of the facility owners or operators. For example, EPA estimates (based on risk modeling described later) that the percentage of new MSWLFs exceeding a 1×10^{-5} risk level drops from 43 percent at the unit boundary to 23 percent at 150 meters.

For the above reasons, EPA believes the 150-meter maximum alternative POC allows for consideration of the practicable capability of the regulated community and State flexibility in setting design criteria while ensuring protection of human health and the environment. The Agency requests comment specifically on the use of this distance to establish an alternative boundary.

In implementing today's proposed performance standard under § 258.40(a), States have two options. Under the first option, the State may establish a performance standard (including the design goal and point of compliance within the limits prescribed in § 258.40(a)) for each facility on a case-by-case basis. For example, after considering site-specific factors, the State may set a performance standard for one MSWLF that specifies a design goal of 1×10^{-5} risk to be met at the waste management unit boundary, while at another MSWLF, the State may require a design goal of 1×10^{-6} to be met at an alternative boundary. In setting this alternative boundary, the State must fully consider the factors specified in § 258.40(d).

Under the second option, a State may establish one performance standard (including the design goal and point of compliance) that applies to all MSWLFs in the State. For example, the State may elect to establish a performance standard that requires all new MSWLFs in the State to be designed to meet a risk level of 1×10^{-6} at the waste management unit boundary. If a State wishes to incorporate an alternative boundary (i.e., other than the waste management unit) into its State-wide performance standard, the State must carefully consider all the facility-specific factors required under § 258.40(d). The Agency believes that this method may be difficult in States that have a large number of MSWLFs.

Regardless of whether the performance standard is set on a site-specific basis or a State-wide basis, the State must still determine MSWLF designs that meet the performance standard. Section 258.40(d) requires the State to consider at least the following factors in determining the specific design necessary to meet the performance standard: (1) The hydrogeologic characteristics of the facility and surrounding land, (2) the climatic factors of the area, (3) the volume and physical characteristics of the leachate, (4) proximity of ground-water users, and (5) ground-water quality. Various methods for considering these factors and determining appropriate designs are discussed later in this preamble (see Part 5 of this section).

In certain cases, the State may find that MSWLF designs required under its existing regulations adequately meet a State-wide performance standard established in accordance with Subpart D of today's proposal. In such cases, the State may use its existing regulations to implement today's proposed requirements for new MSWLF design. The Agency specifically requests comments on the approach to State implementation of today's proposed § 258.40(a) performance standard.

b. Existing Units. The Agency is proposing a different performance standard for existing units than for new units. For existing units, § 258.40(e) of today's proposal would require installation of a final cover system that prevents infiltration of liquids through the cover and into the waste. In proposing a different standard for existing units, the Agency is taking into account the practicable capability of owners and operators of MSWLFs. EPA recognizes that most existing units have not been specifically designed to meet the design goal at the waste management unit boundary. However, some States have design and performance requirements for MSWLFs that, if properly implemented, may have resulted in landfill designs that are capable of meeting the design goal for new units. Further, MSWLFs constructed after the promulgation of the 1979 Criteria (40 CFR Part 257) should have been designed and operated to ensure that the concentration of contaminants introduced to the ground water did not exceed the MCLs specified in the Part 257.

EPA believes that to require existing units to meet the same performance standard as new units would seriously strain the resources of the regulated community. First, the data necessary to make the determination of whether the existing unit meets the design goal, such as the geology beneath the unit or the original design specifications, may not be readily available or may be very costly to obtain. This lack of information was evident in several of the case studies EPA reviewed in developing of this proposal. Second, if the design of the existing unit was determined to be incapable of meeting the design goal, retrofitting would be necessary. The Agency believes retrofitting for Subtitle D facilities should not be required because (1) the procedure is impractical because it requires the excavation and temporary storage or disposal of wastes, (2) the excavation of the waste may create its own set of public health problems (e.g., dangers to workers, contaminated run-off), and (3) such retrofitting would disrupt existing solid waste management activities. Retrofitting may be particularly disruptive if a large number of existing facilities are found to be unable to meet the design goal.

The final cover requirement for existing units could be met by a wide range of designs based on site-specific conditions. These designs range from a cap consisting of soils with adequate moisture-holding capacity, planted with the proper vegetative cover to handle the wettest month at this location and sloped to maximize surface run-off without causing significant erosion problems, to a cap containing a hydraulic barrier, such as a flexible membrane liner to prevent infiltration into the waste.

As with new units, many factors are involved in designing the final cover. These include precipitation, potential and actual evapotranspiration soil moisture holding capacity, vegetation, and run-off. There are several methodologies available that use these factors to estimate the amount of infiltration that may enter the waste. These methods are discussed in the background documents that support today's rule (Ref. 5).

2. Rationale for Proposed Approach

The primary goals of this rule are to establish standards that are protective of human health and the environment, provide flexibility to the States, and minimize disruption of current solid waste management practices by considering the practicable capability of the regulated community. The Agency believes that a performance standard approach for the design of MSWLF units best ensures that these goals can be achieved.

Today's proposed requirements would allow the owner or operator to take into account site-specific conditions when designing the unit to ensure that the concentration of contaminants at a specified compliance point (e.g., the waste management unit boundary) meets the design goal. Furthermore, use of a performance standard allows for the consideration of innovative technologies that may be developed in the future.

Today's performance standard would also provide States the flexibility to make the final decision as to how the standard would be achieved. Many States currently have standards that utilize a performance standard approach

for design of MSWLFs and strongly support the performance standard approach proposed today. The Agency believes that, in many cases, only minor modifications to existing State standards would be necessary to make them consistent with today's proposal. Therefore, EPA believes that the proposed standard allows consideration of practicable capability and will result in minimal disruption to State programs. A review of current State regulations is included in background documents supporting this proposal (Ref. 9).

a. Differences from Existing Part 257 Criteria. Today's proposed standard for MSWLFs is similar to the current requirements under 40 CFR 257.3–4, which prohibits Subtitle D facilities from contaminating ground water beyond the solid waste boundary or an alternative boundary specified by the State. There are, however, several major differences in today's proposal.

First, today's proposal specifically would require the owner or operator to design new units to meet a protective ground water risk level. (See discussion in Section IX.D.1.a. of today's preamble concerning the design goal and EPA's request for comment on alternative risk ranges.) Under the existing Criteria, if a facility contaminates the ground water, the facility is classified as an "open dump" and must be upgraded or closed under a State-approved compliance schedule. Today's proposal, by establishing a design goal tied to ground-water protection, is intended to be preventive rather than reactive.

Second, the proposed design goal is an overall risk level that encompasses risks from a comprehensive set of constituents (i.e., Appendix II), which form the basis of the ground-water protection standard. The standard for the existing Criteria is limited to the contaminants identified in the National Interim Primary Drinking Water Regulations (NIPDWRs), now National Primary Drinking Water Regulations (NPDWRs). The Agency recognized in the preamble when it promulgated the existing Part 257 Criteria that this list did not serve as a comprehensive ground-water quality standard because it did not include all potentially harmful substances that might be associated with leachate from solid waste. Today's proposal requires that an overall risk level (i.e., design goal) be selected and used in new unit design and that, during ground-water monitoring, a more comprehensive list of constituents (i.e., more comprehensive than the existing Part 257 Criteria) be used to ensure that the design goal is being met. This list includes many constituents that may be found in landfill leachate, thereby providing more protection to human health and the environment than the existing Criteria. This proposal is discussed in greater detail in Section IX.E of today's preamble.

Third, EPA is proposing to establish a maximum limit on the distance the alternative boundary may be from the waste management unit boundary. Under the original Criteria, the maximum limit for the alternative boundary was left to the State's discretion. The Agency has chosen to propose a limit of 150 meters from the unit boundary in establishing the alternative boundary. The site-specific factors to be used in establishing an alternative boundary that were identified in the original Criteria, however, have been maintained.

Fourth, today's action proposes ground-water monitoring and corrective action requirements for both new and existing municipal waste landfills. The monitoring requirements would allow continuous evaluation of whether facilities are complying with the design goal, while the corrective action requirements ensure that appropriate responses are taken to protect public health from exposure to contaminated ground water and minimize resource damage.

Finally, today's action proposes different design standards for new and existing MSWLF units, unlike the original Criteria, which established one design standard for both types of units. EPA made this decision for the reasons discussed earlier (e.g., practicable capability); however, when this different standard for existing units is considered in context with other requirements of the proposal (e.g., corrective action), the overall protection is the same.

b. Differences From Subtitle C Standard. There are two major differences between the current Subtitle C standards for hazardous waste landfills and today's proposal. First, the overall performance standard for the design of hazardous waste landfills is more stringent than the performance standard for MSWLFs. Subtitle C landfills must be designed to prevent hazardous waste or hazardous constituents from entering the surrounding soils and ground water. The proposed performance standard for MSWLFs, which would require that the design goal not be exceeded at the compliance point, allows the mitigating effects of the surrounding soils and aquifer material to reduce the concentrations of contaminants. The Agency believes today's standard is appropriate for MSWLFs because it allows for consideration of the practicable capability of the regulated community.

The second major difference between today's proposal and the current Subtitle C standards is the strict Subtitle C design standard. Although there are certain very stringent variances available, location characteristics (e.g., climate and hydrogeology) generally do not reduce the design requirements for Subtitle C facilities as they do under the Subtitle D proposal. Therefore, Subtitle C specifies one design (i.e., double liners, LCSs, and leak detection systems) for almost all locations, while the proposed Subtitle D performance standard would allow location characteristics to be considered when designing the MSWLF unit so that the location and design of the unit complement each other. This proposed standard would allow consideration of the practicable capability of the owner or operator.

3. Alternatives Considered

The Agency considered a number of alternatives to the design requirements proposed today. Various performance standards, uniform design standards (with and without variance provisions), location categories approach, and risk-based approach were considered in developing today's design requirements. The Agency requests comments on all the alternatives presented below. EPA specifically is interested in comments on the advantages and disadvantages of the alternatives in relation to today's proposed approach.

a. Other Performance Standards. EPA considered two alternative performance standards to those contained in today's proposal: (1) Require MSWLFs to be designed to meet the design goal at the unit boundary but make no allowance for an alternative boundary and (2) require MSWLFs to be designed to meet the design goal at the unit boundary or any alternative boundary specified by the State (current standard in 40 CFR Part 257). These alternatives were evaluated based on the potential extent of ground-water contamination that may result, ability to enforce the standard through citizen suits, the practicable capability for the regulated community to comply, and flexibility afforded the States.

The first alternative, requiring MSWLFs to meet the design goal at the unit boundary, would provide the greatest protection to ground water because, by strictly defining the point of compliance as the unit boundary with no alternative allowed, it limits the real extent of ground-water contamination.

This alternative could be enforced easily through citizen suits; however, this option does not allow consideration of the practicable capabilities of the regulated community and could limit State flexibility by not allowing States to consider site-specific conditions when determining the point of compliance. Further, by not allowing consideration of site-specific conditions, this alternative could result in over-regulation and could exceed the practicable capability of the regulated community to comply.

The second alternative, requiring MSWLFs to meet the design goal at the unit boundary or a State-selected alternative, would provide more flexibility to account for the practical capability of the regulated community. It would be less burdensome to the regulated community because site-specific factors could be considered, thereby avoiding over-regulation and increased costs; however, it would be less protective of ground water because it would allow for a greater area extent of ground water to be contaminated than the first alternative. This alternative also could be difficult to enforce through citizen suits because no one alternative boundary would be specified in the rule for all MSWLFs.

The Agency believes that today's proposal provides a balance of the positive aspects of the above alternatives. It limits the potential area extent of ground-water contamination by placing a distance cap on the alternative boundary. In addition, it provides State flexibility, minimizes the potential for over-regulation, and considers the practicable capability of the regulated community. Finally, it would be enforceable at the Federal level or through citizen suits because it would set limits at the point of compliance.

b. Uniform Design Standards. The Agency also considered establishing uniform design standards for MSWLFs. Under this approach, requirements for liners, LCSs, and final cover systems would have been delineated in the regulation and would have been the same for all units. This approach is the same as that used in the Subtitle C regulations. This approach can simplify permitting because the same specific design requirement applies to all units regardless of site-specific differences. The Agency rejected this type of standard for MSWLFs because it would not consider site-specific location factors nor the practicable capability of the regulated community to comply, resulting in possible over-regulation in some areas. Further, it would severely limit State flexibility.

The Agency also considered uniform design standards with variances to allow variation of designs based on site-specific factors. In particular, the Agency considered proposing for all new MSWLFs composite liner and leachate collection system requirements similar to those proposed today only for those MSWLFs that recirculate leachate or gas condensate. As stated previously, the composite liner system would consist of a flexible membrane liner as the upper component and a compacted soil layer as the lower component. The soil layer would be at least three-feet thick with a hydraulic conductivity of no more than 1×10^{-7} cm/sec. The leachate collection system would need to be constructed to maintain less than a 30-cm depth of leachate over the liner. A variance mechanism would be provided to allow use of alternative designs based on site-specific considerations. These variances would be based on the hydrogeological characteristics of the landfill, alternative operating methods, the resource value of ground water, the nature of the alternative design, and other factors. The combination of these factors would have to provide a level of environmental protection equal to the standard design.

The Agency recognizes that this approach would likely be easier to implement and enforce and may provide greater assurance of protection of human health and the environment than other options considered; EPA is not proposing this approach because of concern regarding the difficulty in granting variances and the resulting potential over-regulation of some facilities. The Agency also is concerned that this approach would limit the States' ability to adequately consider the practicable capability of the regulated community.

c. Risk-Based Algorithm. The use of a risk-based algorithm is based on the development of a predictive equation that can be used to determine, on a site-specific basis, the potential human health risks from a proposed landfill. Such an approach could be simple to implement and could incorporate a large number of site-specific factors; however, the development of a valid predictive equation is difficult and its reliability would be limited by the quality of data employed in it. Furthermore, one equation may not be appropriate for all site-specific situations.

d. Categorical Approach. Another alternative considered by EPA, which is described in detail in the next section of this preamble, is an approach that would categorize locations based on hydrogeologic and climatic conditions. Specific designs would be identified for each category, and methods for categorizing locations and their corresponding requirements would be specified. This approach would be relatively easy to implement and would allow the consideration of site-specific conditions. The approach allows the consideration of climatic factors and geologic conditions, but no aquifer characteristics and ground-water resource value. Also, this approach might not adequately account for the practicable capability of the regulated facilities to comply. In addition, this approach would restrict State flexibility by prescribing a methodology States would use in establishing design requirements for various locations. While EPA has not proposed this approach today, EPA also is presenting this approach, along with the risk algorithm, as possible methods for determining adequate designs for meeting the performance standard proposed in § 258.40(a).

The Agency recognizes that the choice of a particular type of standard is a very controversial decision and is interested in obtaining public comment on today's selection. The selection was based on an attempt to balance several factors including the practicable capability of the regulated community to comply, States flexibility in implementing Subtitle D regulatory programs, and Federal or citizen suit enforceability. Commentors may wish to consider additional factors when providing comment and/or submit other factors for EPA's consideration.

4. Implementation of Performance Standard for New Units

Today's proposal would require that new MSWLF units be designed with liners, LCSs, and final cover systems as necessary to meet the performance standard described above. The specific type of design needed would vary depending on the characteristics of the particular location. In some settings, comprehensive liners and LCSs would be needed, whereas in other settings, minimal engineering controls may be needed. This section provides a brief background on engineering controls and describes various methods for determining the landfill design necessary to achieve today's proposed performance standard.

a. Overview of Engineering Controls. The purpose of lining an MSWLF unit is to prevent leachate from seeping from the site and entering the aquifer. A liner is a hydraulic barrier that prevents or

greatly restricts migration of liquids, thus allowing leachate to be removed from the unit by the LCS. Liners function by two mechanisms: (1) They impede the flow of leachates into the subsoil and to the aquifer and (2) they adsorb or attenuate pollutants thus retarding the migration of contaminants. This adsorptive or attenuating capability is dependent largely upon the chemical compositions of the liner material and its mass. Most liner materials function by both mechanisms but to different degrees depending on the type of liner material and the nature of the liquid to be contained. Liners may be grouped into two major types: synthetic (flexible membrane liners) and natural (soil or clay liners).

Flexible membrane liners are the least permeable of the liner materials, but have little capacity to attenuate dissolved pollutants. Natural liners can have a large capacity to attenuate materials of different types, but they are considerably more permeable than the FMLs. Both types of liner materials can prevent or limit leachate migration out of the MSWLF.

A review of the MSWLF case studies identified various types of liners currently being used, including compacted native and imported soils, compacted mixtures of native soils and bentonite, and FMLs. The liner designs used varied somewhat from region to region.

In landfills designed with liners, a leachate collection and removal system is necessary to relieve the hydraulic pressure within the landfill. Without a collection and removal system, the leachate will accumulate, increasing the driving force for migration through the base of the fill. Leachate could eventually back up into the unit (i.e., the "bathtub" effect), resulting in seepage near the surface and possibly affecting surface waters or other receptors. Collection systems also may be needed when a landfill is located in saturated soils. Water from this saturated material eventually will seep into the waste and generate leachate if not removed by an LCS.

The collection and removal of leachate from the unit will assist in meeting the overall performance goal for the unit. An LCS generally consists of perforated drain pipe installed in gravel-filled trenches above the liner at the base of the unit. The collection system is drained by gravity to a sump or series of sumps from which the leachate is withdrawn for treatment or disposal. Additional details on the design and construction of LCSs can be found in "Lining of Waste Impoundment and Disposal Facilities" (Ref. 36).

The Agency believes that placement of a final cover over closed portions of an MSWLF is necessary to: (1) Minimize infiltration of rainwater; (2) minimize dispersal of wastes by human, animal, or physical interactions; and (3) minimize the need for further maintenance at the facility during the post-closure period and beyond. The types and amounts of cover material needed to accomplish these goals and to achieve compliance with the design goal are highly dependent on the location of the landfill. The amount of infiltration of water into the final cover and any subsequent percolation through the waste can be affected by surface conditions such as soil type, soil thickness, final grade, type of vegetation, and climatic factors such as amount of precipitation, temperature, and evapotranspiration. For example, in areas with limited rainfall and high evapotranspiration, minimizing infiltration may be achieved by: (1) Grading the unit in such a way as to promote run-off, (2) using the proper type and thickness of soil to maximize moisture-holding capacity, and (3) establishing vegetation to promote plant transpiration of water. In areas of high rainfall and low evapotranspiration, these design factors may not substantially reduce the amount of water entering the waste after closure. In such cases, additional design factors, such as hydraulic barriers, either synthetic or compacted soils, and/or drainage layers, may be required in the final cover to reduce infiltration to acceptable levels. Further information on the design of cover systems is available in a background document (Ref. 5).

b. Methods for Evaluating Designs. Today's proposal does not prescribe a single method for designing a facility to meet the performance standard. Because the Subtitle D program is implemented by the States, the Agency believes that the appropriate method for implementing the design performance standard is best determined by the States; however, EPA is providing guidance on three methods for determining what design is necessary to comply with the performance standard (i.e., to meet the design goal at the point of compliance). These methods include: (1) A risk-based algorithm, (2) a categorical approach, and (3) an empirical method. A fourth method not discussed involves using a State-selected risk model. Although this last method is not described, the data needed and assumptions made for the risk-based algorithm may be similar to what would be necessary for the State-selected risk model.

For the risk-based algorithm (and the State-selected risk model), the design goal is expressed as a risk level. The risk level selected as the design goal is not directly involved in applying the categorical approach but is used to determine compliance and to establish clean-up levels for corrective action. The categorical approach presented today is based on preventing any leachate from migrating to the aquifer. Because of this no-migration concept, this approach is generally more conservative than the risk-based algorithm and in some cases would require more extensive engineering controls than would be determined from the risk-based algorithm.

The empirical methodology uses historical ground-water monitoring data to assess the effectiveness of existing designs in meeting the design goal. The ground-water monitoring data would be used to calculate a risk level that would be compared to the design goal.

These three methods are described below and in more detail in the background document on facility design (Ref. 5). EPA plans to issue a guidance document addressing facility design after the final rule is promulgated.

(1) Risk-Based Algorithm. Using the Subtitle D Risk Model, EPA derived an algorithm that characterizes a site's potential for ground-water contamination. This algorithm uses information on a facility's potential leachate release rate and the characteristics of the site's hydrogeology to estimate the level of ground-water contamination that would result from an MSWLF operating at that site. The level of contamination is represented in the algorithm by the excess lifetime cancer risk associated with human consumption of ground water at the landfill's compliance point. States and landfill owners or operators can use this algorithm as a screening tool to determine whether a new MSWLF at a given site is likely to achieve compliance with the State-established design goal if constructed with no bottom liner and a vegetative cover. The risk-based algorithm cannot be used to analyze the reduction in human health risks that would be achieved through the use of more stringent control technologies.

The steps involved in using the risk-based algorithm are displayed in Figure 1. The State would establish the design goal that is tied to the trigger levels for hazardous constituents specified in § 258.56 for the landfill. If the calculated risk is lower than the design goal, this would imply that the proposed landfill

would be in compliance with the performance standard. If the calculated risk exceeds the design goal, the owner or operator could choose a new site for the landfill, change the proposed dimensions of the landfill, or employ more stringent control systems (e.g., bottom liners, leachate collection systems, different cover types). The effects of changes in location on risk potential could be calculated using the risk-based algorithm, while the effects of more stringent containment and cover systems could not. EPA recommends that a more rigorous State-selected assessment (either risk- or technology-based) be used to specify the mix of containment and cover system components capable of meeting the design goal.

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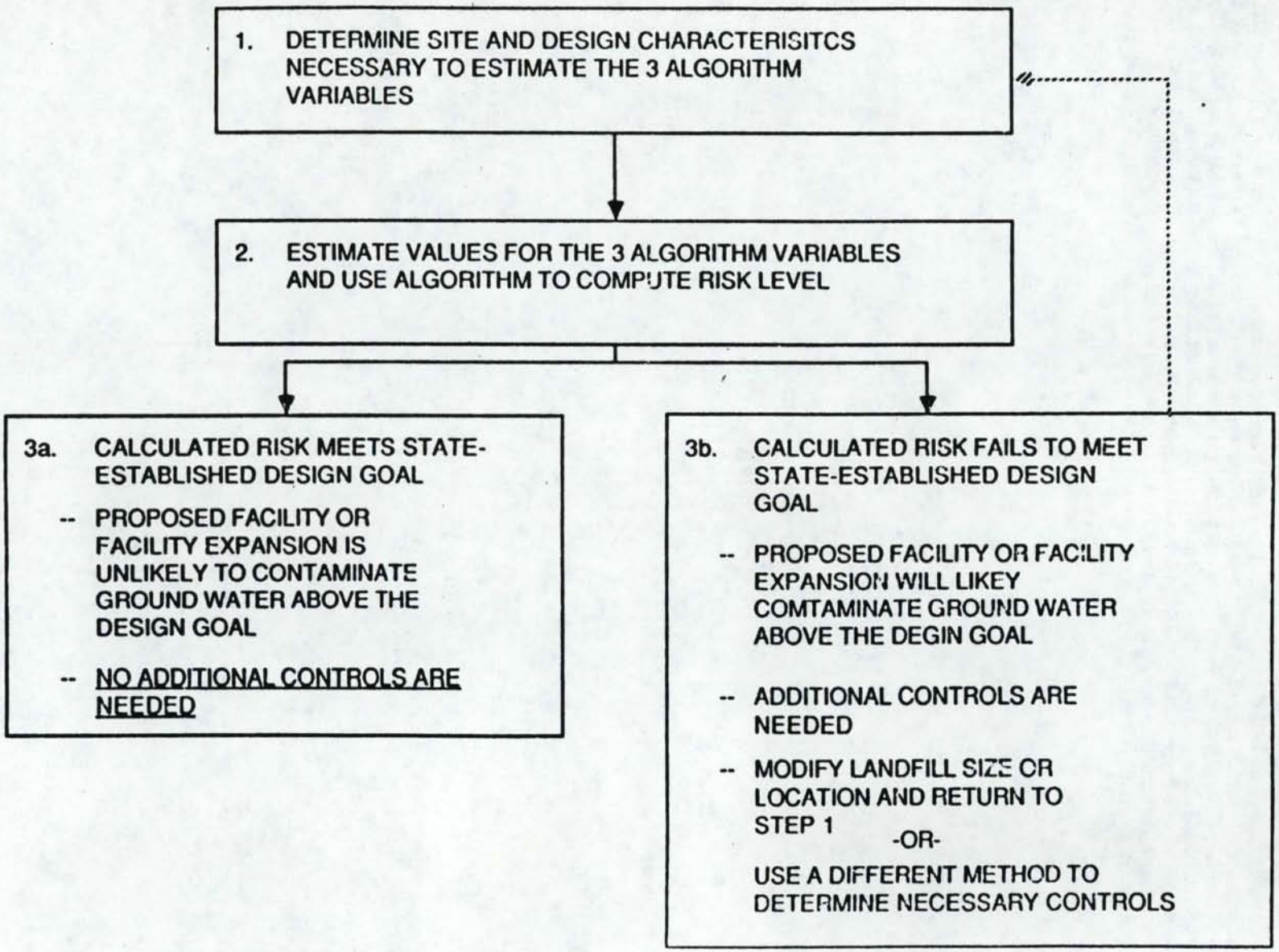
FIGURE 1

APPLICATION OF RISK-BASED ALGORITHM



The risk-based algorithm is as follows:

$$R = 4.5 * 10^{-4} \{Q_R/Q_A\} * e^{(TOT)(-0.028}$$

where:

R = lifetime risk posed by consumption of ground water at designated compliance point.

Q_R = predicted leachate release rate to the uppermost aquifer, m^3/yr.

Q_A = ground-water flow rate for the uppermost aquifer, m^3/yr.

TOT = time-of-travel for leachate in this aquifer from the unit boundary to the compliance point, years (TOT = 0 for unit boundary compliance point).

In essence, the risk-based algorithm states that the risk associated with ground-water contamination from an MSWLF is a function of the rate of leachate release from the site and the attenuation (i.e., dispersion and degradation) of this leachate in the aquifer. Q_R represents the annual leachate release rate, while Q_A and TOT account for the dilution, dispersion and degradation of contaminants in ground water. Methods for calculating Q_R, Q_A, and TOT are described later.

EPA acknowledges several limitations of this approach. First, this approach is dervied by assuming that the MSWLF risk results produced by the Subtitle D Risk Model represent "true" risks and fitting a simplified mathematical model (i.e., the risk-based algorithm) to these results. The Subtitle D Risk Model is currently unverified for predicting ground-water contamination resulting from MSWLFs. However, EPA believes the model is technically correct and believes that it can adequately characterize the risk from MSWLFs.

Second, the approach assumes that the leachate produced from a particular landfill will have a composition and constituent concentrations similar to that used in the Subtitle D Risk Model. The initial leachate constituent concentrations used in the model represent the median concentrations for six constituents found in samples of leachate from numerous MSWLFs (see Section XI of preamble). (A complete discussion of the leachate constituent selection process, including the dose-response parameters used for the constituents, is contained in the draft Regulatory Impact Analysis.) The risk-based algorithm should not be used for proposed MSWLFs that have expected leachate characteristics substantially different from those used in the Subtitle D Risk Model. EPA recommends that, at these landfills, a State-selected Risk Model or other approach be used.

Third, the risk-based algorithm never predicts risks higher than 4.5×10^{-4}. This value was derived from the Subtitle D Risk Model results for approximately 500 distinct combinations of landfill size, environmental and hydrogeologic setting, and exposure distance. In about 5 percent of these scenarios, the modeled risks were higher, although none exceeded 10^{-3}.

Fourth, although the risk-based algorithm is relatively powerful in a statistical sense (i.e., its predicted risks correlate well to the Subtitle D Risk Model's predicted risks), its use introduces some additional uncertainty.

The State might account for some of the uncertainty in the approach by setting the risk-based algorithm goal somewhat lower than the actual design goal. For instance, if the State determines that the actual design goal should be 1×10^{-4}, it could state that any MSWLF with calculated risks exceeding 1×10^{-5} would be required to perform a more detailed site-specific assessment. Such a margin of safety (in this example, one order-of-magnitude) would allow the States and owners and operators to identify low-risk MSWLFs relatively quickly and focus more effort on borderline or high-risk MSWLFs. EPA recommends that the States determine the acceptable margin of safety between the risk-based algorithm-predicted risk and the design goal.

Fifth, the risk-based algorithm does not apply to sites with complex hydrogeology. The ground-water concentrations in sites characterized by fractured, folded, or faulted rock, karst terrain, tidally-induced changes in ground-water flow, or similar complex conditions are not represented in the underlying Subtitle D Risk Model, and thus the risk-based algorithm does not predict them. In these conditions, EPA recommends more sophisticated analytical techniques be used.

Sixth, characterizing the variables needed to solve the algorithm for an individual site may be both costly and difficult. However, some simple methods are available to make these determinations, as discussed later.

These limitations thus relate to the ease of implementation and the uncertainty embodied in the approach. EPA has attempted to propose the risk-based algorithm in a form that strikes a reasonable balance between the desire for accuracy and certainty on the one hand, and timely, moderate-cost implementation on the other.

In order to develop the risk-based algorithm, the Agency identified from case studies, damage cases, field observation, Subtitle D risk modeling results, and other sources several environmental factors that affect leachate generation, leachate release, migration, exposure, and risk. These factors include landfill size, net infiltration, subgrade permeability, depth to ground water, aquifer flow rate, and time-of-travel from the unit to a potential exposure point. Using the list of key environmental factors, EPA conducted an analysis of variance (ANOVA) and a regression analysis. The ANOVA allowed EPA to determine the importance of each of the environmental variables in explaining the variation in the predicted MSWLF's risk. The regression analysis, coupled with an understanding of the physiochemical processes that affect risk, allowed EPA to establish a simple equation, using the key environmental variables identified in the ANOVA, to predict a facility's risk.

For the purpose of the ANOVA and regression analysis, EPA used the risks predicted from the Subtitle D Risk Model. For this application, the model simulated approximately 500 exposure scenarios comprising unique combinations of infiltration rates, facility size, depth to water table, hydrogeologic conditions (aquifer velocity and configuration), and exposure point. For each scenario, EPA predicted the highest lifetime health risk that would be experienced over a 300-year simulation period.

In establishing the importance of the environmental variables, the Agency generated a series of ANOVA tables displaying the relationship between the identified (independent) environmental variables and risk, the dependent variable. The ANOVA tables provided EPA with a means to evaluate the strength of the association between risk and the various independent variables.

The ANOVA results indicated that none of the environmental variables alone explains more than 10 percent of the variability in risk. EPA then combined some of the related variables to test the relationship between risk and three "top" parameters: leachate flux (Q_R), aquifer flux (Q_A), and TOT. Q_R is a function of several variables including the facility size, the infiltration rate, and the subgrade permeability. Q_A is a function of the aquifer velocity (i.e., permeability and hydraulic gradient), aquifer thickness, and effective porosity. It accounts for the dilution and attenuative capacity of the aquifer, and is measured at the downradient point of compliance. TOT is a function of the aquifer velocity and distance to the downgradient compliance point. Using these "top" parameters, EPA analyzed several forms of the equation used to predict MSWLF risks.

As with most regression equations, the chosen algorithm omits some independent variables that could increase the explanatory power of the model; however, EPA believes that it is better to use fewer variables and keep the classification scheme simple. EPA believes that the relationship is conceptually valid and realistically depicts the actual physical relationships between these parameters.

To apply the risk-based algorithm at a given site, the owner or operator must calculate three variables: leachate flux (Qr), aquifer flux (Qa), and ground-water TOT. Several methods exist for calculating TOT, Q_A, and Q_R. TOT equals the distance between the landfill unit boundary and the compliance point; this distance is then divided by the ground-water velocity. Thus, TOT will equal zero whenever a unit boundary compliance point is selected. Calculation of ground-water velocity requires either field measurement or obtaining estimates of hydraulic conductivity, hydraulic gradient, and effective porosity from available literature. Ground-water velocity equals KI/n, where K is the hydraulic conductivity, I is the hydraulic gradient, and n is the effective porosity.

Q_A also can be determined either by field measurement or by empirical calculation. Q_A equals KIA, where K is the hydraulic conductivity, I is the hydraulic gradient, and A is the cross-sectional are of the aquifer.

Q_R can be calculated as the product of the surface area of the MSWLF and the annual recharge. The surface area of the landfill can be taken from site maps and plans. Recharge can be estimated either empirically or through use of a water balance method. EPA recognizes that this approach of calculating Q_R does not account for the potential effects of low-permeability wastes or subgrades in limiting the rate at which leachate can be released from a landfill. In most cases, the leachate release rate will be limited by the recharge rather than the permeability of the waste or the subgrade.

EPA realizes that the cost of estimating values for some of these variables can be high, depending on the method used. EPA believes, however, that at least some of these costs would be incurred independently of the use of the algorithm (e.g., hydrogeologic studies).

EPA requests comments on this approach, particularly on the utility of the approach; the difficulty in implementing it; the leachate characterization; environmental transport; the technical accuracy of the risk-based algorithm; and methods for addressing the uncertainty inherent throughout the risk assessment that is the conceptual foundation for this approach.

(2) Categorical Approach. The categorical approach is an engineering approach for determining whether a facility will meet the performance standard and is based on the ability to match location characteristics to specific design requirements. The intent is to present a simplified methodology that accounts for liquid migration in the overburden (the material between the bottom of the unit and the top of the aquifer). The categorical approach is designed to achieve minimal releases to the aquifer, which is somewhat more stringent than the performance goal proposed today (i.e., meet design goal at unit boundary or alternative boundary). A relative comparison of the (estimated) necessary designs, costs, and benefits of the categorical approach to the proposal is contained in the draft Regulatory Impact Analysis.

The approach uses two basic elements. First, the design selected for use during the active life, takes into account local hydrogeologic and climatic conditions to prevent liquids from reaching the aquifer. Second, at closure, a final cover system is used that minimizes the generation of leachate by preventing the infiltration of liquid into the waste. The Agency recognizes that the final cover will not stop leachate from migrating to the aquifer, but the final cover will minimize the amount of water that moves through the waste into the aquifer. By reducing the amount that enters the aquifer, EPA believes that the performance standard specified in § 258.40(a) can be met because the dilution and attenuation that occurs in the aquifer will reduce the concentrations of the small amounts of contaminants that escape the landfill.

Because the categorical approach seeks to minimize constituent releases to aquifers, it is conservative approach to designing facilities to meet today's performance standard. The State and the owner or operator should be aware of this when using this approach to identify designs necessary to meet today's performance standard.

The categorical approach is based on the potential for contaminants in leachate to migrate from the MSWLF. Leachate is formed by rainwater and other liquids percolating through the solid waste in the landfill. Different hydrogeologic and climatic settings influence both the rate at which leachate is generated and the potential for leachate to escape from the unit and eventually reach ground water. Under this approach, location categories are established based on the migration potential of water from the landfill unit. Once the location categories are defined, design requirements are specified to offset the effects of "poor" locational factors to counteract the rapid movement of contaminants from the MSWLF to the aquifer that these "poor" locations promote.

Under this approach, locations are categorized based on the climate and geology, which determine the potential for contaminants to migrate into the aquifer. In developing this approach, climate and geology were evaluated to determine their contribution and importance to the generation and migration of leachate from landfills. Because this approach is based on preventing the migration of leachate to the aquifer during the active life of the unit, aquifer characteristics do not play a role in the selection of design requirements necessary to meet the design standard.

(a) Climatic Factors. The Agency believes that climatic conditions are key factors in determining the rate and amount of leachate that will be generated in an MSWLF unit. The climate of a particular area is dependent upon the interrelationships of numerous conditions. The factors that the Agency evaluated in developing the categorical approach are: Precipitation, potential evaporation, potential evapotranspiration, temperature, and run-off. Each factor is discussed briefly below.

Precipitation normally is expressed as the amount of rainfall and snowfall that occurs at a specific location. Precipitation is the primary climatic factor affecting the generation of leachate at landfills. When precipitation enters a landfill, it infiltrates the wastes and dissolves contaminants to form leachate. As more leachate is formed, hydraulic head is built up at the base of the landfull that acts as a driving force for migration to the subsurface. Both the rate and degree to which this process occurs will vary, based on the location of the MSWLF.

Potential evaporation (PE), measured as pan evaporation, is normally expressed as the amount of water that potentially will evaporate from a free water surface at a specific location. This factor often is similar to lake evaporation and is not representative of MSWLF conditions. Potential evapotranspiration (PET) is normally expressed as the potential amount of water that will evaporate from soil surfaces and transpire through plants at a given area. Normally, PET is lower than PE in a given area. Temperature

plays an important role in potential evaporation and potential evapotranspiration for a given location; the values for these factors incorporate the effects of temperature.

Run-off, although not a climatic factor, normally is expressed as the amount of water that will migrate from the site in the form of overland flow. Major land surface conditions affecting surface run-off include topography, cover material, vegetation, soil permeability, antecedent soil moisture, and artificial drainage.

In order to achieve the overall goal of this methodology (preventing leachate from reaching the aquifer during the active life of the unit), it is necessary to determine the factor or factors that best represent the potential amount of moisture available for entering the waste, thereby generating leachate. The Agency evaluated the above factors to determine which factor or factors best characterized the climatic elements relevant to leachate generation. The objective of the evaluation was to determine the potential for leachate generation during the active life of a unit. As stated earlier, the Agency believes that once the MSWLF is properly closed and covered, leachate generation should be minimal. No single factor or combination of factors could be found that adequately characterized climatic elements such that leachate generation during the active life could be estimated. EPA, therefore, selected a simple two-step process that can be used to categorize locations based on climate. This process uses mean annual precipitation as the factor in the first step.

The first step of the process requires that the mean annual precipitation (P) for an area be determined. P was chosen because: (1) It is easily determined, (2) it does not necessarily require the collection of new data, and (3) it conservatively describes the amount of water potentially available for infiltration and leachate generation. Using P conservatively estimates the amount of leachate formed because it does not consider evaporation or run-off. Values of P can be obtained from the National Weather Service, the National Oceanographic and Atmospheric Administration (NOAA), and/or USGS Water Atlases. These sources have collected rainfall data over extended periods of time, so values from these sources should be representative of annual rainfall in an area.

The Agency believes that there is a relationship between precipitation and leachate generation. Based on an evaluation of MSWLFs in different climatic settings, EPA has concluded that areas that receive more than 40 inches or precipitation per year generate leachate in quantities sufficient to warrant collection. Therefore, under the categorical approach, units located in areas that receive more than 40 inches of precipitation annually would be required to have leachate collection. For areas that receive less than 40 inches of precipitation per year, the evaluation indicates that leachate may not always be generated in amounts necessitating collection. Therefore, the second step of the process is to estimate the amount of leachate formed in areas receiving less than 40 inches of precipitation to determine if enough leachate is generated to warrant collection.

This estimate incorporates factors that determine the potential for leachate accumulation at a specific landfill. The factors used include P, PET, actual evapotranspiration, soil moisture holding capacity, waste moisture holding capacity, and run-off. Because MSWLFs are ongoing construction projects, the relationship among these factors relative to leachate accumulation continually changes. Therefore, a demonstration method that evaluates the potential amount of leachate accumulation at different stages of landfill construction is necessary. Under this method, the evaluation would be based on the projected landfill configuration at the end of each operating year. The Agency believes that some facilities in low precipitation locations may be able to eliminate the need for leachate collection by adjusting operational characteristics of the site.

The following steps are needed to determine when an LCS is necessary:

Step 1: Estimate topographic contours of the unit at the end of each operating year throughout the active life until final cover has been installed.

Step 2: Compute the quantity of leachate generated for each year of active life using the water balance method. This step may require dividing the landfill unit into discrete areas to take into account differing grades and variations in surface run-off. If so desired, the moisture-holding capability of soil layers used for cover could be considered. Most active portions of a landfull will have no vegetative cover, so moisture loss by evapotranspiration should not be considered in the water balance calculation. Moisture loss from active portions should be accounted for by using estimates of evaporation from bare soil as described in an EPA guidance document (Ref. 35).

Step 3: Calculate the total accumulation of leachate at the base of the unit by adding the amount of leachate generated to the amount predicted for each previous year.

Step 4: If total accumulation of leachate at the base of the unit (as determined by Step 3) exceeds or equals one foot at any stage of the landfill construction, an LCS is necessary. For example, for a unit that has a three-year active life: for year one, it is estimated that one foot of field capacity of the waste remains and no leachate is generated. For year two, it is determined that one foot of field capacity remains and, again, no leachate is generated. However, for year three, before final cover is installed, it is determined that field capacity for the portion of unit planned to be built that year will be exceeded and four feet of leachate will be generated. Presuming that the year three portion of the unit is on top of the year two and year one portions of the unit, the total effect will be to negate the unused moisture holding capacity of the previous two years and result in a head build-up of two feet at the base of the unit, which is sufficient to require the installation of an LCS. This method is further discussed in the backgound document supporting this proposal (Ref. 5).

(b) Geologic Factors. The nature and extent of the geologic material underlying a given MSWLF site strongly influence the fate of any leachate generated. The categorical approach estimates the effects of various geologic materials based on the time it takes water to move through the material above the aquifer. Because leachate is an aqueous solution EPA believes it is reasonable to model water movement rather than leachate movement in the subsurface. The Agency believes this simplifying assumption is conservative. This simplified approach does not include consideration of the variability of MSWLF leachate over time. Also some factors that retard constituent movement, such as absorption, chemical precipitation, degradation, and attenuation, that can result in slower movement of the constituent than the solute (i.e., water) are not a part of this simplified approach. Therefore, the Agency believes that considering only the rate of liquid movement is a conservative approach.

Certain geologic characteristics control the rate at which leachate will migrate to the aquifier. For the categorical approach, the rate must be determined so that design features can be added when the natural conditions do not give adequate protection to the aquifier. The geologic factors evaluated included the following: Depth, saturated

hydraulic conductivity, effective porosity, and linear velocity.

Depth (D) refers to the thickness of the geologic material between the bottom of the unit and the top of the aquifer. This zone is referred to as the overburden. Saturated hydraulic conductivity (Ksat) is a measure of the ability of porous media (soils or rock) to transmit liquids under saturated conditions. Effective porosity (N_e) is a measure of the interconnected pore space in the geologic material. Porosity has a controlling influence on the linear velocity of water in the overburden media. Linear velocity (V) is the speed at which ground water travels in the subsurface under saturated conditions.

Different methodologies were evaluated that could be used to estimate the time for liquids to migrate through the overburden to the aquifer, known as time of travel (T) to the aquifer. The methodologies involve: (1) Calculation of T based on a detailed time-of-travel measurement through the overburden (for saturated and unsaturated geologic material) using the approaches prescribed for determining vulnerable hydrogeology under Subtitle C (Ref. 11), (2) calculation based on Darcy's law, expressed as T=D/Ksat, (3) calculation to T=D/V (based on the linear velocity of water in the overburden with an assumed hydraulic gradient of one), and (4) a wetting front approach for unsaturated soil only.

The detailed time-of-travel analysis results in the most accurate prediction of when leachate may reach the aquifer under ideal conditions; however, it is very data-intensive and complex, particularly for unsaturated conditions. It also requires the development of flow nets.

The second and third methods are more straightforward because the necessary data are readily available from literature and field tests. Because of their simplicity, these methods could be used to pre-screen locations with data available from the literature. These data should be verified by field tests prior to site design because field verification is necessary to ensure that site-specific conditions match conditions predicted by the literature.

D-Ksat is the simpler method to use because it needs only two easily obtained pieces of data: Saturated hydraulic conductivity and depth. Numerous methods are available for determining saturated hydraulic conductivity. For example, in fractured consolidated rock, pressure tests or falling head tests can be used to evaluate Ksat. In unconsolidated materials, constant head gravity tests are commonly used. These and other methods are available and documented. It is important, however, to ensure that the proper methods are used in the material being evaluated. Depth may be obtained easily from a preliminary subsurface exploratory program and/or from boring and drilling logs from surrounding areas.

The third method, D/V, is believed to be more accurate than the second method because the velocity (V) incorporates effective porosity (N_e) in the calculation. As mentioned above, effective porosity is a measure of the interconnected pore space in geologic material. It can be an important controlling influence on hydraulic conductivity (and thus rate of flow) in both unconsolidated and consolidated formations. Porosity values range from 0 to 5 percent for dense crystalline rock, 25 to 40 percent for gravel, and 40 to 70 percent for clay. In fractured rock, secondary porosity also must be considered. When determining the porosity of the overburden at a specific site, both primary and secondary porosity should be considered as warrented.

Although more accurate than D/Ksat, the D/V method has some features that make it less accurate than the detailed time-of-travel calculation discussed earlier. First, it assumes that the hydraulic gradient (a major influence on ground-water velocity) is equal to one. This assumption will result in a conservative time-of-travel value (i.e., the actual time may be longer). Second, it assumed fully saturated conditions, which in most cases will result in a conservative value.

The fourth method involves a wetting front equation and may be a better predictor of flow in the unsaturated zone. The method requires the collection of more data than either the second or third method. This method is based on equations developed for infiltration of water into dry soil and applies simplifying assumptions to calculate the time of travel. The equation used to calculate the time of travel is given as:

$$T=(LWr)/q$$

where:

T=time of travel (T).
L=length of the unsaturated zone (L).
Wr=change in moisture content from soil behind the wetting front to dry soil ahead of the wetting front.
q=infiltration rate (L/T).

The length of the unsaturated zone (L) can be determined from boring logs and piezometer measurements. Moisture content behind and ahead of the wetting front can be calculated, and, therefore, Wr can be determined from field measurements or estimated from empirical equations. The infiltration rate is (q) approximated by using the net precipitation.

The principle assumption of this approach is that there exists a distinct and definable wetting front, and that behind the wetting front the soil is uniformly wet and of constant conductivity. The wetting front approach is applicable for a limited range of conditions. In particular, the approach is useful when a constant water flux is applied to initially dry soil. The approach may not be applicable for soils that are initially moist or that are uniform in moisture content under natural infiltration conditions. The principle value of the approach is in predicting unsaturated flow.

The Agency believes that the D/V method of calculating T is conservative and easy to calculate. The categorical approach assumes saturated flow because the available methodologies that can be used to estimate the flow time of water through unsaturated materials are complex and require extensive data collection. Calculating the time of flow for saturated materials involves less complex equations and requires fewer resources to obtain the required data inputs. Furthermore, the use of saturated conditions is generally conservative in predicting time-of-travel in the overburden because, for the most part, K values increase as soil moisture content increases for a given soil type. The Agency recognizes that in certain unsaturated soils, particularly clays, saturation may not be a conservative assumption. Initial breakthrough of leachate, in small amounts, may occur prior to the prediction, assuming saturation. For the purpose of categorization, EPA believes that it is more important to predict when a major amount of leachate may enter the aquifer. However, the owner or operator has the option of using an alternative method, including the detailed Subtitle C time-of-travel calculation or the wetting front approach.

Under this simplified approach (D/V method), the value selected for T can be used to determine which locations require liners and the type of liner that may be required. The methodology is based on the active life of the unit. A value of T equal to or greater than the active life of the MSWLF unit is classed as "long" and a T less than the active life as "short." A minimum cut-off value for T of 20 years has been selected because a minimum T precludes the siting of short duration units in relatively poor locations. This minimum value of 20 years for T was chosen because the average active life of a

facility is approximately 30 years, and a facility usually consists of more than one unit. EPA therefore selected 20 years as the average life of a unit. T values that are long when compared to the active life of the unit would not need liner systems, while units with T values shorter than the active life of that unit would need liners.

The T value should be determined for each unit rather than for an entire facility. For example, an MSWLF may have a total life of 50 years but comprise several units with active lives less than 50 years each. The T for each of these units is a separate calculation.

(c) Relationship to Design Requirements. Combining P and T values results in a matrix comprising four blocks that correspond to separate categories, as shown in Figure 2. Each location category describes a hydrogeologic and climatic setting with unique characteristics that affect landfill design. For example, Category I has both good climatic characteristics for a landfill (limited precipitation indicated by the low P) and good hydrogeology (acceptable overburden characteristics evidenced by high T value). On the other hand, Category IV represents locations with poor climate and hydrogeology that require specific landfill designs (liners and LCSs) to compensate for the poor locational characteristics. The two key measures of precipitation and time-of-travel to the aquifer are used not only to establish the location categories, but to identify the landfill design requirements needed for a particular location.

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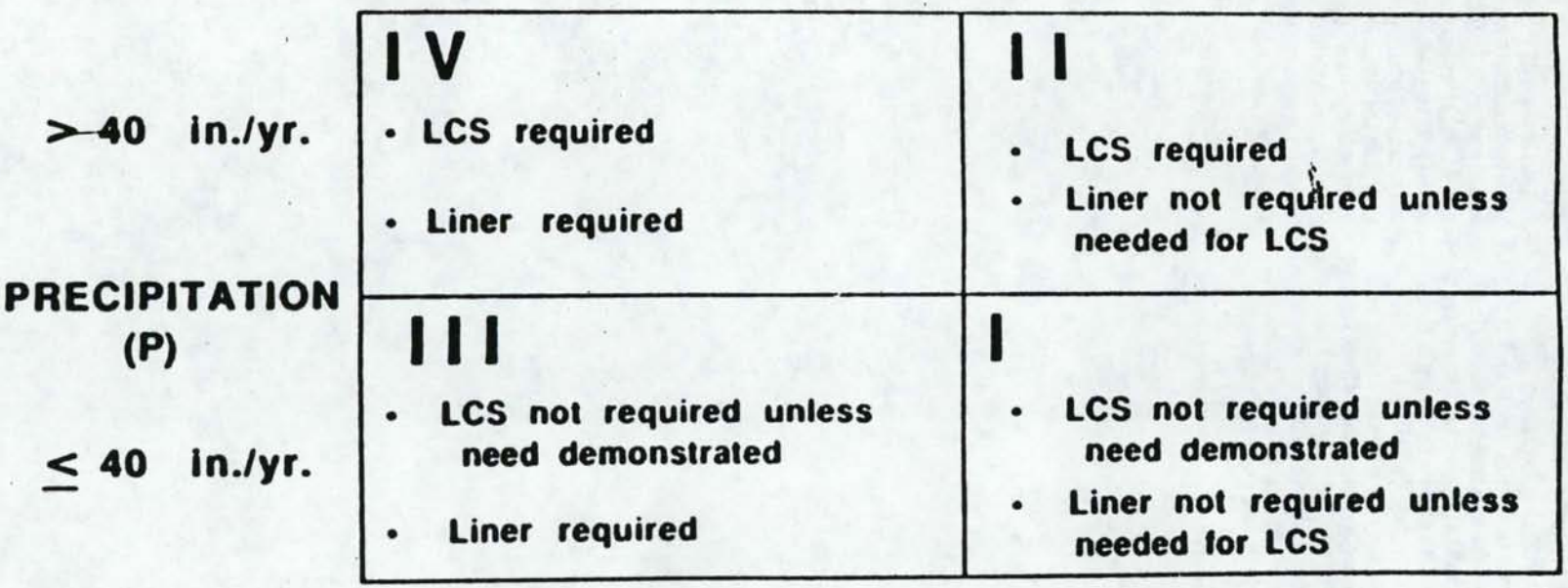
FIGURE 2

CATEGORICAL APPROACH



* MINIMUM T VALUE IS 20 YEARS

In Categories I and III, the low P value indicates that the potential for leachate generation is less than in Categories II and IV. This low potential is not to imply that leachate will not be generated in quantities sufficient to warrant a collection system at facilities in low P areas. The demonstration described earlier to determine if an LCS is necessary should be conducted.

In Categories II and IV, high P values indicate that climatic conditions are conducive to the continual generation of leachate. Leachate control, therefore, is necessary in order to prevent the buildup of a hydraulic head within the unit during the active life of the facility. Any leachate generated after the active life of the unit also must be collected.

In addition, the Agency believes that LCSs are necessary when flexible membrane liners are installed. FMLs are very efficient hydraulic barriers, and an LCS is necessary to remove the hydraulic head that accumulates over time. FMLs installed without such systems will ultimately result in the "bathtub" effect.

Facilities sited in Category I and II locations have overburdens that already satisfy the requirements that T at least equals the active life of the unit. Therefore, modifications to the overburden would not be necessary at these sites. Some Category I and II locations, however, may need a liner if they need an LCS and if the natural overburden material does not have a permeability low enough to allow the LCS to properly function. For example, a site may have an adequate thickness of silty sand to be classified as Category II, but the permeability of this silty sand may be inadequate to allow the LCS to function properly. The base of the unit may need to be modified.

Facilities sited in Category III and IV locations have overburden materials that do not have T values that are at least equal to the active life of the unit or 20 years, whichever is greater. These units should install earthen or synthetic liners or modify the existing subbase such that, in combination with the overburden, the composite T value meets the standard. This may require measures such as soil amendments, recompaction of existing materials, and installation of synthetic membranes.

As discussed earlier, under this approach a final cover system that prevents liquid filtration into the water after closure is necessary. Acceptable methods for determining the design for such a final cover were discussed in a previous section.

(3) Empirical Methodology. A third approach for determining the landfill design characteristics necessary to comply with this rule's design goal relies on the use of ground-water monitoring data from existing MSWLFs. Under this approach, an owner or operator planning lateral expansions of an existing facility or planning to build new units in similar locations to an existing unit could use ground-water monitoring results from existing units to determine if the new or expanded units need to employ designs that are more protective than the existing unit. If the concentration of constitutents detected in the existing units' ground-water monitoring wells do not exceed the design goal (and leachate from the unit could be reasonably expected to have reached the monitoring wells), then the new or expanded unit would not have to apply a more elaborate containment design than the existing unit has to comply with this rule's design goal.

Four conditions would have to be met before this approach could be used. First, the new or expanded unit must have sufficiently similar location and waste characteristics to the existing unit to not pose greater threats to human health and the environment than the existing unit. Second, the existing unit must have operated ground-water monitoring wells over a long enough period to allow for leachate generation and release (accounting for the time required for failure of any liners) and migration through the unsaturated and saturated zones to the monitoring wells. Third, the ground-water monitoring data must address the Phase I parameters (and Phase II parameters, if Phase II has been triggered). Fourth, the monitoring data must be supplemented with appropriate modeling to predict the fate of hazardous constituents over a time period equivalent to the post-closure care period proposed today. This approach would be used most frequently for expansions of existing MSWLFs that have conducted ground-water monitoring over a long period of time.

The Agency recognizes that all three approaches are new methodologies that have not been a part of permitting programs. Comment is requested on the appropriateness of these approaches to a specific permit program or an individual landfill design. Comment is requested on the overall approaches and on ways to modify any approach to make it easier to incorporate into an existing permitting program.

E. Subpart E—Ground-Water Monitoring and Corrective Action

EPA today is proposing ground-water monitoring and corrective action requirements to ensure that ground-water contamination at new and existing MSWLFs will be detected and cleaned up as necessary to protect human health and the environment. These requirements reflect Congressional intent, as interpreted through HSWA and the accompanying legislative history, that protection of ground water be a prime concern of the revised Criteria. HSWA specifically directed EPA to require ground-water monitoring as necessary to detect contamination and corrective action, as appropriate, to protect human health and the environment.

The existing Criteria under § 257.3–4 require that a facility or practice shall not contaminate an underground drinking water source beyond the solid waste boundary or beyond an alternate boundary established by the State. The existing Criteria define "contaminate" to mean the introduction of a substance that would cause: (1) An MCL for any of 10 inorganic chemicals, four chlorinated hydrocarbons, or two chlorophenoxys to be exceeded or (2) a background level to be exceeded for any of these 16 constituents when such background concentration already exceeds an MCL. The existing Part 257 does not specifically require facilities to monitor ground water beneath their units or to implement a corrective action program when ground-water contamination has occurred. Facilities that are in violation of the current Criteria, however, are required to close or enter into a compliance schedule with their respective State.

Today's proposed Criteria revisions completely replace the existing criteria for MSWLFs under 40 CFR 257.3–4, providing ground-water monitoring and corrective action requirements under 40 CFR Part 258 for all new and existing MSWLF units. The proposed requirements call for assessment of the hydrogeology beneath landfill units, ground-water monitoring, reports on ground-water quality, the establishment of ground-water trigger levels and ground-water protection standards, and corrective action. These requirements are discussed separately below.

The corrective action program proposed today addresses releases to ground water only. In section 4010 of HSWA, Congress specifically instructs the Agency to evaluate the current Subtitle D criteria (40 CFR Part 257) for their adequacy to protect human health and the environment from ground-water contamination. Congress clearly considers ground-water contamination to be the major concern, and indeed, requires the new criteria (today's proposal) to provide for ground-water monitoring to detect contamination and corrective action, as appropriate. For

this reason, the corrective action program envisioned today addresses releases to ground water. In addition, there are other authorities the Agency may use to address corrective action at MSWLFs. These authorities (e.g., CERCLA, RCRA Section 7003, the Clean Water Act) may be used to address media other than ground water.

The Agency did, however, consider addressing corrective action for all media while developing today's proposal. The Agency requests comment on the need for corrective action requirements for surface water and soil contamination at MSWLFs. (The Agency currently is assessing the risks associated with releases to air from MSWLFs and is considering proposing regulations to control these emissions.) Currently, the Agency has very little data describing the extent or the risks posed by soil or surface water contamination at MSWLFs.

If corrective action requirements were deemed necessary for surface water and soils, the Agency would most likely consider provisions similar to those required for ground water. Specifically, the Agency would consider requiring monitoring, trigger levels, a corrective measures study, cleanup standards, and criteria for selecting remedies. Appropriate trigger levels for surface water may be water quality standards (WQS) (developed by the State based on Federal Water Quality Criteria) or, if a WQS was unavailable, MCLs may be appropriate (for surface waters used for drinking water). If neither MCLs nor WQS has been established, an appropriate trigger level may be a concentration that meets the criteria specified in § 258.52 of today's proposal, assuming consumption of the contaminated water. If the surface waters are designated for a use other than drinking water, the appropriate trigger level may be a concentration established by the State that meets the criteria specified in § 258.52 of today's proposal and takes into consideration the use or uses of the receiving waters.

Appropriate trigger levels for contaminants in soils might be concentrations that meet the criteria specified in § 258.52 of today's proposal and that assume exposure through consumption of the contaminated soil.

If trigger levels for soils and/or surface water cannot be developed (because a concentration that meets the criteria in § 258.52 is not available), an appropriate trigger level might be a State-developed concentration that serves as an indicator for protection of human health and the environment and incorporates the above-referenced exposure assumptions. If not health-based trigger level is available, the appropriate trigger may be the background concentration.

If the Agency expands the critiera to address corrective action for releases to all media, it may consider using the following compliance points. For soils, the point of compliance for achieving the cleanup level may be any point where direct contact exposure to the soils may occur. The State may specify the locations or methods for determining appropriate locations where soil samples should be taken to demonstrate compliance with the soil cleanup standard(s). For surface water, the criteria might require that the surface water cleanup standard be achieved at the point where the release(s) enters the surface water in its highest concentration. The State may specify the location where surface water or sediment samples should be taken to monitor surface water quality and to demonstrate that compliance with the surface water cleanup standard has been achieved.

1. Section 258.50 Applicability

Today's proposed ground-water monitoring and corrective action requirements apply to the owners or operators of all new and existing MSWLFs. The Agency has several reasons for applying ground-water monitoring requirements to all new and existing MSWLFs. First, the Agency believes that the Congressional intent was to require ground-water monitoring at all MSWLFs that may receive HHW or SQG waste. Section 4010(c) directs EPA specifically to include ground-water monitoring "as necessary to detect contamination" among the revisions to the criteria and, while allowing the Agency to consider practicable capability, does not identify any exceptions to this requirement. The legislative history also is silent with respect to any exemptions from ground-water monitoring.

Second, as discussed earlier in this preamble, EPA has evidence that gound water has been contaminated by MSWLFs on a local basis in many parts of the nation and on a regional basis in some heavily populated and industrialized areas. Evaluation of 163 MSWLF case studies has indicated ground-water contamination or adverse trends in ground-water quality at 146 of these landfills. The Agency recognizes that these case studies may not be representative of the universe of MSWLFs; however, they do provide examples of the impacts of improperly designed or operated MSWLFs.

Current data from a 1986 survey indicate that only 25 to 30 percent of MSWLFs currently are equipped with ground-water monitoring systems; therefore, the total number of MSWLFs that are contaminating gorund water is unknown. Information submitted by the States in 1984, however, indicated that ground-water contamination has been detected at 586 active MSWLFs or roughly 25 percent of those facilities that currently are monitoring ground water. The nature and extent of the contamination from these sites is unknown. In addition, as of May 1986, EPA has included 184 MSWLFs on the Superfund National Priorities List.

The case studies and risk assessments indicate that these failing landfills are located in a wide range of hydrogeologic and climatic settings, making it virtually impossible, on a regional basis, for the Agency to predict which existing landfills may be contaminating ground-water resources. Therefore, the ground-water monitoring requirements are not restricted to landfills of a particular age or region.

Third, ground-water monitoring is the most reliable method for determining whether a landfill is in compliance with the overall performance standard of the proposed Criteria revisions, i.e., to meet health-based limits for hazardous constituents in the ground water at the waste management boundary or alternative boundary specified by the State. Even the best designs, operating practices, and quality control procedures cannot always prevent unexpected failure of a landfill. Therefore, ground-water monitoring at all facilities, including those that are properly designed and operated, is viewed by the Agency as an essential measure to ensure protection of human health and the environment.

Because this proposal requires MSWLFs to conduct ground-water monitoring, today's action effectively prohibits the location of MSWLFs in areas where subsurface conditions prevent monitoring of contaminant migration from the landfill unit. MSWLFs in such unmonitorable areas will be unable to receive an operating permit from the State. Some geologic settings that could preclude effective ground-water monitoring are fractured bedrock where complex fractures and joint systems impede flow direction prediction, and areas where extensive subsurface mining or faulting has modified flow direction. The ability to perform corrective action as necessary also must be considered. It is the responsibility of the owner or operator to prove that a landfill unit can be monitored. The Agency requests comment on adding a specific location

restriction for unmonitorable areas in the final rule.

Section 258.50(b) specifies that ground-water monitoring requirements of § 258.50 through § 258.55 will be suspended for owners and operators who can demonstrate that there is no potential for migration of hazardous constituents from the landfill unit to the uppermost aquifer during the active life, closure, or post-closure periods. The requirements of § 258.56 through § 258.58 are never suspended, however. The proposed limited suspension of the ground-water monitoring requirements provided in the § 258.50(b) is designed for MSWLF units located in hydrogeologic settings that prevent leachate migration to ground water for very long periods of time. In such a setting, leachate from the MSWLF should not be able to reach the uppermost aquifer during the active life, closure, or during post-closure care. Because of the very favorable hydrogeologic conditions, such settings are highly desirable for the location of MSWLFs and the Agency wishes to encourage the use of these settings. Furthermore, requiring ground-water monitoring in these settings would place an additional financial burden on the owner or operator with very little added protection to human health and the environment. The financial burdens placed on owners or operators in these settings would be high because of increased drilling costs caused by the extreme depths to ground water that are typical in these settings.

The Agency intends to ensure that there is a high degree of confidence in the demonstration that no leachate will reach the uppermost aquifer before an exemption from the ground-water monitoring requirements is allowed. Therefore, today's proposal requires that the demonstration be conducted by a qualified geologist or geotechnical engineer based on site-specific hydrogeologic information or, where that is insufficient, based on assumptions that maximize the rate of hazardous constituent migration.

While § 258.50(a) of today's proposal requires ground-water monitoring at all MSWLFs, except in the rare circumstances described above, the Agency is proposing to ease the burden of this requirement by phasing in the ground-water monitoring requirements over time. The Agency is proposing this approach because the thousands of wells that will be needed at the approximately 6,000 existing MSWLFs are expected to cause shortfalls in the availability of competent hydrogeologists and drilling companies who must assist the owner or operator in sampling and analyzing the landfill's hydrogeology, provide recommendations on well placement, drill the appropriate bore holes and monitoring well holes, and install the monitoring wells.

Furthermore, the Agency recognizes that the proper review and evaluation of proposed ground-water monitoring programs will place significant demands on State resources. Therefore, § 258.50(c) of today's proposal requires States to establish compliance schedules for each facility within six months of the effective date of this rule. This six-month period is the maximum amount of time that a State should take in setting compliance schedules. The sooner an owner or operator knows when the MSWLF must be in compliance with the ground-water monitoring requirements, the better the necessary activities can be planned. The Agency has set goals for the percentage of existing units that must be in compliance after the effective date of this rule. Within two years of the effective date, 25 percent of the existing landfill units must be in compliance; within three years of the effective date, 50 percent of the existing landfill units must be in compliance; within four years of the effective date, 75 percent of the existing units must be in compliance; and all landfill units must be in compliance within five years of the effective date. Any new unit must be in compliance with the ground-water monitoring requirements before accepting waste.

States should set compliance schedules for each facility based on an evaluation of the potential risks posed by the facility. Risks posed to human health and the environment can be weighed by considering the proximity of human and environmental receptors, design of the landfill unit, age of the landfill unit, and resource value of the underlying aquifer. The Agency believes that ground-water monitoring is critical at existing facilities that pose a threat to human health or the environment and expects States to move aggressively to address these facilities as soon as possible.

If a State does not set a schedule of compliance for MSWLF units, § 258.50(d) specifies a compliance schedule for owners or operators of landfills. This "fall-back" schedule is based on distance to the nearest drinking water intake. While this method of setting priorities does not ascertain potential risk as well as the method outlined in § 258.50(c), it is objective and easy for an owner or operator to determine.

2. Sections 258.51–55 Overview of Ground-Water Monitoring Requirements

Today's proposed Criteria revisions require a system of monitoring wells to be installed at new and existing MSWLFs. The proposed Criteria revisions also provide procedures for sampling these wells and methods for statistical analysis of analytical data derived from the well samples to detect the presence of hazardous constituents released from MSWLFs. The Agency is proposing a two-phased ground-water monitoring program and a corrective action program. This phased approach to ground-water monitoring allows proper consideration of the transport characteristics of MSWLF leachates in ground water, while protecting human health and the environment. As shown in Figure 3, the proposed monitoring and corrective action programs provide for a graduated response over time to the problem of ground-water contamination as the evidence of such contamination increases, thereby keeping down costs.

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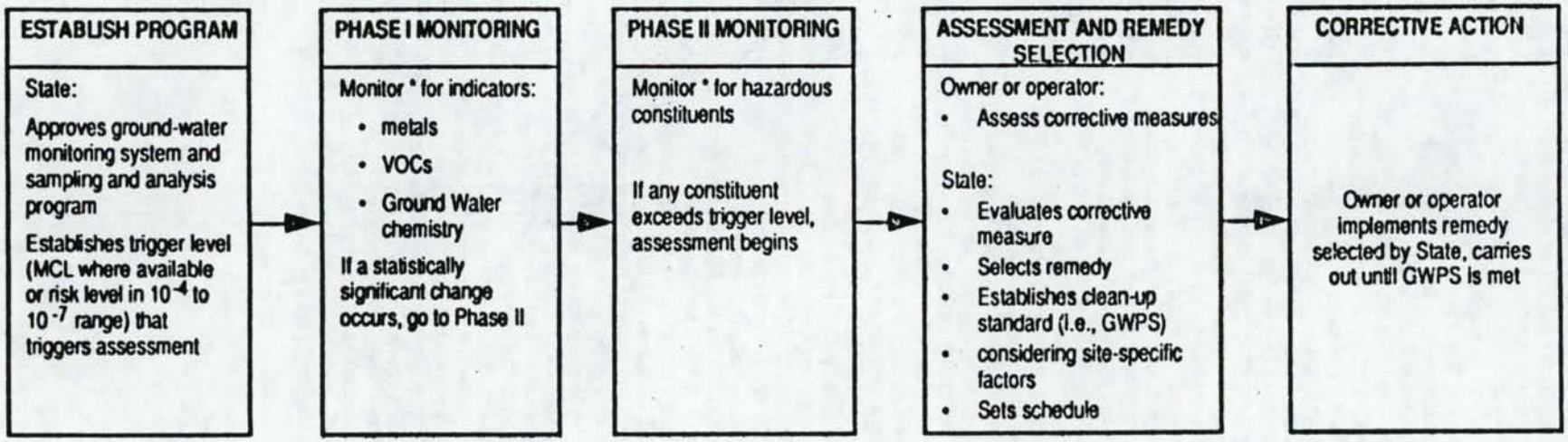
FIGURE 3

SUBTITLE D GROUND-WATER MONITORING AND CORRECTIVE ACTION



* Minimum monitoring frequencies: Semiannual during Phase I and quarterly during Phase II for constituents found above background.

The proposal requires that all new and existing MSWLFs begin their ground-water monitoring programs by complying with the Phase I monitoring requirements. When a change in ground-water chemistry is indicated by an increase or decrease of two in more of parameters (1) to (15), or when any one of parameters (16) to (24) or the volatile organics (VOCs) listed in Appendix I is detected at statistically significant levels above background, Phase II monitoring is triggered. Phase II requires monitoring an expanded list of hazardous constituents (see Appendix II). If any of the Phase II parameters are detected at statistically significant levels above background, the owner or operator must compare those levels to the appropriate ground-water trigger levels. The State will set the ground-water trigger levels as specified in § 258.52. These "trigger levels" trigger the assessment of corrective measures and establishment of the ground-water protection standard. Corrective action continues until the owner or operator demonstrates compliance with the GWPS for a period of time determined by the State to be appropriate, based on site-specific factors. The Agency is considering changing its Subtitle C requirements from a three-year period to one that is site-specific. EPA requests comment on the appropriateness of a minimum period of compliance for Subtitle D.

The Agency is proposing that ground-water monitoring, once initiated, continue through post-closure care. Adequate post-closure care is essential for continued protection of human health and the environment, and ground-water monitoring is necessary in determining the effectiveness of post-closure care. The Agency has not set minimum monitoring frequencies during the post-closure period, instead leaving that determination entirely up to the State. This decision was based on the idea that the appropriate frequency at which to monitor during post closure will vary significantly not only among units, but also over time. Site-specific information should be evaluated by the State when determining post-closure monitoring frequency. Factors that should be considered by the State include the hydrogeology of the site, the age and design of the landfill, and the operating history of the landfill. During the early years of post-closure care (e.g., 10 years), it may be appropriate to monitor as frequently as during the operating period. In many cases it may be appropriate to lessen the frequency of monitoring in the latter years of post-closure care. If during post closure a unit triggers the next phase of ground-water monitoring, it would be appropriate for the State to set a monitoring frequency the same as the minimum frequency designated for the operating period.

Comments are requested on whether individual monitoring wells at a landfill unit should be allowed to be in different phases of monitoring. The Agency is not proposing this option today, but believes that this option could be appropriate in situations where the unit is very large, and only a few monitoring wells have triggered the next phase of monitoring. Once corrective action had been triggered in one well, however, all of the ground-water surrounding the particular unit would be subject to corrective action provisions.

a. § 258.51 Ground-Water Monitoring Systems. Section 258.51 of the proposed Criteria specifies requirements pertaining to appropriate methods for constructing and placing ground-water monitoring wells. The purpose of these requirements is to ensure that consistent, reliable ground-water monitoring systems are installed at all MSWLFs. The Agency has specified the use of well systems because other technologies may not be as reliable as well systems for detecting changes in ground-water quality. In making this determination, the Agency reviewed many other methods of ground-water monitoring, including resistivity, ground penetrating radar, and lysimeters. Detailed discussions of the strengths and weaknesses of these methods for use in monitoring ground water at MSWLFs are provided in the background document for Subpart E of today's proposal.

The monitoring well system must be designed so as to monitor the performance of the landfill design in terms of its ability to meet the design goal (as defined in § 258.40(b)) in the aquifer at the waste management unit boundary or the alternative boundary as specified by the State pursuant to § 258.40. As such, well location is linked directly to the performance standard for the design of the landfill unit. If the unit is designed to meet the design goal at the waste management unit boundary, wells should be installed at the waste management unit boundary. On the other hand, if the unit is designed to meet the design goal at an alternative boundary, the wells should be installed at the alternative boundary.

Section 258.51 allows the placement of wells at the closest practical distance from the waste management unit or alternative boundary to account for the presence of important structures, such as run-off controls, anchors for liners, and gas lines, that would be impaired or destroyed by well installations in the area. Other factors can affect the exact placement of monitoring wells. In some hydrogeologic settings, perched water tables and/or other hydrogeologic phenomena may cause leachate from an MSWLF to travel horizontally for a significant distance before reaching the uppermost aquifer. Therefore, § 258.51(a) specifies that the State may select the closest practical distance downgradient from the waste management unit boundary or the alternative boundary (as specified by the State) if the State determines, based on site-specific hydrogeologic evaluations required in § 258.51, that the uppermost aquifer would not be affected directly beneath the appropriate boundary by release of leachate from the MSWLF.

In some cases, several discrete units may constitute the MSWLF. Because of topographic conditions and design limitations, constructing discrete cells may be the only means of constructing a landfill on the property. Section 258.51(c) states that separate monitoring systems are not required for each landfill unit at a multi-unit facility if the State approves the grouping of units. Such approval would be allowed only if the multi-unit ground-water monitoring system will be protective of human health and the environment. If local conditions make it infeasible or impractical to install a monitoring system around each landfill unit, the State may allow the grouping of units within one monitoring system. Factors that the State should consider when deciding whether more than one unit should be within a monitoring system include: the number of units, the spacing of the units, the orientation of the units to one another, the age of the units, and the hydrogeologic setting. The State should not approve the grouping of units within one monitoring system if the downgradient portion of the system would be located more than 150 meters from any landfill unit.

The Agency does not believe that there are any differences between MSWLFs and hazardous waste land disposal units with respect to the factors used to determine appropriate types of well materials or well construction techniques. Therefore, today's proposed performance standards for ground-water monitoring system design found in § 258.51(d) are similar to those specified for hazardous waste disposal facilities in 40 CFR Part 264. This similarity ensures consistent design and construction standards for monitoring wells at all RCRA landfill facilities.

Because hydrogeologic conditions vary widely from one site to another, it is not possible to establish requirements specifying the exact number, location, and depth of monitoring wells needed to adequately monitor ground water in the aquifer. Such requirements are dependent on actual site-specific aquifer and geologic conditions. Therefore, in § 258.51(e) the Agency has proposed that specifics of the system be based on aquifer thickness, flow rate, and flow direction, and the characteristics of the material overlying the aquifer. For example, a complex aquifer flow system may require multilevel wells to effectively monitor ground water. A facility located in an area of very low hydraulic gradient may be better monitored by a ring of wells, since mounding could cause contaminant flow in all directions.

b. Section 258.52 Determination of Ground-Water Trigger Level. This section discusses what procedures the State must follow when establishing appropriate trigger levels. Trigger levels must be established by the State before the Phase I monitoring program is initiated. The levels established are health- and environmental-based levels that are determined by the State to be indicators for protection of human health and the environment. Where appropriate, these levels are based on promulgated standards; otherwise, they are established by the State on the basis of general criteria described below.

Contamination exceeding trigger levels indicates a potential threat to human health or the environment that may require further study. Therefore, the owner or operator must conduct an assessment of corrective measures whenever concentrations of hazardous constituents in the ground water exceed trigger levels. Trigger levels provide the owner or operator a point of reference for suggesting and supporting alternative remedies during the assessment of corrective measures (see preamble discussion for § 258.56). Trigger levels must be distinguished from ground-water protection standards, which are established during the remedy selection process.

Under § 258.52 of today's proposal, the concentration limits for the trigger levels are: (1) Maximum contaminant levels promulgated under § 1412 of the Safe Drinking Water Act, or (2) if an MCL has not been established, the concentration limit is a health-based limit established by the State that meets the proposed criteria described in § 258.52(b)(2) (i–iv), or (3) if levels under (1) or (2) are not available, the concentration limit is a level established by the State that is an indicator for protection of human health and the environment, or (4) background levels, if such levels are higher than concentrations under (1), (2), or (3), or if concentrations under (1), (2), or (3) have not been established.

The MCLs are maximum concentrations of contaminants allowed in water used for drinking. They are based upon toxicity, treatment technologies, and other feasibility factors such as availability of analytical methods. The MCLs are set following an analysis based on health considerations as guided by the SDWA.

The use of MCLs is consistent with current ground-water protection standards under 40 CFR Part 264, Subpart F (Releases from hazardous waste disposal facilities). Under the 1986 Amendments to the SDWA, MCLs must be set for 83 specific contaminants by 1989 as well as for any other contaminants in drinking water that may have any adverse effect upon people's health and that are known or anticipated to occur in public water systems. Currently, there are 28 MCLs promulgated; relevant MCLs to these requirements are listed below in Table 2.

TABLE 2—MAXIMUM CONTAMINANT LEVELS

CAS No.	Chemical name	MCL (mg/L)
7440-38-2	Arsenic	0.05
7440-39-3	Barium	1.0
71-43-2	Benzene	.005
7440-43-9	Cadmium	.01
56-23-5	Carbon tetrachloride	.005
1308-38-9	Chromium (III)	.05
1333-82-0	Chromium (VI)	.05
106-46-7	para-Dichlorobenzene	.075
107-06-2	1,2-Dichloroethane	.005
75-35-4	1,2-Dichloroethylene	.007
72-20-8	Endrin	.0002
7439-92-1	Lead	.05
58-89-9	Lindane	.004
7439-97-6	Mercury	.002
72-43-5	Methoxychlor	.1
7782-49-2	Selenium	.01
7440-22-4	Silver	.05
93-72-1	Silvex (2,4,5-TP)	.01
8001-35-2	Toxaphene	.005
71-55-6	1,1,1-Trichloroethane	.2
79-01-6	Trichloroethylene	.005
75-01-4	Vinyl chloride	.002

The Agency is proposing that health-based concentrations established by the State be used for the trigger level when MCLs are not available. These health-based levels must meet four criteria listed under § 258.52(b)(2) (i–iv). First, they must be consistent with principles and procedures set forth in Agency guidelines for assessing the health risks of environmental pollutants, which were promulgated on September 24, 1986 (51 FR 33992, 34006, 34014, 34028).

Second, the levels msut be based on scientifically valid studies conducted in accordance with the Toxic Substances Control Act Good Laboratory Practice Standards (40 CFR Part 792) or other equivalent standards. The Good Laboratory Practice Standards prescribe good laboratory practices for conducting studies related to health effects, environmental effects, and chemical fate testing and are intended to assure quality data of integrity. In addition, the Agency guidelines for assessing the health risks of environmental pollutants (cited above) cite several publications that outline procedures for evaluating studies for scientific adequacy and statistical soundness. Third, for carcinogens, these levels must be associated with a risk level within the protective risk range. (See discussion in Section IX.D.1.a. of today's preamble concerning the design goal and EPA's request for comment on alternative risk ranges.) Finally, for toxic chemicals that cause effects other than cancer or mutations, the levels must be equal to a concentration to which the human population (including sensitive subgroups) could be exposed on a daily basis without appreciable risk of deleterious effects during a lifetime. These criteria will ensure that the trigger level represents valid and reasonable estimates of levels in ground water that are safe for human consumption.

Health-based levels that have undergone extensive Agency scientific review, but that have not been formally promulgated, are available for many chemicals. The four criteria proposed in § 258.52 and discussed above will enable the State to use these nonpromulgated levels to derive trigger levels. Appendix III provided health-based levels that the Agency believes meet these four criteria for selected hazardous constituents. These levels may be used to determine trigger levels. EPA established these levels by an assessment process that evaluated the quality and weight-of-evidence of supporting toxicological, epidemiological, and clinical studies. These levels are discussed below.

For noncarcinogens, health-based limits based on Reference Doses (RfDs) have been developed by the Agency's Risk Assessment forum. An RfD is an estimate of the daily exposure a sensitive individual can experience without appreciable risk of health effects during a lifetime. The experimental method for estimating the RfD is to measure the highest test dose for a substance that causes no

statistically or biologically significant effect in an animal bioassay test. The RfD is derived by dividing the "no observed adverse effect level" (NOAEL) by a suitable scaling or uncertainty factor. Confidence in the RfD is dependent on a number of factors, including the quality and duration of the animal study. The derivation of RfDs has been evaluated and verified by internal Agency review. Applying the standard drinking water exposure assumptions (i.e., a 70 kg person drinks two liters of water a day for 70 years) to RfDs yields the ground-water concentration limit. Appendix III lists the RfDs (mg/kg-day) for several hazardous constituents.

The use of the RfD is appropriate only for noncarcinogenic constituents. EPA science policy suggests that no threshold dose exists for carcinogens; in other words, no matter how small the dose, some risk remains. The dose-response assessment for carcinogens usually entails an extrapolation from an experimental high-dose range where carcinogenic effects in an animal bioassay have been observed, to a dose range where there are no observed experimental data by means of a preselected dose response model. The carcinogenic slope factors (CSFs), estimated by EPA's Carcinogen Assessment Group, may be used to calculate a dose that corresponds to a given risk level by dividing the risk level (e.g., 1×10^{-6}) by the CSF. CSFs for selected carcinogens are provided in Appendix III. This dose is called a risk-specific dose (RSD). An RSD is an estimate of the daily dose of a carcinogen that, over a lifetime, will result in an incidence of cancer equal to a given risk level.

The ground-water concentration, in milligrams per liter, can be calculated by multiplying the RSD by the average adult body weight (70 kg) over the average water intake (two liters of water per day). Chemicals that cause cancer also may evoke other toxic effects. These constituents may have both an RfD and RSD available. In these cases, the lower level (i.e., more protective) should be used as the trigger level.

EPA has developed a classification scheme for carcinogens based on the weight of evidence for carcinogenicity. This scheme is presented in the Agency's cancer guidelines (51 FR 3992). Appendix III includes the class for each carcinogen listed. Known or probable human carcinogens are designated as Class A and Class B carcinogens, respectively, under the Agency guidelines. Constituents for which the weight of evidence of carcinogenicity is weaker are known as Class C, or possible human carcinogens under the Agency's guidelines.

Examples are included in Appendix III to illustrate how the States may use RfDs and CSFs to set trigger levels. For carcinogens, the State may use the CSF to determine a trigger level anywhere within the protective risk range. (See discussion in Section IX.D.1.a. of today's preamble concerning the design goal and EPA's request for comment on alternative risk ranges.)

The Agency believes that the protective risk range is appropriate for setting a trigger level for carcinogens without a MCL. For new MSWLFs, the State should consider using the same risk level for trigger levels as was used for the design goal. For example, if the MSWLF was designed to meet a 1×10^{-5} risk level at the chosen boundary, then the MSWLF should be triggered into an assessment of corrective measures once that risk level (for carcinogens with no MCL) is exceeded. For existing MSWLFs, to ease implementation, the Agency suggests that the State choose one risk level to be used at an MSWLF for all carcinogens that do not have an MCL. The State may consider choosing a risk level to use at all MSWLFs within the State. As discussed in the preamble discussion for the design goal, the Agency is requesting comment on two alternatives to the protective risk range. Any change made to the proposed design goal criteria would most likely be made for the trigger level. For example, if a fixed risk level of 1×10^{-6} was required as a design goal, then the trigger levels for carcinogens without MCLs would also be required to be set at 1×10^{-6}.

RfDs and RSDs will be available soon through the Integrated Risk Information System (IRIS), a computer-housed, electronically communicated catalogue of Agency risk assessment and risk management information for chemical substances. IRIS is designed especially for Federal, State, and local environmental health agencies as a source of the latest information about Agency health assessments and regulatory decisions for specific chemicals. The risk assessment information (i.e., RfDs and RSDs) contained in IRIS, except as specifically noted, has been reviewed and agreed upon by intra-Agency review groups, and represents an Agency consensus. As EPA continues to review and verify risk assessment values, additional chemicals and data components will be added to IRIS. A hard copy of IRIS soon will be available through the National Technical Information Service. The background document for Subpart E contains further information on IRIS.

If MCLs or other health-based levels meeting the proposed criteria are not available or cannot be developed for use as trigger levels, § 258.52(b)(3) allows the State to establish a trigger level that acts as an indicator for protection of human health and the environment. In many cases, partial data or data on structural analogs will allow the State to estimate whether the detected level of a contaminant is likely to cause a problem. In other cases, other contaminants will be present at high levels (triggering an assessment of corrective measures in any case), and it will be clear that the constituent for which no level is available is not a driving factor in determining the risk at the site, even under worst-case assumptions concerning its toxicity. In such cases, it may not be necessary to specify a trigger level for that constituent.

Finally, background concentrations may be used as the trigger level when no health-based level or indicator is available or when background is higher than any health-based level.

c. Section 258.53 Ground-Water Sampling and Analysis. Section 258.53 of today's proposed Criteria revisions includes requirements for consistent sampling and analysis procedures that are designed to ensure accurate ground-water monitoring results. Also included in this section are requirements for determining ground-water flow rate and direction, establishing background ground-water quality and applying appropriate statistical analyses to detect any changes in ground-water quality beneath an MSWLF.

Section 258.53(a) requires that the sampling and analysis techniques used by owners and operators of MSWLFs be sufficient to provide an accurate representation of ground-water quality in the uppermost aquifer beneath the landfill. At a minimum, these procedures must address sample collection, preservation, shipment, chain-of-custody, and quality assurance and quality control (QA/QC). The Agency recommends Chapter 2 of the "RCRA Technical Enforcement Guidance Document" (TEGD) for use in complying with this section. Although this chapter of the TEGD contains a number of references to the hazardous waste requirements under 40 CFR Part 264, the recommended sampling and analytical procedures are appropriate for any solid waste disposal facilities, including MSWLFs. These recommendations provide clear descriptions of how to

conduct ground-water sampling and analysis and also allow the use of alternate procedures on a site-specific basis. Therefore, by recommending the TEGD, the Agency is not ignoring the use of alternate procedures that are consistent with the level of performance reflected in the TEGD.

In the RCRA Subtitle C program, the Agency has observed problems with ground-water sampling procedures, monitoring well network design, laboratory analyses, and data interpretation. EPA believes that a rigorously enforced, comprehensive quality assurance program based on sound quality objectives and backed up with an appropriate set of reference methods and procedural guidance will assist in remedying these problems. As a result, the Agency is considering adding QA/QC requirements to the sampling and analytical methods for Subtitle C facilities under § 264.97(e). To avoid duplicating the problems of Subtitle C, § 258.53(a)(5) of today's proposal requires that QA/QC procedures be included in sampling and analysis techniques. Owners or operators should refer to EPA guidance on "Test Methods for Evaluating Solid Waste (Physical/Chemical Methods)" for information on QA/QC procedures (Ref. 34).

Section 258.53(d) of today's proposal requires that ground-water elevations be measured immediately prior to sampling. In addition, the owner or operator must determine the rate and direction of ground-water flow in the uppermost aquifer each time ground-water gradient changes. These requirements for determining ground-water flow rate and direction are included to ensure that any unexpected changes in these parameters will be recognized and that changes in the location or spacing of monitoring wells will be made as needed to maintain the integrity of ground-water monitoring systems. Ground-water flow rates and directions may vary seasonally or over a number of years due to human-made or natural causes and, because the spacing and location of wells are highly dependent on these parameters, the Agency has decided not to rely entirely on the measurements of these parameters made prior to well installation. In selecting a site-specific frequency, i.e., tied to changes in ground-water gradient, the Agency has attempted to strike a balance between areas where aquifers exhibit no variability and those that exhibit frequent changes in flow rate and direction. At facilities that overlie aquifers with little or no variability in gradient, these assessments may be fairly infrequent. At facilities overlying aquifers with more variable ground-water gradients, more frequent assessments of flow rate and direction may be required, based on measurements of piezometric surface taken at least semiannually. Ground-water flow rate and direction data should be presented in the form of a flow net.

Today's proposed ground-water sampling and analysis procedures also include requirements for establishing background ground-water quality. Information on background ground-water quality is essential for determining whether the presence of monitoring parameters or constituents beneath an MSWLF indicates leakage from the landfill unit. Section 258.53(e) requires the owner or operator to establish background values for those monitoring parameters or constituents included in the monitoring phase applicable to that MSWLF. For example, if the MSWLF currently is in the Phase I monitoring program, background values must be established for all of the Phase I parameters. Background values of all of the Phase II parameters must be established if Phase II monitoring is triggered. The minimum number of background samples needed to fulfill the statistical requirements will depend on the statistical procedures selected.

Background ground-water quality must be established in wells that are hydraulically upgradient of the MSWLF, except as allowed in §§ 258.53 (f) and (g). Section 258.53(f) states that background quality at landfill units may be based on samples from wells that are not upgradient from the landfill if hydrogeologic conditions do not allow the owner or operator to determine what wells are upgradient, and sampling at other wells will provide an indication of background ground-water quality that is as representative or more representative than that provided by upgradient wells. Areas with no hydraulic gradient and those with reversing hydraulic gradient (such as those influenced by tides) are examples of hydrogeologic conditions that could make it impossible to determine which direction is upgradient.

Section 258.53(g) of today's proposal gives the State flexibility in determining background ground-water quality on a site-specific basis where such levels cannot be measured on the facility. An example of such a situation would be a landfill unit that is leaking and causing a mounding effect (where leachate is flowing out of the unit in all directions). If the leachate flowed far enough from the unit, it could contaminate all of the ground water between the unit and the property boundary, thus leaving no uncontaminated ground water from which to determine background ground-water quality. The State would be able to set background values for this site. Background ground-water quality should be based on actual monitoring data from the aquifer of concern. A State may have well data from another landfill site that overlies the same aquifer, or the data may be from another type of well from which the State can obtain data. The reader is referred to the background document for Subpart E for a full discussion of this provision.

The requirements for applying the statistical procedures contained in §258.53(h) are the same as the procedures proposed on August 24, 1987, for hazardous waste disposal facilities under Subtitle C of RCRA (see 52 FR 31948). The Agency believes that the revised Subtitle C procedures are also appropriate for MSWLFs and provide sufficient flexibility to allow effective State implementation at MSWLFs. The final statistical procedures promulgated under § 258.53(h) will reflect comments received on this proposal as well as the final statistical package promulgated under Part 264.

The required statistical procedures for comparing background ground-water quality data to those samples taken at downgradient wells are included in today's Criteria revisions to clarify the purpose and timing of statistical comparisons and their relation to ground-water sampling events at MSWLFs. These requirements ensure that statistical comparisons of analytical results between background and downgradient monitoring wells will be made promptly after each sampling event, and will cover all applicable parameters and constituents at MSWLFs. For further discussion of the statistical requirements, the reader is referred to the preamble for the proposed Subtitle C procedures found at 52 FR 31948.

d. Section 258.54 Phase I Monitoring Requirements. The Phase I monitoring parameters proposed today in § 258.54 were developed with the dual objectives of providing a reliable means of detecting the possible presence of releases from MSWLFs while avoiding unnecessary analytical costs to the regulated community. The proposed list of Phase I parameters is consistent with the results of research conducted under the direction of EPA's Office of Research and Development and other institutions. These research results reveal that Phase I parameters (1)–(15) are reliable indicators of ground-water

chemistry and possible precursors to other more hazardous constitutents that may be released later from MSWLFs. Furthermore, States typically require routine monitoring of one or more of these parameters (1) to (15) at MSWLFs as the primary means of detecting ground-water contamination. The major cations and anions on the Phase I parameter list are those used to classify ground water into geochemical facies. These parameters are, therefore, useful for tracking changes in the ground-water geochemistry that may occur as the result of leakage from an MSWLF. In addition, the Agency is proposing to require semiannual monitoring for the metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver), cyanide, and 46 VOCs.

The Agency believes that these VOCs in Appendix I constitute the first group of potentially hazardous constituents that would be present in the ground water prior to other, less mobile, constituents proposed for Phase II (see Appendix II of the proposed rule.) Due to their chemical nature, these VOCs generally would not migrate any faster than the non-VOC Phase I parameters, but do migrate faster than most of the Phase II constituents. Research by EPA and other institutions that supports these statements is summarized in the background document to this Subpart.

Heavy metals and cyanide also can exist under certain conditions in a well-defined leachate ground-water plume, depending on the waste present in the landfill. It is not certain whether heavy metal concentration would be as significant in leachate plumes from newer MSWLFs as they tend to be attenuated more than other constituents, such as VOCs. MSWLF leachates containing heavy metals can, however, pose serious threats to human health and to aquatic environments; therefore, the Agency is proposing to include the heavy metals that are included in the primary drinking water standards along with cyanide and the VOCs as the minimum Phase I monitoring parameters.

The reader is referred to the background document for this Subpart for more information.

The Agency is proposing to include the following as the minimum Phase I parameters that must be monitored for at least semiannually:

(1) Ammonia (as N)
(2) Bicarbonate (HCO_3)
(3) Calcium
(4) Chloride
(5) Iron
(6) Magnesium
(7) Manganese (dissolved)
(8) Nitrate (as N)
(9) Postassium
(10) Sodium
(11) Sulfate
(12) Chemical Oxygen Demand (COD)
(13) Total Dissolved Solids (TDS)
(14) Total Organic Carbon (TOC)
(15) pH
(16) Arsenic
(17) Barium
(18) Cadmium
(19) Chromium
(20) Cyanide
(21) Lead
(22) Mercury
(23) Selenium
(24) Silver
(25) Volatile Organic Compounds listed in Appendix I

The Agency specifically requests comment on the proposed set of Phase I monitoring parameters and the monitoring frequency. EPA is proposing that the frequency of monitoring during Phase I be determined by considering aquifer flow rates in the vicinity of the monitoring wells and the resource value of the aquifer. Semiannual sampling is proposed as a minimum frequency during the active life and closure of a unit. This frequency also is the minimum specified in the ground-water monitoring requirements (40 CFR Part 264) for hazardous waste landfills. The Agency believes that a six-month maximum interval between sampling events is reasonable in terms of protection of human health and the environment and the burden on the regulated community. During post-closure care, a State may set a different minimum monitoring frequency.

Today's proposal does not set a minimum frequency for ground-water monitoring during post-closure care. Because of the variable length of the post-closure care period and the variability of site-specific conditions, the Agency believes it is more appropriate to allow States to determine the frequency of ground-water monitoring on a site-specific basis.

Section 258.54(d) states that a Phase I ground-water monitoring program must be expanded to Phase II ground-water monitoring when two or more of the parameters (1) to (15) are detected at levels that significantly differ from background levels. Because the parameters (1) to (15) are monitored to detect changes in ground-water chemistry beneath an MSWLF, both increases and decreases in these parameters may be significant. The Agency is not implying that decreased levels of any of these parameters indicate degradation of ground water, just that further monitoring should be done to determine what is causing the change in ground-water chemistry. For example, a change in water chemistry, such as a decrease in pH and sulfate, may indicate the release of liquids from a landfill. The Agency is proposing to use increases or decreases of any two or more of the parameters (1) to (15) to trigger Phase II monitoring because preliminary analysis of ground-water samples taken at MSWLFs show that: (1) Substantiated leachate contamination of ground water from MSWLFs normally involves more than one of those Phase I parameters and (2) levels of a single one of those Phase I parameters in backgroud ground-water samples in some areas of the country are highly variable, which could lead to false indications of contamination. Section 258.55(a) states that if anyone of parameters (16) to (24) or the VOCs listed in Appendix I is detected at levels that are statistically significant above background, the unit must begin Phase II monitoring. During Phase II monitoring, the owner and operator has the opportunity to revert back to Phase I monitoring if it is found that there has not been a statistically significant increase over background levels of relevant parameters (see § 258.55(e)).

Once an MSWLF has triggered Phase II monitoring, the owner or operator is not required to monitor parameters (1) to (15). States may require an owner or operator who has entered a Phase II monitoring program to continue occasional monitoring for parameters (1) to (15), particularly if that State has established corrective action requirements that involve those parameters. The Agency does not intend to require any corrective action for Phase I parameters (1) to (15) because: (1) It is not apparent that these parameters would ever occur at high levels without corresponding increases over background levels for many of the constitutents listed in Appendix II of the proposed regulations, (2) it is difficult to assign a target level for cleanup of the non-VOC, nonmetal Phase I parameters, since none of them are hazardous to human health at levels found in MSWLF leachate, and (3) cleanup of any Appendix II constituents is likely to result in concurrent cleanup of the other Phase I parameters to acceptable levels.

Section 358.54(d)(3) of today's proposal allow the MSWLF owner or operator to demonstrate that detection of significant changes in ground-water quality during Phase I monitoring was caused by sampling and analytical error or by a source other than the MSWLF. The Agency included this provision in

today's proposal because it is known that sampling and analytical errors are made with sufficient frequency that they cannot be ignored. This provision avoids unnecessary costs to the owner or operator who would otherwise be required to begin Phase II monitoring. Furthermore, this provision is consistent with the RCRA Subtitle C regulations governing hazardous waste landfills. Owners or operators of MSWLFs attempting to make this demonstration must notify the State of their intent, submit the demonstration to the State in the form of a report, and continue the Phase I monitoring program. If the demonstration is not successful, the owner or operator must establish a Phase II monitoring program within a reasonable time period.

The Agency specifically requests comments on the list of Phase I monitoring parameters, methods for setting triggering mechanisms, and potential required actions at MSWLFs that are contaminating ground water only with non-VOC, nonmetal parameters (1) to (15) Phase I constituents. The Agency also requests information about any MSWLFs that are known to be causing significant contamination of ground water with only non-VOC, nonmetal Phase I constituents.

e. Section 258.55 Phase II Monitoring Requirements. If it is determined that the ground water contains significant increases (or decreases) over background levels of Phase I parameters, the Phase II monitoring program is triggered. The purpose of this phase of ground-water monitoring is to determine the concentration of hazardous constituents specified in Appendix II of today's proposal. Therefore, Phase II monitoring is initiated by sampling all wells and analyzing each sample for all of the constituents listed in Appendix II of today's proposal.

Triggering into Phase II does not necessarily indicate a threat to human health and the environment. Rather, entering Phase II monitoring signals the need to more fully analyze ground water to determine if any constituent has exceeded health-based levels (i.e., trigger levels). The technical basis for selection of the Appendix II parameters for Phase II monitoring is presented below and in the background document for Subpart E of today's proposal.The Agency's major objective on identifying the constituents for Phase II monitoring was to include those hazardous constituents that pose risk to human health and the environment, are present in MSWLF leachate, and may potentially migrate to ground water. The proposed constituents (Appendix II of today's proposal) are the same as those used for the GWPS at hazardous waste disposal facilities under Subtitle C of RCRA. The Agency considered several options for the specific list of Phase II constituents. The regulatory alternatives included: (1) The list of constituents in the current Subtitle D Criteria, (2) the list of priority pollutants, (3) a list of all constituents that have been found in MSWLF leachates, (4) a site-specific list of constituents, based on analyses of leachate samples, and (5) the list of constituents in Appendix II.

The first option the Agency considered was the 10 inorganic chemicals, four chlorinated hydrocarbons, and two chlorophenoxys specified in the current Criteria (40 CFR Part 257). This option was rejected because the Agency's analytical leachate data indicate the presence of numerous other toxic organic compounds that would not be addresed by this option.

The second option considered was the list of priority pollutants under section 307(a)(1) of the CWA. The constituents on this list are toxic, and many have been found in leachate samples from MSWLFs. Because the list fails to include many constituents that have been detected in MSWLF leachate, however, the priority pollutant list was rejected for use as the GWPS.

The Agency considered a third option of developing a new list of constituents for Phase II monitoring at MSWLFs. The new list would have been compiled from existing data on the types of toxic compounds that have been detected in leachate samples from MSWLFs. EPA's current data on MSWLF leachate are limited but indicate the tremendous range of constituents and concentrations that may be found in MSWLF leachate. Altogether, data were received for 59 landfills, with 37 landfills providing both organic and inorganic leachate analyses, 7 landfills providing only organic analysis, and 15 landfills providing only inorganic analysis. Sixty-four hazardous organic constituents were identified as well as 49 hazardous inorganic constituents and other parameters. In most cases, the list of constituents analyzed for was unknown, so these data may not indicate the full range of constituents that may be found in the leachate even from these MSWLFs. Thus, this option was rejected because of data limitation, particularly for hazardous organic constituents.

The fourth option the Agency considered was developing site-specific Phase II monitoring constituents through the analysis of leachate samples from each MSWLF. This approach would allow owners and operators of MSWLFs to limit their analyses to only those hazardous constituents present in the leachate of their landfill. The Agency has the following concerns with this approach: (1) It is unworkable for sites with no leachate collection system (including the majority of existing landfills), (2) it does not account for degradation processes occurring during constituent migration through the unsaturated zone and ground water, and (3) it would require periodic resampling of the leachate to account for the wide variations in leachate quality over time. The Agency is interested in comments on the efficacy of this approach for facilities that have leachate collection systems.

The option adopted in today's proposal was to use the Appendix II constituents. Sixty-nine of the constituents in Appendix II have been found in MSWLF leachate. This number is based on limited data, particularly for hazardous organic constituents. In examining the variability of substances appearing in landfill leachate samples and all the potential waste streams that may be placed in MSWLFs, the Agency has concluded that any of the Appendix II constituents potentially could be present in ground water beneath an MSWLF at levels that may pose threats to human health and the environment. The Agency requests comments on the constituents proposed for Phase II monitoring at MSWLFs.

Section 258.55(c) requires the MSWLF owner or operator to sample the ground water in all monitoring wells and determine which, if any, of the Appendix II constituents are present in the ground water at concentrations that significantly exceed background levels. This activity must be done within 90 days after triggering Phase II. If the owner or operator concludes on the basis of the Appendix II constituent scan that none of the constituents significantly exceed background levels, pursuant to § 258.54(d), the State must determine the frequency for any subsequent Appendix II constituent scans to be conducted at the MSWLF during the active life or post-closure care.

Section 258.55(e) of today's proposal allows MSWLFs to revert to a previous phase of ground-water monitoring after the owner or operator determines that there has not been a statistically significant increase over the background levels of the relevant monitoring parameters. This proposal is similar to changes being considered for ground-

water monitoring under Subtitle C of RCRA, and is particularly applicable to Subtitle D, under which the practicable capability of the owner or operator can be considered. The Agency realizes that it can be very difficult to prove that error in sampling or analysis caused the indication of a statistically significant increase above background levels of a ground-water monitoring parameter. If such an error were to occur and could not be proven to be the cause, a unit would be triggered into a higher and more costly phase of ground-water monitoring. The owner or operator would be forced to pay for a more costly monitoring program for an indefinite time period, with no added benefit to human health or the environment. Allowing a unit to revert to a previous phase of monitoring when no constituents have been detected above background levels eases the financial burden of the owner or operator without harming human health or the environment. A specific time period over which monitoring must be conducted before reverting to a previous monitoring phase has not been proposed, based on the concept that the appropriate time period should be site-specific. A minimum time period also was not proposed, but the Agency requests comments on the appropriateness of a minimum time period.

It should be noted that the criterion for returning to Phase I monitoring (i.e., background levels for Appendix II constituents) is consistent with those for facilities that have never entered Phase II monitoring. Therefore, an MSWLF may not return to Phase I monitoring merely by maintaining concentration levels at the trigger levels that initiate corrective measures assessment. Instead, before returning to Phase I monitoring, the concentration levels for Appendix II constituents must be at or below the background, which is the level that initiates phase II monitoring for a reasonable time period determined by the State.

If any Appendix II constituents are detected at statistically significant levels above background, § 258.55(f) requires the owner or operator of the MSWLF to notify the State of this fact in writing within 14 days; and, within 90 days of the finding, he or she must submit to the State a report containing all data necessary for establishing a ground-water trigger level.

Section 258.55(f)(2) of today's proposal requires that each hazardous constituent that is present at levels exceeding background concentrations must be analyzed from ground-water samples taken on a quarterly basis. The Agency believes that the presence of hazardous constituents over background signals the need for a more thorough assessment of the ground-water condition, necessitating more frequent monitoring than for Phase I. Thus, the Agency is proposing quarterly monitoring at a minimum to provide the earliest possible indication of when the trigger level has been excceeded. This approach is consistent with the approach taken in other Agency ground-water monitoring programs, such as under Subtitle C of RCRA. More frequent monitoring may be required by the State depending on site-specific conditions, such as ground-water flow rates and directions. The Agency considered alternatives that would require more stringent minimum frequencies, but these alternatives would have been unnecessarily burdensome at sites where ground water travels a distance of only a few feet per year. Therefore, today's proposed minimum frequency balances the need for early detection and thorough assessment with the statutory need to consider the "practicable capability" of the regulated community.

In addition to the quarterly monitoring for those constituents exceeding background, § 258.55(d) requires that each MSWLF monitor other Phase II constituents (Appendix II constituents) on a periodic basis to determine if any additional constituents have entered the ground water at concentrations that significantly exceed background levels. The frequency for monitoring these other Phase II constituents is determined by the State. These periodic analyses are essential for use in determining whether the design of an ongoing corrective action program must be changed to accommodate the treatment or removal of additional constituents. The Agency considered requiring annual Appendix II analyses at all MSWLFs, but the Agency believes selecting an appropriate frequency based on site-specific factors is essential given that Phase II constituent analyses may approach $3,000 per sample. The "practicable capability" of the owner or operator needs to be considered. The Agency's decision to allow State determination of the frequency for periodic Appendix II analyses also is based on the fact that site-specific conditions will have a significant impact on the release of any new constituents to the ground water from an MSWLF. The State also must determine the frequency for Phase II constituent analyses during post-closure care for those constituents that have exceeded background concentrations.

Under § 258.55(g), if the periodic analyses of Appendix II constituent reveals additional constituents in the ground water that are present at above-background levels, the owner or operator must notify the State within 14 days and, within 90 days, must submit a report on the concentrations of these new constituents. The MSWLF also must begin monitoring these new constituents at the minimum quarterly rate, which is required for all Phase II parameters that have exceeded background levels. Under § 258.55(h), if any Phase II parameters are detected at concentrations that exceed the ground-water trigger level, the MSWLF owner or operator must notify the State of this finding within 14 days. The owner or operator of the MSWLF also must begin to assess corrective measures as required under § 258.56 and continue to follow the Phase II monitoring program requirements.

The proposed Phase II monitoring requirements under § 258.55(h)(4) allow the owner or operator to demonstrate that an increase over the ground-water trigger level was caused by a sampling or analytical error or by a source other than the MSWLF. The rationale for including this demonstration in today's proposal is provided under the discussion of the Phase I monitoring program in this preamble.

3. Section 258.56 Assessment of Corrective Measures

An assessment of corrective measures is required whenever concentrations of hazardous constitutents in the ground water exceed trigger levels. Trigger levels are health- and environmental-based levels established by the State as indicators for protection of human health and the environment (see preamble discussion for § 258.52).

The State shall specify the scope of the corrective measures study. Factors that generally may be appropriate are listed in § 258.56(c). The purpose of the assessment is to study potential corrective measures. In general, the extensiveness of the assessment (i.e., the number and type of alternatives evaluated) should be commensurate with the complexity of the site. (The reader is directed to the Background Document for Subpart E for a more detailed discussion of what may be appropriate for specific situations.) There may be some situations where a limited assessment is appropriate. For example, if the ground water is known to be Class III ground water (see preamble discussion for § 258.57(f)(2))

and remediation will not be required, the assessment may be limited to an evaluation of institutional-type controls to limit exposure.

Under § 258.56(c), the Agency specifies several activities that the State may include in the scope of the assessment. First, the State may require the owner or operator to assess the effectiveness of potential remedies in meeting the requirements and objectives of the remedy (for a discussion of these requirements and objectives, see the preamble discussion for § 258.57 (b) and (c)). Next, the State may require the owner or operator to perform an evaluation of the performance, reliability, ease of implementation, and impacts (including safety, intermedia contaminant transfer, and control of exposures to residual contamination) associated with any potential remedy evaluated. In evaluating the performance of each remedy, the owner or operator should evaluate the appropriateness of specific remedial technologies to the contamination problem being addressed. During this assessment, the owner or operator may need to conduct additional monitoring to characterize the nature and extent of the plume of contamination.

Analysis of a remedy's performance, reliability, and ease of implementation may include an assessment of its effectiveness in achieving intended functions of containment, treatment, remediation, or disposal of the hazardous constituents and the degree of protection afforded human health and the environment. In addition, consideration should be given to the frequency and complexity of necessary operation and maintenance and the extent to which the technology has been successfully demonstrated under analogous conditions. The technical feasibility for the remedial strategy should also be considered in terms of ability to construct and operate the remedial technologies and the availability of necessary treatment, storage, or disposal services, and capacity.

The Agency is particularly concerned about potential cross-media impacts (intermedia transfer of contaminants) of remedies, and, therefore, the Agency specifically identified them as an area that the State may require the owner or operator to consider. Some remedial technologies may cause secondary impacts. For example, in some circumstances, air stripping of VOCs from ground water may release these VOCs to the air unless specific emissions control devices are installed on the air stripper.

In today's proposal, the State also may require the owner or operator to evaluate the timing of the potential remedy (§ 258.56(c)(3)), including construction, start-up, and completion time. Timing will be important in distinguishing among remedies. The State ultimately determines the compliance schedule for final cleanup of the ground water under § 258.57(d).

The owner or operator may be required by the State to include cost estimates for alternatives considered (§ 258.56(c)(4)). Cost estimates will be very important to the State when approving the selected remedy. The practicable capabilities of the facility, including the capability to finance and manage a corrective action program may be considered by the State in determining the duration of the clean-up. Therefore, the cost of the remedy may affect the remedy selected and the timing of the cleanup (see preamble discussion of § 258.57(d)).

The owner or operator may be required to consider institutional requirements under § 258.56(c)(5). For example, local governments may have specific requirements related to the remedial activities that may affect implementation of the remedies evaluated.

Finally, the State may require the owner or operator to evaluate the public acceptability of alternatives. The consideration of community concerns is a decision factor that the State will use in selecting a remedy (see § 258.57(c)(5)).

Under the proposed § 258.56(d), the State may require the owner or operator to evaluate one or more specific potential remedies. These potential remedies may include innovative technologies. The State may know of technologies that have been successful at other landfills with similar contamination problems. The proposed § 258.56(e) requires that, after all remedies have been evaluated, the owner or operator must submit a report to the State on the assessments so that the State may choose which remedy should be implemented.

Under proposed § 258.56(f), if the State determines at any time that human health or the environment are being threatened by the release of hazardous constituents from the MSWLF, the State may require the owner or operator to implement the measures required in proposed § 258.58 (a)(3) or (a)(4) (see preamble discussion of § 258.58(a)).

4. Section 258.57 Selection of Remedy and Establishment of Ground-Water Protection Standard

The proposed § 258.57 outlines the general requirements for selection of remedies for MSWLFs. As structured, it establishes four basic standards that all remedies must meet and specifies decision criteria that will be considered by the State in selecting the most appropriate remedy. In addition, decision factors for setting schedules for initiating and completing remedies are outlined, and specific requirements for establishing ground-water protection standards, including requirements for achieving compliance with them, are contained in this section.

Proposed § 258.57(b) specifies that all remedies must: Be protective of human health and the environment; attain ground-water protection standards as specified pursuant to § 258.57 (e) and (f); control the sources of releases so as to reduce or eliminate, to the maximum extent practicable, further releases that may pose a threat to human health or the environment; and comply with standards for management of wastes as specified in § 258.58(d).

These standards reflect the major technical components of remedies: cleanup of releases, source control, and appropriate management of wastes that are generated by remedial activities. The first standard—protection of human health and the environment—is a general mandate derived from the RCRA statute. This overarching standard requires remedies to include those measures that are needed to be protective, but are not directly related to ground-water protection, source control, or management of wastes. An example would be a requirement to provide alternate drinking water supplies in order to prevent exposure to releases to ground water used for drinking water. Another example would be barriers or other controls to prevent direct contact with the unit.

Remedies will be required to attain the ground-water protection standards that will be specified for the remedy by the State according to the requirements outlined below. The GWPS for a remedy often will play a large role in determining the extent of and technical approaches to the remedy. In some cases, certain technical aspects of the remedy, such as the practicable capabilities of remedial technologies, may influence to some degree the GWPS that are established. It is because of this interplay between cleanup standards and other remedy goals and limitations that today's rule establishes requirements for GWPS within the overall remedy selection structure of § 258.57. Thus, the standard setting process and the remedy selection process occur concurrently with both processes affecting the other.

Section § 258.57(b)(3) is the source control standard for remedies. A critical objective of remedies must be to reduce further environmental degradation by controlling or eliminating further releases that may pose a threat to human health and the environment. In some cases, unless source control measures are taken, efforts to clean up releases may be ineffective. EPA is persuaded that effective source control actions are an essential part of ensuring the effectiveness and protectiveness of corrective actions at MSWLFs.

The standard of § 258.57(b)(3) requires that further releases from sources of contamination that may pose a threat to human health or the environment be controlled to the "maximum extent practicable." This qualifier is intended to account for the practicable capabilities of the owner or operator and the technical limitations that may, in some cases, be encountered in achieving source controls. For some very large MSWLFs, engineering solutions such as treatment or capping to prevent further leaching may not be technically feasible or completely effective in eliminating further releases above health-based contamination levels. In such cases, source control may need to be combined with other measures, such as plume management or exposure controls, to be an effective and protective remedy.

The Agency does not intend this source control requirement to disrupt solid waste disposal at operating MSWLFs that have contaminated ground water. The Agency believes that, until the MSWLF is closed with an appropriate final cover (pursuant to § 258.40), other effective measures may be implemented. For example, depending on the source(s) of the release(s), capping inactive cells or units may help to control further releases. As mentioned above, plume management and exposure controls also may be needed, especially while the facility is continuing to receive waste.

The concept of effective source control as a remedial objective, as expressed by this remedy standard in § 258.57(b)(3), is closely linked to the CERCLA preference for Superfund remedial actions that utilize "permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable."

The proposed remedy standard of § 258.57(b)(4) requires that remedial activities that involve management of wastes must comply with the requirements for solid waste management, as specified in § 258.58(d) in today's proposed rule. Remedies may involve treatment, storage, or disposal of wastes, particularly in the context of source control actions. This standard will ensure that management of wastes during remedial activities will be conducted in a protective manner. The Agency requests comment on the four proposed standards for remedies.

Proposed § 258.57(c) specifies general factors to be considered by the State in selecting a remedy that meets the four standards for remedies. These factors, which generally are consistent with the evaluation criteria specified in SARA, are discussed briefly below. The Agency requests comment on these factors.

These factors are meant to aid the States in evaluating the data provided by the owner or operator as a result of the assessment of corrective measures. The general decision factors are: (1) Long- and short-term effectiveness and protectiveness, (2) reduction of future releases, (3) implementability, (4) practicable capability of the owner or operator, and (5) community concerns.

The first two factors described under § 258.57(c) are directly linked to the standards for the remedy. The long- and short-term effectiveness and protectiveness of the remedy is a measure of whether human health and the environment will be protected while the remedy is being implemented and once it is completed. It also is a measure of whether the GWPS can be met. The second factor, the reduction of future releases, should be used in evaluating how well the source control standard has been met. The practicable capability of the owner or operator also may be considered when evaluating to what extent source control can be achieved.

The Agency believes that the implementability of potential remedies also must be considered by the State when evaluating remedies. Factors that may affect the implementability of a remedy included: (1) The degree of difficulty associated with constructing the technology, (2) the expected operational reliability of the technologies, (3) the availability of necessary equipment and specialists, and (4) the available capacity and location of needed treatment, storage, and disposal services.

The practicable capability of the owner or operator is another remedy selection factor. As described elsewhere in this preamble, practicable capability includes both economic and technical capability of the owner or operator. The consideration of practicable capability allows the State to choose the remedy or combination of remedies that can meet the overall goal of protection of human health and the environment. This may affect the timing of corrective action, and, therefore, practicable capability has been listed as a factor for the States to consider in establishing the cleanup time frame (see preamble discussion of § 258.57(d)). In addition, as mentioned previously, the practicable capability of the owner or operator may be considered by the State in defining to what extent the source of releases will be controlled.

Community concerns is another factor that the Agency believes must be considered by the State when selecting a remedy. It is very important that the community has confidence in the remedy, how it was chosen, and the party responsible for implementation. The success of the corrective action process with regard to community involvement may significantly affect the siting of future MSWLFs in that community.

Any remedy proposal developed during the assessment of corrective measures presented to the State for final remedy selection must, at a minimum, meet the four standards of § 258.57(b). The State then will evaluate those remedies. The decision factors discussed above will be used by the State in selecting the appropriate remedy. The relative weight given to any one of the factors will vary from facility to facility. For example, short-term effectiveness considerations may be of particular concern where remedial activities will be conducted in densely populated areas, or where waste characteristics are such that risks to workers are high and special protective measures are needed. Implementability factors will often play a substantial role in shaping remedies—some technologies will require State or local permits prior to construction, which may increase the time needed to implement the remedy.

Proposed § 258.57(d) would require the State to specify a schedule for initiating and completing remedial activities as a part of the selection of remedy process. This provision gives the States the flexibility to prioritize MSWLF cleanups within their borders. The Agency believes that the flexibility these factors (described below) allow is essential considering the practicable capability of many MSWFs. Further, the Agency believes that the use of these factors will not in any way compromise protection of human health or the environment.

The Agency is proposing that the State consider numerous factors in determining the cleanup time frame. First, threats to human health or the environment from exposure to contamination during implementation of the corrective action program must be

considered. Ground-water cleanup should be hastened if protection of human health and the environment cannot be ensured. Current ground-water users and actual or potential ecological damages must be identified. Second, the extent and nature of the contamination should be considered to determine what remedies and time frames are technically feasible.

The resource value of the contaminated aquifer is a third factor. Resource value is broadly defined as the value of the aquifer as a current and future water supply for domestic, industrial, agricultural, and other beneficial uses. This provision allows the States to balance the resource value of the affected ground water against the corrective action costs to determine the corrective action time period. States then can determine and require, at a minimum, that owners or operators implement the combination of replacement and corrective actions that most efficiently address the short- and long-term protection of human health and the environment. When evaluating the resource value of the aquifer, States should consider the value of the regional aquifer, not just the value of the portion of the aquifer affected by the facility. In addition, local values with respect to maintaining uncontaminated aquifers should be considered.

A fourth factor to be used by the state in determining the corrective action time period is the availability of treatment or disposal capacity for any waste managed during the corrective action program. Capacity should be ensured before removal or treatment of the wastes or ground water begins. In addition to ensuring capacity, the owner or operator must also ensure that wastes will be managed in compliance with requirements in § 258.58(d).

The fifth and sixth factors concern remedial technologies. New and innovative corrective action technologies are being investigated continually and it may be appropriate for the State to postpone ground-water remediation if a new technology (i.e., one that currently is not available) offers significant advantages over current technologies. Along the same lines, the State must consider the practicable capabilities of existing remedial technologies before setting up a compliance schedule. For example, the amount and complexity of construction needed to implement a particular remedical technology could be an important factor or the amount of time that would routinely be needed to achieve the GWPS given a specified technology.

The States also may consider, in dtermining a cleanup time schedule, the practicable capability of the owner or operator of the MSWLF. These capabilities include both the economic and technical capabilities of the owner and operator to initiate the corrective action program. As mentioned previously EPA does not intend to tradeoff environmental or human health protection for cost considerations. The use of practicable capability as a remedy decision factor was described earlier. Using the practicable capability of the owner or operator as well as other cost considerations (e.g., discussed in relation to resource value) in combination with the other factors described above to determine the cleanup time frame, allows the State to choose the combination of actions that will effectively and erfficiently protect human health and the environment and ensure that ground-water remediation is completed.

The proposed factors undr § 258.57(d) would allow the State to accept a combination of remedies to be implemented in discrete phases. This phased approach may affect the time required to achieve the final cleanup. Such an approach will ensure that important environmental problems are addressed first (interim measures may also be used; see preamble discussion of § 258.58(a)(4)). This phased approach may be frequently necessary at operating facilities to prevent the disruption of solid waste disposal. Initial actions would always include steps to prevent exposure to the contaminated ground water (e.g. make alternative water available). An initial remedial step may be to install a pump and treat system that would minimize further migration of the plume. These steps could continue until more active remediation or source control could be implemented.

Section 258.57(e) of today's proposal requires the State to establish a GWPS for each Appendix II constituent detected above trigger levels. The GWPS represents constituent concentrations that remedies must achieve. The GWPS is set on a constituent-specific basis during the remedy selection process.

The State must set the GWPS within the overall context of the remedy selection process. During the assessment of corrective measures (§ 258.56) the owner or operator should design remedies to meet target cleanup levels. These target cleanup levels may start out as trigger levels, but, as pertinent site-specific information becomes available, the State should modify the target levels. The remedies analyzed by the owner or operator should generally be designed to meet the target levels. The State will ultimately select a remedy and set a ground-water protection standard that must be achieved.

The State's primary consideration in setting ground-water protection standards will be to ensure that human health and the environment are protected. As in the case of trigger levels, the State should generally use promulgated health-based standards (e.g., MCLs) and GWPS, where they are available.

Where MCLs or other such standards are not available, the State may rely on RfDs and RSDs in developing ground-water protection standards (see preamble discussion of Determination of Trigger Levels for more information about RfDs and RDSs). For noncarcinogens, the State may set a level based on the RfD. States have flexibility to select a GWPS within the protective risk range (see preamble discussion of risk range alternatives being considered and of Determination of Trigger Levels).

A variety of site-specific and/or remedy-specific considerations may enter into the determination of where within the cancer risk range the ground-water protection standard for a given hazardous constituent will be established. The most appropriate level for cancer risk must be determined through an analysis of factors related to exposure, uncertainty, and technical limitations. Proposed § 258.57(e) lists five factors the State may consider in establishing GWPSs.

The first site-specific factor is multiple contaminants in the ground water. To ensure that individuals exposed to ground water will be protected, it may be necessary to consider the risks posed by other constituents in the ground water before a GWPS for a single constituent can be extablished. In considering the risks posed by multiple contaminants, the State should follow the procedures and principles established in the Agency's "Guidelines for the Health Risk Assessment of Chemical Mixtures" (51 FR 34014) issued on September 24, 1986. All other factors being the same, the GWPS for a constituent present in ground water that is contaminated with other constituents that pose significant risks should be established at a lower concentration than if that constituent were the sole contaminant in the ground water. Taken as a whole, once final remediation is completed, ground water must not pose a risk greater than 1×10^{-4}. To the extent practicable for new MSWLFs, the overall risk level for the ground water (not for each constituent) should be equivalent to the risk level used in

meeting the design standard (see preamble discussion of § 258.40).

The second factor is actual or potential exposure threats to sensitive environmental receptors. Frequently, levels set for protection of human health also will be protective of the environment. However, there may be instances where adverse environmental effects may occur at or below levels that are protective of human health. Sensitive ecosystems or threatened or endangered species' habitats should be considered in establishing the GWPS.

The next factor is other site-specific exposures to the contaminated ground water. For example, residents living near a municipal solid waste landfill may receive unusually high exposures of hazardous constituents from other sources (e.g., lead from a lead smelter). These other exposures should be considered when developing the GWPS.

The last consideration is remedy-specific factors. The State must consider the reliability, effectiveness, practicability, and other relevant factors of the remedy when establishing a GWPS. For example, a remedy that can treat constituents in ground water down to concentrations posing a 1×10^{-5} risk level may be selected in preference to another remedy that might achieve a 1×10^{-6} risk level, but that relies on technology that has not been successfully demonstrated or may be unreliable for other reasons.

There also are technical limitations that must be considered, in addition to scientific information about the hazards to human health and the environment, in establishing ground-water protection standards. For example, GWPSs should not be set lower than detectable levels.

Proposed § 258.57(e)(5)(i) establishes that a GWPS hould not be set below background levels unless the State determines that cleanup to levels below background is necessary to protect human health or the environment. In general, the Agency believes that it may not be reasonable to require the owner or operator to reduce the concentrations of hazardous constituents to levels below background. In many cases such a reduction would not be technically feasible. Today's proposal, however, does not allow MSWLFs located in contaminated areas to ignore incrementally significant facility contributions to the contamination unless a determination is made under proposed § 258.57(f) that remediation is not required.

Proposed § 258.57(f) identifies three situations in which the State may decide not to require cleanup of a release to ground water of hazardous waste or hazardous constituents from an MSWLF, thus obviating the need to establish ground-water protection standards. These situations are limited to cases where there is no threat of exposure to releases from MSWLFs, or cases where cleanup will not result in any reduction in risk to human health or the environment. In any case, the State may impose under § 258.57(g) source control requirements to minimize or eliminate further releases from the MSWLF even if remediation is not required. The Agency does not believe that continued further degradation of the environment is warranted, even in those situations where cleanup may not be required.

In some cases, MSWLFs releasing hazardous constituents to the ground water will be located in areas that already are significantly contaminated. Where releases from the MSWLFs are trivial compared to the overall area-wide contamination, or where remedial measures aimed at the MSWLF would not significantly reduce risk, EPA believes that remediation of releases from the MSWLF would not be necessary or appropriate. In these situations, proposed § 258.57(f)(1) would allow the facility owner or operator to provide the State information demonstrating that remediation would provide no significant reduction in risk. If the demonstration were made, the State should determine that remediation is not necessary.

For example, ground water below a leaking MSWLF might be heavily contaminated from off-site sources. In this case, removal of the MSWLFs contribution to the contamination might have very limited benefit, particularly if that contribution was relatively minor. Control of the MSWLF releases might do very little, in such a case, to improve the overall situation in the area, yet (in the case of an operating unit) might be extremely burdensome to the owner or operator.

Two points should be stressed here, however. First, the facility owner or operator would be required to remediate the ground water where it could have a significant effect on reducing risks—for example, as part of an area-wide cleanup strategy. Second, in any case, under § 258.57(g) source control may be required to prevent further releases.

The Agency has not attempted to define "significant reductions" in risk in this rulemaking, and believes the decision is best made on a case-by-case basis by the State. However, the Agency seeks comment on whether a more specific definition is necessary for the purposes of this rulemaking.

Under proposed § 258.57(f)(2), the State may determine that a hazardous constituent that has been released from an MSWLF to ground water does not pose a threat to human health and the environment and, therefore, does not require remediation if: (1) The ground water is not a current or potential source of drinking water and (2) the ground water is not hydraulically connected with waters to which the hazardous constituents are migrating or are likely to migrate in a concentration(s) that represents a statistically significant increase over background concentrations.

In interpreting whether the aquifer meets these criteria, the State may use the approach outlined in the Agency's Ground-Water Protection Strategy (August 1984) as guidance. Typically, Class III ground waters will be considered to meet the requirements specified in § 258.57(f)(2)(i). Class III ground waters are ground waters not considered potential sources of drinking water. They are ground waters that are heavily saline, with TDS levels over 10,000 mg/l, or are otherwise contaminated beyond levels that allow cleanup using methods reasonably employed in public water system treatment. These ground waters also must not migrate to Class I or II ground waters or have a discharge to surface water that could cause degradation. The need to remediate Class III ground waters should be assessed on a case-by-case basis.

Proposed § 258.57(f)(3) would allow the State to make a determination that remediation of a release is not required when remediation is technically impracticable or when remediation presents unacceptable cross-media impacts. Such a determination may be made, for example, in some cases where the nature of the hydrogeologic setting would prevent installation of a ground-water pump and treat system (or other effective cleanup technology), e.g., in Karst formations or where heavily fractured bedrock lies under the facility. In these situations, the installation of such a system could possibly increase environmental degradation by introducing the contaminant into ground water that was not previously affected by the release. The Agency is persuaded that in this and other situations remediation should not be required. The Agency is specifically soliciting comment today on the types of situations that might warrant a determination that remediation of a release is technically impracticable or presents unacceptable impacts and would not, therefore, be required.

Proposed § 258.57(h) outlines the Agency's proposed approach to

establishing conditions the owner or operator must fulfill to achieve and demonstrate compliance with the GWPS established by the State during the remedy selection process.

First, the GWPS must be achieved at all points within the plume of contamination that lie beyond the ground-water monitoring well system established under § 258.51(a). The ground-water monitoring well system is established at the boundary chosen for the design (i.e., at the unit boundary or a State alternative boundary that does not exceed 150 meters from the waste management unit boundary and is on land owned by the owner or operator of the MSWLF (see preamble discussion of § 258.51(a)). It is logical that cleanup be required up to the boundary for which the facility was designed to meet a health-based risk level.

The Agency also is proposing under § 258.57(h)(2) that the State specify in the remedy the length of time during which the owner or operator must demonstrate that concentrations of hazardous constituents have not exceeded specified concentrations in order to achieve compliance with GWPSs. Under existing Subtitle C regulations (§ 264.100), the Agency has required that facility owners or operators remediating ground-water contamination from regulated hazardous waste units continue corrective action until the designated GWPSs have not been exceeded for a period of three years. The Agency has found that, given the variety of hydrogeologic settings of facilities and characteristics of the hazardous constituents, it is difficult to demonstrate reliably that the GWPSs have been achieved by imposing a uniform time for demonstrating compliance. Consequently, the Agency is considering proposing changes to the Subtitle C program.

In today's proposal for MSWLFs, the Agency is proposing that the State specify the length of time required to make such a demonstration on a site-specific basis. As described under proposed § 258.57(h)(2), the State may consider four factors in setting this timing requirement: (1) The extent and concentration of the release, (2) the behavior characteristics of the hazardous constituents in the ground water, (3) the accuracy of the monitoring techniques, and (4) characteristics of the ground water. The Agency believes that consideration of these factors will allow the State to set an appropriate time period for demonstrating compliance with GWPSs rather than relying on an arbitrary time period for all facilities or all situations at the same facility.

One example of how these considerations might affect a decision on the time a ground-water protection standard must not be exceeded to demonstrate compliance is given here. The Agency expects that pump and treat systems will be necessary at many MSWLFs. Experience in the RCRA Subpart F program (which addresses releases of hazardous constituents to ground water from regulated hazardous waste units) has shown that continuous operation of a pump and treat system may interfere with the owner or operator's ability to obtain accurate sampling data on constituent concentration levels. Allowing natural restoration of chemical equilibrium in the affected ground water after the pump and treat system is turned off will be necessary to obtain accurate readings of constituent concentrations. If the concentration(s) rise to unacceptable levels after the remedial technology is disconnected, reinitiation of treatment may be required. This process would have to be repeated until acceptable concentration levels are achieved after chemical equilibrium has been reached in the ground water with the treatment system suspended.

5. Section 258.58 Implementation of the Corrective Action Program

Implementation of a corrective action program is required when hazardous constituents are detected at levels higher than the GWPS. Several activities are required of the owner or operator under proposed § 258.58. First, a corrective action ground-water monitoring program is required under proposed § 258.58(a)(1). This program must meet the requirement of the Phase II monitoring program (§ 258.55), demonstrate the effectiveness of the remedy(s), and demonstrate compliance with the GWPS.

Second, under § 258.58(a)(2), the owner or operator must implement the remedy(s) selected by the State under § 258.57. As described under § 258.57, the "remedy" encompasses not only the technology to be used to remediate the ground water (if remediation is to be conducted), but also the GWPSs to be reached and the time the owner or operator has to reach the standards (see preamble discussion of § 258.57).

Next, under § 258.58(a)(3), the owner or operator must notify all persons who own or reside on the land that overlies any part of the plume of contamination. The State may require the owner or operator to notify such persons any time the trigger level has been exceeded (i.e., before the GWPS has been established) if the State determines it necessary to protect human health or the environment (see § 258.58(f)).

Under the proposed § 258.53(a)(4) the State may require the owner or operator to conduct interim measures at an MSWLF whenever the State determines such actions are necessary to protect human health or the environment. The interim measures would serve to mitigate actual threats and prevent potential threats from being realized while a long-term comprehensive response can be developed. Interim measures should, when possible, be consistent with the expected final remedy. The State should consider the immediacy and magnitude of the threat to human health or the environment as primary factors in determining whether an interim measure(s) is required. Proposed § 258.58(a)(4)(i)–(vii) lists factors that the State may consider in determining whether an interim measure is required.

Interim measures may encompass a broad range of actions. For example, an owner or operator responsible for contamination of a drinking water well may be required to make available an alternative supply of drinking water as an interim measure in an effort to protect human health. This replacement action could be temporary or permanent. The duration of the period over which replacement supplies must be provided can affect the type of action selected. Replacement actions may include hooking up affected aquifers, relocating wells, and treating contaminated ground water at the point of use.

During the implementation stage, other factors may arise that make the chosen remedy technically impracticable. For example, the unexpected occurrence of an area of unstable soils may render the chosen source control remedy impossible to construct. Proposed § 258.58(b) describes factors the State must consider in making such a determination. In these instances, the State may require that the owner or operator implement other alternatives to control exposure to residual contamination as described under § 258.58(c). The State also may require the owner or operator to implement other source control options and other equipment, unit, device, or structure decontamination activities. The State will evaluate these alternative activities for their technical practicability and their consistency with the overall objectives of the original remedy. The GWPS will not be changed; however, the State may want to adjust the time allowed for completion of the remedy.

Proposed § 258.58(d) requires that wastes generated during the implementation of corrective action be managed in a manner that is protective of human health and the environment. In particular, the waste management practices must be in compliance with all applicable RCRA requirements.

According to proposed § 258.58(e), the remedy is considered complete when the GWPS has been achieved according to the requirements of § 258.57(h) and all other actions required in the remedy have been completed (e.g., source control measures). After the required remedy is complete, the owner or operator must submit a statement that certifies that the remedy has been completed in accordance with requirements under § 258.58(e). In addition to the owner or operator's signature the certification must contain the signature of an independent professional engineer geologist, or other appropriate technically trained person. According to § 258.58(g), after the State receives the certification and is satisfied that the remedy is complete, the State releases the owner or operator from the requirements for financial assurance for corrective action.

The Agency considered an alternative approach to the corrective action program proposed today. The alternative would involve the following steps. First: the owner or operator would be required to do three activities: (1) Report to the State any concentration of hazardous constituents in the ground water above trigger levels, (2) investigate the nature and extent of the contamination, and (3) take all necessary actions to abate any immediate risks to human health and the environment. Second, after the owner or operator submitted the results of the investigation, the State would assess, site-specifically, the risks to human health and the environment posed by the ground water contamination. Based on this assessment, the State would set site-specific requirements for clean up of the ground water (including cleanup levels). Next the owner or operator would be required to submit to the State for approval a plan for meeting the cleanup requirements. The owner or operator then must implement the approved plan. Modifications to the plan would be allowed, if needed, based on site-specific considerations. The approach would present fewer specific Federal requirements for cleanup. The Agency requests comment on this alternative approach as well as the proposed corrective action requirements discussed above.

X. Effective Date, Implementation, and Enforcement of the Revised Criteria

Subtitle D of RCRA, as amended by HSWA in 1984, requires the Administrator to revise the Criteria for sanitary landfills under § 4004(a) and the solid waste management guidelines under section 1008(a) for facilities that may receive HHW or hazardous wastes from SQGs. Subtitle D also contains specific requirements with respect to the implementation and enforcement of the revised Criteria for facilities that may receive these wastes. Of particular significance is the provision in § 4005(c) requiring that States adopt and implement, within 18 months of the promulgation of the revised Criteria, a facility permit program or other system of prior approval to ensure compliance with the revised Criteria. In addition, this section provides that "in any state that the Administrator determines has not adopted an adequate program * * * the Administrator may use the authorities available under section 3007 and 3008 of [Subtitle C] to enforce the prohibition contained in subsection (a) of this section with respect to such facilities." A discussion of the issues regarding the implementation and enforcement of the revised Criteria and the options the Agency is considering for addressing these issues is set forth below.

A. Effective Date of the Revised Criteria

EPA today is proposing that the revised Criteria become effective 18 months after their promulgation. The Agency considered an alternative two-stage approach, which is described below, but decided that 18 months is the most appropriate time period for several reasons.

1. Eighteen-month Period

First, the 18-month time period would coincide with the period within which States, under section 4005(c) of RCRA, are to adopt and implement a permit program or other system of prior approval to ensure that facilities comply with the revised Criteria. Congress provided this 18-month period after the promulgation of the revised Criteria to provide States adequate time in which to adopt new or revise existing applicable State standards and to institute a permit process for ensuring facility compliance. Because the States are given the lead responsibility for implementing the revised Criteria under these provisions, EPA believes it is critical to set an effective date for the revised Criteria that coincides with the date the States are required by RCRA to have their implementation mechanisms in place.

Second, the 18-month period would provide MSWLF owners and operators with sufficient time to take the necessary measures at their facilities to bring them into compliance. EPA recognizes that certain of the revised Criteria proposed today may require substantial efforts on the part of the facility owner and operator both in modifying management practices at an existing MSWLF and in planning full compliance for a new one. The fact that most MSWLFs are owned and run by local governments, which have limited resources, also is a consideration. Congress directed EPA to take into account the "practicable capability" of facilities in revising the Criteria. EPA believes that the proposed 18-month period for allowing MSWLFs to come into compliance recognizes the practicable capability of MSWLFs to meet certain of the revised Criteria.

Although EPA recognizes that some of the revised Criteria could be implemented in shorter periods of time, i.e., six or 12 months, EPA believes that a uniform effective date of 18 months would minimize confusion on the part of the regulated community. Also, while the 18-month period before the effective date proposed today would postpone application of the revised Criteria to MSWLFs, it would not leave these facilities unregulated. The current part 257 Criteria and applicable State standards would remain in effect for these facilities until the revised Criteria become effective. In addition, some States may adopt the revised Criteria, making them effective under their own authorities, before the 18-month period expires.

EPA recognizes that there are some limitations with this approach. EPA is concerned that the 18-month period between the promulgation and the effective date of the revised Criteria might allow some MSWLFs to close to avoid meeting the new requirements. The Agency does not intend for this period to be a window of escape for marginal MSWLFs. Experience shows, however, that MSWLFs do not open and close overnight. In fact, the long operating lives of most existing MSWLFs and years of advance planning needed for siting and permitting new facilities significantly mitigate against such actions. The Agency is aware that some closures may occur, however, and intends to work with the States to guard against closures performed in an unsatisfactory manner that may pose threats to human health and the environment.

2. Two-stage Approach

The 18-month approach would preclude enforcement of the revised Criteria through the citizen suit provisions of RCRA § 7002 pending their becoming effective. Thus, for 18 months, citizens will be unable to use RCRA to enforce the revised Criteria. For this reason, EPA is considering the option of establishing two stages of effective dates. The first stage of effective dates would be for only those requirements that can be implemented by the facility owner or operator in less than 18 months and are self-implementing on their face, thus, leading themselves to more immediate effective dates. The effective date would be set at six or 12 months after the promulgation date as appropriate for the specific requirement. The self-implementing provisions of this rule include the general operating criteria such as the liquids management restrictions, the disease vector and explosive gas controls, recordkeeping, and closure and post-closure planning requirements. The second-stage effective date would be limited to those requirements that require interactions with or determinations by the State and substantial efforts on the part of the facility owner or operator for effective implementation. These requirements include the ground-water monitoring and corrective action requirements. The two-tiered approach would maximize the use of citizen suit provisions during the 18-month period because some of the requirements would be in effect sooner, i.e., in 6 12 months; however, this approach runs the risk of causing considerable confusion on the part of regulated facilities and inconsistent application of the revised Criteria nationwide.

Although EPA has decided to propose an effective date for all the revised Criteria of 18 months after the date of promulgation, EPA specifically solicits public comment on the alternative two-stage effective date approach described above.

B. Review of State Permit Programs

Section 4005(c) of RCRA, as amended in 1984 by HSWA, requires the Administrator to determine whether each State has developed an adequate permit program or other system of prior approval and conditions to ensure that each solid waste disposal facility that receives HHW or SQG hazardous waste will comply with the revised Criteria. The Administrator also is given the discretionary authority to preform these reviews in conjunction with the reviews of State solid waste management plans under RCRA § 4007.

The Agency solicits comments concerning the most appropriate means for determining the adequacy of State permit or other prior approval programs. Issues include whether the Agency should confine its review to assessement of a State's permit or other prior approval program or whether the Agency should expand this review to include all the components of the State's solid waste management plan. Under the first option, the Agency only would review the State's permit or approval program that incorporated the revised Criteria. The Agency's review of the State program would be limited to that portion of the State's Subtitle D program. The Agency recognizes that an expanded review under the second option would provide the State with the flexibility to present additional elements of its solid waste management program, outside of the permit or other prior approval program, that help ensure the proper management of solid waste disposal facilities. In addition, this broader evaluation would provide the Agency with a better understanding and appreciation of State implementation activities under Subtitle D.

The latter option, however, would require all of the States to either develop or modify their solid waste management plans to reflect the revised Criteria. The development and/or modification of these plans is a lengthy, and resource-intensive process. The States may not be able to meet the HSWA requirement to adopt and implement a permit program or other system of prior approval within 18 months from promulgation of the revised Criteria if they also must revise their solid waste management plans.

Depending on the outcome of the above issues, the Agency may need to modify the Guidelines for Development and Implementation of State Solid Waste Management Plans (40 CFR Part 256), which delineate the requirements and procedures for State solid waste management plan review. The current Part 256 guidelines comprehensively address program requirements, solid waste management plan submittal procedures, organizational issues, permit programs, legislative and regulatory authorities, and public participation requirements. The Agency may need to modify Part 256 to clearly specify the Agency's evaluation criteria and review procedures for the revised Subtitle D Criteria.

There are two other issues on which the Agency specifically requests comments. The first issue relates to what evaluation criteria the Agency should use to determine the adequacy of State permit programs. One option is for the Agency to base its determination of program adequacy on the content of the State's statutory and regulatory requirements. Under this approach, the Agency would develop evaluation criteria for determining whether these State requirements ensure that the revised Criteria are met.

On the other hand, the Agency could assess State programs on the basis of legislative and regulatory mechanisms together with an evaluation of program effectiveness. This review would include an assessment of the State's past performance (i.e., enforcement, permitting) in managing solid waste disposal activities. In particular, the Agency would consider State resource and technical capabilities in evaluating State program adequacy.

The second issue concerns the extent of public participation that should be provided for in the Agency's review of State program adequacy. The Agency is soliciting comments on whether there should be opportunities for public review and comment on the Agency's evaluation of the adequacy of State solid waste permitting programs or other aspects of the State's solid waste management plan. While the Agency recognizes that such participation opportunities may significantly extend the review period, EPA nevertheless is interested in providing such opportunities when appropriate. EPA will publish a more specific proposal addressing these issues at a later date.

C. Enforcement of the Revised Criteria

States that have adopted the revised Criteria under State law may enforce them in accordance with State authorities. Under today's proposal, there would be no authority for EPA enforcement of the revised Criteria until, 18 months after the date of promulgation of the revised Criteria, the Agency determines that a State's program is inadequate. Also, citizens would be precluded from enforcing the revised Criteria via citizen suits until the Criteria become effective.

1. Citizen Suits

As with the Part 257 Criteria, citizens may seek enforcement of the Part 258 revised Criteria (independently of any State program for their enforcement) by means of citizen suits. The citizen suit provisions of RCRA contained in section 7002 provide an important mechanism for ensuring compliance with the requirements of the statute and its implementing regulations. They authorize individuals, environmental groups, and local governments, among

others, to bring legal actions for noncompliance with RCRA requirements. Thus, once the revised Criteria become effective, they have the full force of law and may constitute the basis for citizen enforcement actions against facilities that fail to comply. Citizens would be able to bring actions against facilities for failure to comply with the Criteria and actions against States for failure to develop and implement permit or other prior approval programs as required by RCRA section 4005.

2. Federal Enforcement

Section 4005(c)(2) of RCRA, as amended by HSWA in 1984, provides authority for EPA enforcement of the revised Criteria under authority of sections 3007 and 3008 of Subtitle C. This provision is significant in that it represents the first authority for EPA enforcement of regulatory requirements under Subtitle D. According to section 4005(c)(2), EPA enforcement is contingent on an EPA determination that a State has not adopted an adequate permit or other prior approval program to ensure the compliance of facilities with the revised Criteria by 18 months from the date of promulgation of the revised Criteria. Having made this determination, EPA may use the inspection and enforcement authorities under sections 3007 and 3008 to enforce against facilities failing to comply with the revised Criteria. Disposal of solid waste at facilities that do not comply with the revised Criteria constitutes open dumping. These authorities provide EPA with the necessary tools to enforce Subtitle D's prohibition against open dumping.

EPA expects the States to assume the primary responsibility for implementing and enforcing the revised Criteria, and a major EPA enforcement program for Subtitle D is not envisioned. If States fail to assume their responsibility with respect to the revised Criteria, however, EPA may step in to ensure compliance with Part 258 as necessary to protect human health and the environment. As explained above, EPA is soliciting comments on the criteria and procedures that it should use to determine whether a State has adopted an adequate program.

EPA has determined that it is necessary to formulate an enforcement strategy with respect to the revised Criteria and welcomes public comment on the overall role of EPA enforcement under Subtitle D, the proper elements of an enforcement policy for ensuring compliance with the revised Criteria, and strategies for targeting MSWLFs that pose the greatest threat to human health and the environment. EPA is soliciting public comment on the specific circumstances and situations of facility noncompliance with the revised Criteria that should precipitate direct EPA enforcement actions. In addition, the Agency is particularly interested in comments on circumstances under which the Agency should act to enforce criteria once the Administrator has determined that the State's program is inadequate pursuant to section 4005(c)(1)(C).

D. Other Implementation Issues

1. Implementation Strategy

In conjunction with the development of this rule, the Agency is preparing an implementation strategy. This strategy will serve as a planning document for EPA and the States in understanding what actions are necessary to modify the management of their regulatory programs to accommodate the revised Criteria. This strategy is designed to limit future implementation problems by anticipating potential problems or obstacles and crafting implementation options to resolve or minimize these issues before they emerge.

The Agency currently is identifying implementation issues and needs concerning permitting, compliance monitoring, and enforcement activities; public education and outreach activities; guidance and training needs; resource needs; and EPA/State roles and responsibilities. In particular, the Agency requests comments on the following implementation concerns: (1) What types of education-outreach programs are needed for State and local officials, the regulated community, and the general public? (2) In what areas is there a need for guidance and training? What types of technical assistance activities are needed? (3) What is an appropriate and practical EPA role if the States do not adopt and implement the revised Criteria?

The Agency also solicits comment on whether additional issues should be considered in developing this strategy.

2. Co-disposal of Sewage Sludge

One of the major disposal practices for sewage sludge is disposal at a municipal solid waste landfill. Approximately 6,800 POTWs dispose of their sewage sludge in this manner. By promulgating the Part 258 requirements jointly under RCRA and CWA section 405, questions arise as to the extent to which the Part 258 criteria would be implemented through NPDES permits issued to POTWs. Under RCRA Subtitle D (section 4005(c)), the Part 258 criteria are to be imposed by States on the owner or operator of an MSWLF. States are to impose the criteria by a system of prior approval and conditions, such as issuance of a permit to the MSWLF. The Agency has selected this approach to reconcile the two programs in a way that would minimize duplicative regulation while best ensuring complete coverage under both statutes. This approach would be consistent with section 1006(b) of RCRA, which requires EPA to integrate the provisions of RCRA for purposes of administration and enforcement, and to avoid duplication to the maximum extent practicable, with the appropriate provisions of the CWA and other environmental laws administered by EPA.

Under this proposal, the Part 258 criteria applicable to the characteristics of sewage sludge that must be met if sewage sludge is placed in an MSWLF would be implemented through permits issued to POTWs pursuant to section 405(f) of the CWA. The Part 258 criteria applicable to the landfill site would be implemented under the RCRA Subtitle D program. This would mean that the POTW permit would prohibit the disposal in an MSWLF of sludge found to be hazardous (§ 258.20), and would require that the sludge pass the Paint Filter Liquids Test (§ 258.28). The POTW permit also would prohibit the POTW from sending its sludge to MSWLFs that are not in compliance with the applicable Federal and State regulations. Thus, to obtain a permit authorizing disposal of sludge at a landfill, the POTW would have to ascertain that the MSWLF either has a permit under Part 258 or otherwise is authorized to operate as an MSWLF by the State in which it exists, as prescribed by RCRA.

EPA believes that this implementation scheme fulfills the goals and policies of both RCRA and the CWA and is a rational way to reconcile overlapping programs. EPA also considered separate implementation of the Part 258 criteria under each program. Under the sludge management program of the CWA, this method would involve implementation of all Part 258 criteria, including those applicable to location, design, and operation of the landfill, through permits issued to the POTWs. The Agency decided against this approach for two reasons. First, it would establish duplicative coverage without apparent corresponding environmental benefits. Typically, sewage constitutes a small proportion of the wastes disposed at an MSWLF. Compared to other wastes sent to an MSWLF, such as household hazardous waste and hazardous waste from very small quantity generators,

sewage sludge is unlikely to be the source of environmental problems at the landfill. In fact, the presence of sewage sludge in a co-disposal facility may even improve the quality of the leachate at least in the short run (Ref. 15). Second, holding POTWs liable for compliance by the landfill with the Part 258 standards may not be appropriate because other solid waste contributors are not similarly held liable.

EPA invites comment on whether the approach proposed here is an appropriate and effective means to ensure proper management of sewage sludge disposed of in a landfill.

XI. Regulatory Requirements

A. *Executive Order No. 12291*

1. Purpose

The Agency estimated the costs, benefits, and economic impacts of today's proposed rule. These analyses are required for "major" regulations as defined by Executive Order No. 12291. The Agency also is required under the Regulatory FLexibility Act to assess small business impacts resulting from the proposed rule. The cost and economic impact analyses also are a measure of the "practicable capability" of facilities to comply with the proposed rule.

The cost, benefit, and economic impact results indicate that today's rule is a "major" regulation and it would likely impose differential impacts on a significant number of small entities. This section of the preamble discusses the results of the analyses of the proposed rule as detailed in the draft Regulatory Impact Analysis of Proposed Revisions to Subtitle D Criteria for Municipal Solid Waste Landfills. The draft RIA is available in the public docket. This rule was submitted to the Office of Management and Budget (OMB) for review as required by E.O. No. 12291.

2. Regulatory Alternatives

E.O. No. 12291 requires EPA to estimate the costs and benefits for the proposed rule as well as any viable alternatives. Several current provisions (e.g., performance standards for existing units, post-closure care, ground-water monitoring parameters) of the proposed rule do not exactly reflect what was analyzed in the RIA. For this reason, the results presented in this section and the RIA may understate the fraction of existing landfills requiring more stringent covers (and the resulting costs of these covers), overstate costs for post-closure care, and understate the sampling costs for ground-water monitoring. Nonetheless, the Agency believes the basic conclusions of the draft RIA are accurate estimators of the effects of the proposed rule.

In addition to the proposed rule, EPA analyzed the effects of three regulatory alternatives in the RIA. The analysis of the regulatory options provides a comparison of the proposed rule in the context of other regulatory scenarios. The alternatives predominantly differ with respect to the stringency and uniformity of the containment and cover requirements. Corrective action (the benefits of which currently are modeled for new units only) and extended post-closure care are required for all regulatory options.

Alternative 1 consists of a uniform set of technology-based requirements that are imposed on all MSWLFs irrespective of location or migration potential. This alternative has the most stringent design requirements and essentially reflects the Subtitle C regulations for land disposal. New units are required to have a double composite containment system (i.e., two synthetic liners over a clay liner) with two LCSs and a composite cover. New and existing units are required to close with a composite cover. Ground-water monitoring (as detailed in Subpart F of 40 CFR Part 264), gas monitoring, run-on and run-off controls, and exclusion plan for nonmunicipal solid waste, corrective action, and extended post-closure care are required for both new and existing units under this regulatory alternative.

Alternative 2 requires cover and containment designs based on the migration potential at the site. This categorical approach is described in Section D of this preamble. General facility standards are identical to those for the proposed rule. Corrective action and extended post-closure care are required for all units.

Alternative 3 imposes ground-water monitoring, corrective action, and extended post-closure care on both new and existing units. This alternative is similar to the statutory minimum described under Section D of this preamble except that location standards are not analyzed.

Costs, economic impacts, and risk estimates (including resource damage) are presented in this section for the proposal and the three regulatory alternatives; primary emphasis will be on results for the proposed rule.

3. Cost Analysis

a. Methodology. The Agency developed an engineering cost model to estimate total costs for an MSWLF under a variety of technical and regulatory scenarios. This model estimates the cost to design, construct, operate, close, and provide post-closure care for an MSWLF. The model allows for user-specified input variables such as waste throughput, operating life, type and depth of fill operation, number of phases of construction, containment and cover systems, waste density, environmental monitoring and control, post-closure care, and a variety of unit costs and fees for construction and operation of the facility. Based on these inputs, the model calculates the necessary landfill dimensions (e.g., active area), capital costs, operating and maintenance costs, closure costs, and post-closure costs of the facility. In addition, the model assigns these costs to specific years of the operating life and post-closure care and then calcualtes a present value (in 1986 dollars) based on a 3 percent real disocunt rate. The model can estimate costs for any landfill size between 10 and 1,500 TPD. National costs for a given option then are calcualted using these unit costs and a size distribution of MSWLFs.

EPA selected a limited number of generic user inputs to the model and held these constant across the regulatory options so that cost differences in the environmental controls would be highlighted. EPA selected seven model facility sizes for modeling costs. Preliminary results form the Subtitle D Solid Waste (Municipal) Landfill Survey (referred to here as the Facility Survey) were used to assign a frequency distribution to each size category. The seven model sizes used (and the assigned frequency of MSWLFs) are: 10 TPD (51.4 percent), 25 TPD (16.9 percent), 75 TPD (12.7 percent), 175 TPD (7.1 percent), 375 TPD (6.5 percent), 750 TPD (3.2 percent), and 1,500 TPD (2.3 percent). (Although the 1,500 TPD category includes only 2.3 percent of all MSWLFs, these facilities handle 36.5 percent of all waste.) EPA assumed for the cost analysis that all MSWLFs opertate in one phase and use a cut-and-fill method of operation.

EPA estimated corrective action costs separately using the failure and release component of the risk model (described in Section X1.A.4 of this section). EPA's approach to estimating corrective action costs partially reflects the flexibility of this requirement in the proposed rule. EPA estimated costs based on aggessive cleanup of new contamination and either aggressive or passive cleanup of existing plumes. This approach to estimating corrective action costs was used for all regulatory alternatives in addition to the proposed rule.

For new contamination, EPA modeled the effects of ground-water recovery wells as the selected corrective action technology. The recovery wells are

assumed to be installed one year after the corrective action has been triggered.

For existing contamination, EPA estimated corrective action costs for two types of responses. The first response consists of active restoration of the plume using ground-water recovery wells (i.e., the approach modeled for new facilities). EPA assumed that this approach will be utilized for larger plume sizes as the most effective remedial measure. To partially account for the flexibility provided by the corrective action requirement in terms of the timing and response to contaminant plumes. the second response represents a passive approach for smaller plumes. EPA assumed that this passive approach would consist of providing an alternative water supply to affected user of the gound water. EPA recongizes that alternative technologies or remedies may be employed for cleanup of affected ground water. Corrective action costs were added to the design and operating costs to derive total costs for a given regulatory option.

To obtain incremental regulatory costs, EPA first characterized MSWLF baseline practices. Baseline practices are those design and operating practices that exist prior to the imposition of the requirements in today's proposed rule. EPA characterized baseline conditions using preliminary results from the Facility Survey and results from the State Census. For purposes of this analysis (including the economic impact and risk analyses discussed later), EPA characterized the baseline facility as an unlined landfill with a vegetative cover at closure, no environmental monitoring, no post-closure care, and no corrective action. However, as described below, EPA adjusted compliance costs to account for existing State requirements with respect to liners, leachate collection systems, and ground-water monitoring well requirements. The MSWLF population is extremely diverse in terms of its technical characteristics (e.g., presence of environmental controls, design capacity, remaining life), which is due in part to a broad range of State requirements that vary in both scope and detail. EPA reviewed the State requirements to identify those States that require containment (i.e., liners, leachate collection systems) and ground-water monitoring well requirements that would likely satisfy the conditions in today's proposed rule. EPA identified 22 States with similar liner and LCS requirements and 24 States that have similar ground-water monitoring well requirements. EPA adjusted the regulatory compliance cost estimates for facilities in these States. The adjustment for State liner and leachate collection system requirements was made only for analyzing the costs of the proposed rule; the costs for all regulatory options accounted for the existence of State requirements for ground-water monitoring wells. To the extent that other existing State requirements are similar to those in today's proposed rule, the estimated compliance costs will be overstated. Although EPA adjusted the national compliance cost estimates to reflect these State requirements, the risk and resource damage estimates were not adjusted to reflect the presence of containment systems in the baseline. The benefits of the regulatory options in protecting ground water as a drinking water source (presented in this section and in the RIA) will likely be overstated by not incorporating the presence of these State requirements; however, EPA has not analyzed the benefits of the regulatory options in reducing risk from other routes of exposure (e.g., surface water, subsurface gas, risks to the ecosystem). Therefore, the net benefits of the rule will likely be understated.

The Agency estimated compliance costs for each Facility Survey respondent. EPA assigned each respondent a weighting factor that represents the frequency of that type of facility in the total national regulated population of 6,034 active MSWLFs. The weighting factors were used to scale respondent facility costs up to national compliance costs for the regulatory options. EPA estimated compliance costs separately for new and existing requirements. In addition, EPA combined the new and existing MSWLF estimates to produce a compliance cost figure that represents an average cost for existing units and their new replacement landfills. New landfills are assumed to be perpetually replaced for this combined estimate.

For new MSWLFs, all regulatory costs are assumed to apply from the time construction begins. A new landfill is assumed to operate for 20 years and compliance costs (in present value terms) are annualized over this time period. For those facilities with longer operating lives (approximately 60 percent of all MSWLFs as reported in the Facility Survey), the annualized costs will be lower due to an increased amortization period for capital costs.

For existing MSWLFs, the regulatory costs are applied over the remaining operating life as reported in the Facility Survey. (Existing MSWLFs that were reported in the Facility Survey to be closing before the effective date of the proposed rule were not assigned existing requirement costs. These landfills were assumed to be replaced with new facilities to which appropriate requirements were applied.) EPA annualized the regulatory costs for an existing MSWLF over the remaining life of the facility. EPA assumed that revenues are generated to pay for regulatory costs during the operating life. Although this is likely to be true for private landfills, publicly owned facilities may have the option of passing on the costs (for facilities with short remaining lives) to future facilities and thus reduce the cost impact. Existing landfill costs will tend to be overstated for these facilities that amortize the costs over a period that extends past the reported remaining life.

To develop a combined estimate of average annualized compliance costs for the regulatory options, costs for existing units plus their new replacement landfills have been discounted to one present value that spans the existing landfill's remaining life plus the ongoing life of a new landfill that is replaced every 20 years. (Replacement of all existing MSWLFs with new MSWLFs does not account for the current trend away from siting new landfills; moreover, it is unlikely that each of the existing 6,034 MSWLFs will have a replacement landfill in perpetuity. Regionalization, recycling, shifts to resource recovery, and better siting of landfills in "good" locations will result in fewer new MSWLFs than estimated in this analysis. EPA has not incorporated these factors into the analysis because they involve simulating site-specific local decisions that are difficult to analyze. EPA's costs will tend to be overstated by not including these factors.) EPA assumed that the new MSWLF would be built at the same location such that the required designs remain the same. EPA then annualized this present value as a perpetuity to obtain an annualized combined compliance cost estimate for a given regulatory option. Although this figure does not represent the actual cash flow (i.e., for capital outlays) that would likely result from regulation, it does represent a level annual payment as if the facility operator had borrowed funds to pay the capital costs. This annualized combined cost estimate is used in the economic impact analysis of the regulatory options. Compliance costs specific to new and existing requirements are presented in detail in the RIA; however, costs (and economic impacts) presented in this section of the preamble only reflect the combined estimates.

For the proposed rule, EPA estimated the effect of the design goal on new MSWLFs by analyzing the baseline risks (a detailed discussion of the risk methodology is presented later in this section). For the purposes of this analysis, EPA assumes all MSWLFs would comply with a design goal of 10^{-5} from the allowable protective range of 10^{-4} to 10^{-7}. Actual costs (and benefits) of the proposed rule will vary depending on the state-selected design goal. Landfills with an average most exposed individual risk below 1×10^{-5} in the baseline (i.e., unlined with a vegetative cover) were excluded from any further design requirements. EPA estimated that these facilities would not trigger corrective action since risks at these units would never exceed the 1×10^{-5} trigger level used for this regulatory analysis.

Those new facilities that exceeded a 1×10^{-5} risk level in the baseline then were modeled with a synthetic cover. EPA assigned these facilities a synthetic cover if risks were reduced to below 1×10^{-5}. For the subset of facilities that still exceeded the design goal, EPA assigned a synthetic containment system with leachate collection and a synthetic cover. Those landfills that still exceeded the risk threshold with this more stringent design would trigger corrective action. EPA selected these designs for the purpose of conducting this analysis. These designs are neither specifically required by the proposed rule nor do they represent the only designs that could satisfy the performance standard; however, the chosen designs do represent features that would be applicable and effective in a wide range of environmental settings.

EPA only assigned liners and leachate collection systems to new units: no lateral expansion was assumed to occur at existing facilities so that covers would be the only applicable design requirement to meet the performance standard. Under the proposed rule, existing units must have a cover that prevents infiltration. In the RIA, EPA assigned a vegetative cover if baseline risks were less than 1×10^{-5}; for the subset of facilities that exceeded this baseline risk level, EPA assigned a synthetic cover. Other cover systems besides these two modeled in the RIA could be used to comply with the performance standard. EPA moedled the proposed rule at one design goal (1×10^{-5}) and two POCs: The waste unit management boundary (modeled as the 10-meter POC) and the maximum allowed alternative boundary of 150-meters (the 150-meter POC).

For compliance at the 10-meter POC, EPA estimated that 61 percent of the MSWLFs would require an unlined unit with a vegetative cover design, 11 percent an unlined unit with a synthetic cover, and the remaining 28 percent a synthetic liner with leachate collection and a synthetic cover. At the 150-meter POC, EPA estimated the resulting percentages as 79, 9, and 13 percent, respectively. In addition to the design requirements necessary to achieve the design goal, EPA assigned compliance costs to both new and existing units for the general facility standards and other requirements. These requirements include: Developing procedures for excluding hazardous waste from the landfill, monitoring for methane in the subsurface and in structures, run-on and run-off controls, developing and implementing a closure plan, and ground-water monitoring. Although EPA modeled an extended post-closure care period (including cover and slope maintenance, cover inspection, and ground-water monitoring) the proposal requires a two-phased post-closure care period at a minimum of 30 years. In addition, the ground-water monitoring parameters modeled in the RIA differ from those under the proposed rule. EPA did not estimate costs for financial responsibility requirements. Detailed discussion on how EPA estimated compliance costs for these requirements is provided in the RIA.

Under the proposed rule, States may take into account the resource value of ground-water supplies when determining ground-water monitoring requirements. EPA assumed in this cost analysis that ground-water monitoring systems include one upgradient (three-well) cluster and a number of downgradient clusters that vary with the length of the downgradient boundary (e.g., four clusters for a 10 TPD MSWLF, 20 clusters for a 1,500 TPD facility). EPA assumed that ground-water monitoring would be conducted on a semiannual basis. For existing MSWLFs, the ground-water monitoring requirements were phased in over five years. Under the proposed rule, States may vary the number of wells, frequency of monitoring, and timing of ground-water monitoring implementation. To the extent that actual ground-water monitoring requirements specified by the States differ from what was modeled in this analysis, the actual compliance costs will vary from those estimated by EPA.

Alternative 1 imposes uniform standards on all MSWLFs. Existing unit requirements are the same as for new units except that the containment and LCS requirements were not assigned. Ground-water monitoring is not phased in, and the Phase II list of parameters under the proposed rule is used as the list of constituents for which all units must monitor. EPA assigned a composite cover to all new and existing units (similar to that described in 40 CFR 264.310) and a double composite containment system with two LCSs (similar to that described in 40 CFR 264.301) to all new units. EPA assumed that clay for the cover and containment systems was obtained off site unless the survey respondent reported that clay or sandy clay was available at the facility.

Alternative 2 represents a categorical approach, based on location, to determine the necessary containment and cover requirements. This categorical approach is described in Section IX.D of this preamble. Landfills are assigned designs based on the local climate and hydrological factors that control the potential for leachate contamination (i.e., the migration potential at the site).

To estimate the effects of Alternative 2, EPA used respondent-supplied data on location, primary soil type, saturated permeability, and porosity to determine the distribution of MSWLFs across the four location categories. EPA used the location data to assign an annual precipitation figure obtained from the nearest National Weather Station. The annual cutoff value for high and low precipitation under Alternative 2 is 40 inches. To determine the split between short and long time-of-travel, the Agency used either a saturated time-of-travel equation or an alternative equation (a wetting-front approach) depending on whether the site was reported to be in a saturated environment. The cutoff for short versus long time-of-travel is the greater the active life or 20 years. Using this approach, the Agency estimates that the percentages of all MSWLFs in location Categories I, II, III, and IV are 29.2 percent, 5.8 percent, 37.8 percent, and 27.2 percent, respectively.

Cover and containment requirements, which are performance-based for Alternative 2, were assessed for each survey respondent as described below. Alternative 2 requires facilities to use a water-balance method to select the proper cover that will minimize infiltration through the cover at any time in the future. There are several measures that the facility owner or operator could undertake to meet this performance standard if the vegetative cover by itself is not sufficient. For example, in order to minimize infiltration, the owner or operator could vary the type of vegetation to increase

the evapotranspiration, vary the slope of the cover to increase run-off, use heavier soils from off site, or install a clay or synthetic layer with a drainage collection system beneath the vegetative cover. These decisions involve site-specific factors and are difficult to analyze. Thus, EPA limited the options for cover type to either vegetative or synthetic. EPA assumed that MSWLFs with positive annual net precipitation (precipitation minus potential evapotranspiration) will use a synthetic cover. EPA assumed that landfills with zero or negative net precipitation use the same cover design that was simulated for the baseline, except that the cost includes additional fees for quality assurance. (Potential evapotranspiration was determined using the Thornwaithe-Mather equation.) Using this approach, EPA estimates that 67 percent of all MSWLFs have positive net precipitation and thus are assigned synthetic covers; the remaining 33 percent are assumed to achieve the performance standard with vegetative covers. EPA applied costs for these covers to both new and existing units.

Alternative 2 assumes that all MSWLFs in location Categories II and IV (34 percent of all facilities) must have a leachate collection system; units in location Categories I and III must collect leachate if more than one foot of leachate is generated over the active life. The Agency determined the leachate generation for Facility Survey respondents in Categories I and III using the approach described in EPA publication 530/SW-168. The Agency estimates that 63 percent of the landfills in these two categories (or 41 percent of all facilities) would need an LCS. Thus, across all MSWLFs, the Agency estimates that 75 percent will be required to have an LCS.

Under Alternative 2, the need for a containment system for MSWLFs in location Categories I and II only is related to the need for an LCS since they already have a long time-of-travel. A containment system is necessary if the native soil does not have a sufficiently low permeability to allow the LCS to function properly. EPA assumed that MSWLFs in these categories that need an LCS and that reported clay as their primary natural soil type in the Facility Survey do not need a liner (estimated as 10 percent of all MSWLFs). EPA assigned the remaining units (four percent of all facilities) that need an LCS in these categories a synthetic liner so that the LCS would perform efficiently.

MSWLFs in Categories III and IV that need an LCS (estimated as 61 percent of all facilities) also must have a containment system that will increase the time of travel to greater than the active life or 20 years. Although a clay liner could possibly meet the performance standards, EPA assigned a synthetic liner, which would be less expensive in most cases, to these units.

MSWLFs that do not need an LCS (estimated as 25 percent of all MSWLFs) are all in Categories I and III. Those facilities that are in Category I (20 percent of all MSWLFs) have a long time of travel, and thus do not need a liner. For those in Category III (five percent of all MSWLFs), EPA assigned a two-foot thick clay liner that should provide sufficient delay to meet the performance standard. Moreover, even if clay had to be brought from off site, a clay liner is less expensive than synthetic given that a synthetic liner would also require installation of a leachate collection system.

Although these assignments of designs to meet the performance standards for Alternative 2 do not reflect the inherent flexibility of performance requirements, EPA believes that they do provide an indication of how these standards would be met. The general facility standard requirements (and resulting compliance costs) for Alternative 2 are identical to those analyzed for the proposed rule.

Alternative 3 consists of uniform criteria applied to both new and existing landfills. This regulatory alternative is similar to the statutory minimum mandated under HSWA and includes analysis of ground-water monitoring (throughout an extended post-closure care period) and corrective action requirements; however, EPA has not incorporated any location standards into the analysis for this alternative. Alternative 3 is the only regulatory option that does not include general facility standards. EPA assumed that ground-water monitoring would begin on the effective date of the regulation. A more detailed discussion of the cost analysis for each of the regulatory options is included in the RIA.

b. Cost Results. The Agency estimates that the proposed rule will result in an annualized cost of approximately $880.0 million at the 10-meter POC and $691.4 million at the 150-meter POC. Thus, based on the $100 million annual cost threshold established in E.O. 12291, today's proposal is a "major" regulation.

Table 3 shows the size distribution of MSWLFs across the seven facility sizes modeled in the cost analysis, as well as the annualized cost of the proposed rule for each facility size. EPA estimates that the smallest size category (i.e., 10 TPD), while accounting for 51.3 percent of all MSWLFs, only accounts for 6-percent and 7-percent of the total cost of the proposed rule under the 10-meter and 150-meter POCs, respectively. The two largest size categories modeled (750 and 1,500 TPD) account for only 5.7 percent of all MSWLFs, but 35 percent to 38 percent of the total cost under either POC.

TABLE 3.—ANNUALIZED COMBINED COST BY SIZE, PROPOSED RULE

[Dollars in millions]

Size category (TPD)	Percentage of all MSWLFs	Annualized cost	
		10-meter POC	150-meter POC
10	51.3	$52.3	$47.3
25	17.0	85.8	72.2
75	13.1	134.0	107.6
175	7.3	128.5	95.8
375	5.5	148.7	130.3
750	3.1	137.3	93.4
1,500	2.6	193.4	145.0
Total	[1] 100.0	880.0	691.4

[1] Does not add due to rounding.

EPA estimates that, under the 10-meter (150-meter) POC, approximately 46.7 percent (52.5 percent for the 150-meter POC) of all MSWLFs will incur an incremental cost increase of less than $10 per ton; 49.2 percent (45 percent for 150-meter POC) face an increase between $10 and $25 per ton, and 4.3 percent (1.4 percent for 150-meter POC) will incur a compliance cost between $25 and $50 per ton. Under the 150-meter POC, EPA estimates that 1.2 percent of all MSWLFs will incur cost increases of greater than 50 percent per ton due to expensive corrective actions that are triggered.

Table 4 shows the total annualized combined costs for today's proposed rule and the three regulatory alternatives. The annualized costs, including corrective action, range from $419 million for Alternative 3 up to $3,341 million for Alternative 1. The costs for the proposed rule, under either POC, falls near the lower end of the range. Corrective action is triggered under all the regulatory options and represents from 2-percent (under Alternative 1) to 72 percent (under Alternative 3) of the total costs. Corrective action represents 11 percent and 19 percent of the total cost of the proposed rule for the 10-meter and 150-meter POCs, respectively. The relative costs across options are affected by the stringency of the requirements only,

nce the facility size distribution and ıe range of remaining lives are constant cross all regulatory scenarios. The ide range in contribution of corrective ction costs across the options reflects ıe reactive or preventive nature of a ven regulatory scenario. Alternative 3, epresenting a reactive approach to eleases, has the largest percentage of orrective action costs to total costs mong the regulatory options.

TABLE 4.—TOTAL ANNUALIZED COSTS FOR REGULATORY SCENARIOS

[Dollars in millions]

Regulatory scenario	No corrective action	Including corrective action
roposal:		
10-meter POC	$782.2	$880.0
150-meter POC	562.0	691.0
Alternative 1	3,268.6	3,341.0
Alternative 2	1,336.9	1,426.9
Alternative 3	117.1	419.4

Table 5 presents the incremental cost er ton for the regulatory scenarios. The ıedian, minimum, and maximum stimates are shown for each option.

TABLE 5.—ANNUALIZED INCREMENTAL COSTS PER TON BY OPTION

	Proposal		Alt. 1	Alt. 2	Alt. 3
	10-meter POC	150-meter POC			
Median	$11.01	$9.54	$47.58	$15.62	$5.17
Maximum	40.61	81.39	108.11	48.38	54.45
Minimum	0.76	0.75	4.01	0.75	0.06

ı. Economic Impact Analysis

a. Methodology. Preliminary results rom the Facility Survey indicate that 80 ercent of all MSWLFs are owned by ocal governments (e.g., counties, cities, owns, villages). These governments will ncur the initial costs and impacts ttributable to the revised Criteria; owever, ultimately the governments will likely pass on the regulatory costs to their citizens and to other governments that also may use the landfill. The compliance costs will be passed on in the form of increased taxes or fees or decreased services of other types if the community is operating under tight budgetary constraints. Thus, local citizens (the households that use the landfills to dispose of their wastes) will eventually pay the increased costs of landfill operation. The Agency assessed these short- and long-term impacts in a two-phase economic impact analysis. In the first phase, the ability of governmental entities to pay for the regulatory costs was assessed. The second phase was an assessment of the ability of citizens to pay for the increased compliance costs.

The first phase, an assessment of impacts on local governments, consisted of two components. Firet, the cost of compliance was reviewed relative to the overall financial capability of the community. Financial capability (or financial health) was determined from the "1982 Census of Governments" and the "1983 County and City Data Book." These data bases represent the most recent available and complete information on local government finances (as government censuses are conducted every five years). As described in the RIA, the Agency assessed financial capability by developing a composite score. The score categorizes communities' financial capabilities as weak, average, or strong.

The financial capability score of a community will not change significantly due to compliance costs from the imposition of the proposed rule because many of the indicators used to develop the score are not directly affected by increased operating expenditures. In addition, it would not be appropriate to presuppose the reaction of a community to higher landfill costs. Some communities will increase taxes while others will reallocate available funds to meet the regulatory burden. In the area of debt impact, it also is not clear how a given project will be financed. Many communities will use pay-as-you-go financing as they always have, others will incur debt, and the remainder will turn to private contractors who will raise their own capital.

The development and categorization of the composite score is described in detail in the RIA. The economic impact analysis results presented in this section of the Preamble focus on comparisons of compliance costs to government and demographic indicators as described below.

The second component of the community impact analysis consisted of calculating compliance costs as a percentage of total current community expenditures (CPE) and comparing this ratio to a threshold level. The CPE indicator serves as a convenient summary of the local government's ability to pay.

The second phase of the economic impact analysis consisted of comparing compliance costs to the ability of citizens to pay. This comparison is appropriate because, ultimately, the burden will fall on the citizens, regardless of whether the local government pays for the increased MSWLF costs by increasing taxes, reducing other services, increasing debt levels, or turning to private contractors. EPA has assessed the absolute impact in terms of total cost per household (CPH). EPA has measured the relative impact using costs as a percentage of median household income (CPMHI). Both CPH and CPMHI are compared to selected threshold levels. When combined, these various analyses produce an overall indication of the significance of municipal economic impacts for specific regulatory options.

For this analysis, the Agency selected threshold levels to identify high impacts for the three primary economic measures (i.e., CPE, CPH, CPMHI). For CPE, preliminary results from the Facility Survey indicate that municipal solid waste disposal costs average approximately 0.5 percent of communities' total expenditures. In comparison to other municipal services, costs at this level represent a very small obligation. Data from the "1982 Census of Governments" indicate that the average community spends 36 percent of its total budget on education, 5-percent of its total budget for police protection, 3-percent for sewage disposal, 2-percent for fire protection, and 1-percent for sanitation services other than sewage (including solid waste collection and disposal and street cleaning). Based on these data, the Agency established a threshold for identifying high impacts as one percent of compliance costs relative to total community expenditures.

The Agency used two threshold levels to assess the severity of costs per household. An incremental regulatory cost of $100 per household per year was selected as a threshold for moderate impacts. Although this cost represents a large percentage increase in many households' disposal costs, it represents a relatively small absolute charge. An annual threshold of $220 per household was used to identify severe impacts. This threshold level is equivalent to one percent of the median household income of all the communities in the country according to the "1983 City and County Data Book."

The Agency has previously selected a threshold level for costs as a percentage of median household income under the Construction Grants Program. The criteria ranged from one percent of median household income for low-income communities to 1.75 percent of MHI for high-income communities. The Agency selected one percent in this analysis to identify a high impact level for CPMHI.

b. Economic Impact Results. Table 6 shows the percentage of communities

under each regulatory scenario that have compliance costs exceeding one percent of total current community expenditures, the percentage of all people that reside in these communities, and the maximum CPE under each option.

TABLE 6.—COSTS AS PERCENTAGE OF EXPENDITURES

[Regulatory Options]

Regulatory scenario	Percent of communities with CPE>1%	Percent of people with CPE>1%	Maximum CPE (percent)
Proposal: 10-meter POC	16	7	4.0
Proposal: 150-meter POC	11	4	5.3
Alternative 1	68	34	14.0
Alternative 2	33	12	6.3
Alternative 3	10	3	8.6

EPA estimates that greater than one-half of all communities under Alternative 1 have CPE exceeding one percent. Under Alternative 2, 33 percent of all governmental entities have CPEs that fall in this category. The percentage of municipalities with costs above 1-percent of current expenditures under the proposal is much lower: 16 percent and 11 percent, given the 10-meter POC and 150-meter POC, respectively. Because most of these severely-impacted communities are small, the percentage of the total U.S. population that resides in these communities is much smaller than the percentage of communities affected (as shown in Table 6).

Several factors will tend to mitigate the actual impact of the alternatives on communities with high CPE. One important factor is the relatively small proportion of the municipal budget that is usually devoted to municipal solid waste disposal. Although CPE greater than 1-percent indicates that municipal solid waste disposal expenditures may double in many communities, after regulation these expenditures will still represent less than 2-percent of the total municipal budget in most communities. Although it may be difficult for communities to cope with large percentage increases in municipal solid waste disposal costs in the short run, once the initial adjustment is made, these costs should be easier for communities to absorb because they comprise a very small portion of communities' total budgets.

Table 7 shows the average CPH across the entire nation, maximum CPH, and percentage of all communities with costs per household exceeding $100 per year (the moderate impact level). The Agency estimates that average incremental CPH across the entire nation ranges from $5 under Alternative 3 to $40 under Alternative 1. For the proposal, EPA estimates that the average CPH is $11 at the 10-meter POC and $8 at 150-meter POC.

TABLE 7.—AVERAGE COST PER HOUSEHOLD PER YEAR

(Regulatory Options)

Regulatory scenario	Average CPH	Percent of communities with CPH < $100 (percent)	Maximum CPH
Proposal: 10-meter POC	$11	0.2	$119
Proposal: 150-meter POC	8	2.1	253
Alternative 1	40	23.5	335
Alternative 2	17	0.1	160
Alternative 3	5	0.2	178

EPA has selected, for this analysis, a threshold level for severe impacts on households of $220 per year. The Agency estimates that this threshold is exceeded under Alternative 1 and at the 150-meter POC for the proposal, but only by fewer than 0.1 percent of all communities in both cases. When the $100 per year threshold is considered, EPA estimates that, for all regulatory options except Alternative 1, the percentage of communities that exceed this level is low (i.e., less than 3-percent). However, under Alternative 1, EPA estimates that 23.5 percent of all communities experience increases in CPH of greater than $100 per year.

Cost per household as a percentage of MHI is relatively low across all of the regulatory options. The Agency estimates that the 1-percent threshold level is exceeded under the proposal at the 150-meter POC and under Alternative 1. Even under these regulatory options, fewer than 2-percent of all households fall into the high impact-category (0.1 percent exceed the threshold at the 150-meter POC and 1.1 percent for Alternative 1). EPA estimates that the maximum CPMHI is 1.3 percent under the proposal at the 150-meter POC and 1.7 percent under Alternative 1.

Impacts on households also depend on who owns the landfill that serves those households. Table 8 indicates the number of communities and landfills by each major ownership category—county, city, village or town, private, and other. (The other category covers landfills owned by nonlocal governments including special districts, States, and the Federal government.) The distribution of communities by ownership type looks somewhat different than the distribution of landfills by ownership type because county-owned and private landfills tend to serve a larger number of communities than city or town landfills. The table indicates that communities served by village or town landfills have much higher CPH than average. These landfills tend to serve only one or two communities and are commonly very small, thus the CPH is higher. Communities served by private landfills tend to have lower than average CPH. These landfills usually serve many communities and, on average, are larger than publicly owned landfills. Smaller communities could reduce the regulatory burden by participating in larger regional landfills.

TABLE 8.—NUMBER OF COMMUNITIES AND LANDFILLS BY TYPE OF OWNER

[Average Community CPH for Proposed Rule]

Owner	Communities		Landfills		Average number of communities per landfill	Average Community CPH	
	Number	Percent	Number	Percent		Fed POC	State POC
County	10,618	37	1,760	29	6.0	$18	$13
City	6,622	23	1,743	29	3.8	16	15
Village or Town	2,115	7	1,182	20	1.8	34	31
Private	8,556	30	912	15	9.4	10	10
Other	1,087	4	427	8	2.6	15	15
Total	28,998 [b]	100 [a]	6,024 [b]	100 [a]	4.8	$16	$14

[a] Totals may not add to 100 percent because of rounding.

[b] Data are missing for 10 landfills in 19 communities.

As stated previously, the costs used in the economic impact analysis represent a reasonable upper-bound estimate. Several opportunities exist for communities to reduce the regulatory burden: Regionalization to share the economies of scale at larger landfills, shifts to resource recovery facilities, increases in the rate of recycling to reduce the waste volume for disposal, and better siting of new MSWLFs in "good" locations. (As explained above, EPA has not incorporated these mitigating factors into the analysis because they involve site-specific local decisions that are difficult to predict.)

5. Risk Assessment

a. Methodology. The Subtitle D MSWLF universe consists of a diverse group of facilities that occur in a wide variety of environmental settings. Hundreds of factors affect the nature, extent, and severity of environmental impacts from these facilities. To identify and evaluate some of the most important factors, EPA developed the Subtitle D Disk Model. This model couples information from case studies and other sources with a series of mathematical formulations of engineering, physiochemical, hydrologic, toxicologic, and socioeconomic processes that govern impacts to provide a framework that allows evaluation of regulatory options.

Although the Subtitle D Risk Model has been neither peer reviewed nor verified, EPA has used it in its preliminary form to help analyze: (1) Problems associated with Subtitle D facilities under the current set of Criteria (i.e., baseline), (2) estimates of the level of risk reduction available from preventive measures (liners, leachate collection systems and covers), and (3) remedial measures (corrective action) under various regulatory options. For each regulatory alternative, risk and resource damage has been modeled in hundreds of scenarios that represent unique combinations of landfill size and design, environmental setting, and exposure distance. EPA has estimated the frequency for which each scenario occurs in the total population of MSWLFs and weighted the results for each scenario reflect the frequency of occurrence. The following is an overview of the risk model.

(1) The Subtitle D Risk Model. The Subtitle D Risk Model provides: (1) An analytic framework for estimating human health risk reduction and other benefits of regulatory options, (2) a direct link between estimates of benefits and costs of regulations, and (3) scenarios that contain different combinations of design, waste, environment, and response. The model builds directly on the Subtitle C Liner Location Risk and Cost Analysis Model (Ref. 20), and has adopted many of its basic characteristics. It is a dynamic model. For this analysis, EPA simulated 100 years of leachate release and 200 years of gound-water transport for each year's release. Environmental fate and transport and dose-response relationships are modeled as deterministic processes, while containment system failure and some hydrologic events are considered stochastic phenomena. The model only assesses effects on ground water as the environmental medium of concern: ecosystem risks and subsurface gas and surface water pathways (which also would contribute to risk) are not analyzed. Some parameters can be varied over a wide range; for others, the user selects from specified, generic values.

The model includes a series of submodels that simulate pollutant release (liner failure and leachate quality submodels), fate and transport (unsaturated zone and saturated zone transport submodels), exposure, impacts (dose-response and resource damage submodels), and corrective action. Following are brief summaries of each of these submodels.

(a) Pollutant Release. The Agency used Monte Carlo simulation in the failure/release submodel to estimate the probability and time of failure (defined as release to the unsaturated zone) for MSWLFs and to estimate the quantity of leachate released. The submodel uses a fault tree structure that traces each possible failure event from all possible combinations of basic events (e.g., liner failure, infiltration of liquid) that could combine to cause failure. Each of these basic events is assumed to occur at random, following specified probability distributions. The model provides distributions of the year of failure and the release rate. EPA used the model to simulate the performance of several combinations of containment and cover systems in eight environmental settings.

The leachate quality submodel simulates the concentrations of chemical constituents in leachate released from the MSWLF between years 1 and 100. Given differences in the leaching behavior of constituents, the submodel utilizes three different modeling approaches to simulate the concentrations of inorganics, biodegradable organics, and synthetic organics in leachate. The submodel applies the appropriate algorithm to calculate the concentration of each leachate constituent for each year. The concentration then is combined with the release volume calculated by the failure/release submodel to calculate the mass flux of the constituent across the landfill/subgrade boundary.

One representative leachate, consisting of eight constituents of concern (COC), was simulated. This leachate is intended to represent typical leachates generated from co-disposal of municipal solid waste, nonhazardous industrial waste, and VSQG hazardous waste. EPA selected the COC based on analyzing limited leachate data from only 44 operating MSWLFs. The COC were selected based on potential for causing human health risk or resource damage given their observed median concentrations in municipal solid waste leachate, toxicity to humans, regulatory limits under SDWA taste and odor thresholds, and mobility and persistence in the subsurface environment. The eight COC and the effect of concern for each are given below:

Constituent	Criterion effect
Vinyl chloride	Human health risk (cancer)
Arsenic	Human health risk (cancer)
Iron	Resource damage (taste and odor).
1,1,2,2, - tetrachloroethane.	Human health risk (cancer)
Dichloromethane	Human health risk (cancer)
Antimony	Human health risk (systemic).
Carbon tetrachloride	Human health risk (cancer)
Phenol	Rsource damage (taste and odor).

(b) Fate and Transport. Subsurface transport modeling addresses transport through both the unsaturated zone and the saturated zone. The Subtitle D Risk Model uses the McWhorter-Nelson wetting front equation to calculate the delay between the time of failure and the time that contaminants reach an underlying aquifer. The mass that breaks through the unsaturated zone then disperses through the ground water. Using an adaptation of the Random-Walk Solute Transport Model (Ref. 25) developed by Prickett, Naymik, and Londquist, the saturated zone model simulates downgradient ground-water concentrations over time.

To model the transport of constituents, EPA developed eight environmental settings consisting of four net infiltration regimes (0.25-inch, 1-inch,

10-inch, and 20-inch) and two categories of ground-water depths (deep and shallow). These two parameters are important in affecting the release rate of leachate to the unsaturated zone and ultimately the aquifer. Net infiltration represents the amount of water that can enter the landfill as a result of precipitation. Ground-water table depth represents the potential for pollutant attenuation and degradation to occur in the unsaturated zone. In addition, for facilities that are seasonally inundated with ground water, the inundation depth determines the rate at which ground water can flow through the waste.

EPA performed a statistical analysis of USGS data for each infiltration category to determine the mean depth to ground water and the average annual ground-water fluctuation. Shallow and deep water table depths are represented by the 50th and 90th percentiles, respectively.

For transport through the saturated zone, EPA developed 11 generic ground-water flow fields to represent the range of hydrogeologic conditions in the United States. The flow fields are based on data collected from ground-water supply reports for each of the USGS regions. The flow fields vary in terms of aquifer configuration, materials, and flow velocity. Five of the flow fields are single-layer aquifer systems, two contain two adjacent aquifers, three consist of an aquifer overlaid with a nonaquifer, and one contains two aquifers separated by a nonaquifer.

EPA assigned each surveyed landfill to a net infiltration region based on its precipitation level (obtained from the nearest National Weather Station) and other climatic data. Each of these MSWLFs also was assigned a DRASTIC (Ref. 39) setting to select appropriate ground-water table depths and flow fields. These assignments were used to develop a frequency distribution for each environmental setting. EPA used these frequency weights to scale up the risk model results to obtain national estimates.

(c) Exposure Distance and Populations. EPA selected seven well distances for modeling risk: 10 meters, 60 meters, 200 meters, 400 meters, 600 meters, 1,000 meters, and 1,500 meters. Preliminary results from the Facility Survey were used to develop a frequency distribution of distance from the MSWLF to the closest drinking water well at each site. This distribution (i.e., distance to closest well) was used to estimate risk to the maximum exposed individual (MEI). Approximately 54 percent of the MSWLFs were reported to have no downgradient drinking water well within one mile of the facility. For the other 46 percent of MSWLFs: 12.8 percent reported wells within 300 meters, 22.5 percent reported wells within 500 meters, and 40.3 percent reported wells within 1,250 meters of the facility boundary.

EPA used the preliminary Facility Survey data on distance to all wells within one mile downgradient and the number of people served at each well to calculate the total population risk (i.e., number of predicted cancer cases). EPA calculated the mean number of well-using people per acre (i.e., 1.6) using facility survey results for private and/or public wells. The land area associated with each exposure well was multiplied by this population density to estimate the size of the exposed population for each affected well.

Ground-water concentrations of chemical constituents released from landfills can cause human exposure via drinking water. All exposed individuals are assumed to weigh 70 kilograms and drink two liters of water per day. The lifetime dose is calculated as the running 70-year average over an individual's lifetime.

(d) Impacts: Human Health Risk. For this analysis, reported risk is the average lifetime maximum exposed individual risk (i.e., the mean of the average lifetime (70-year) risks over the 300-year modeling period).

Of the eight COC selected for modeling human health risk, five are carcinogens and one is a noncarcinogen. The approach for estimating risks for carcinogenic effects is consistent with the Agency's cancer risk assessment guidelines. Carcinogenic potencies are from the Agency's Carcinogenic Assessment Group (i.e., 95th percentile upper-bound slopes based on a linearized multistage model).

For noncarcinogenic effects, the Weibull equation was used with a threshold to predict a probability of effect. Below the threshold, risk equals zero. At doses above the threshold, risk depends on the dose, the constituent-specific threshold, and the shape of the dose-response curve.

(e) Impacts: Resource Damage. The measure of resource damage in the model is based on the cost to replace contaminated ground water that currently is used, or may be used, for drinking water. Resource damage is determined by plume area, the density of drinking water wells, the source of replacement water and its distance from the affected wells, the time the plume first appears, and whether ground water currently is used.

The Agency assumed that the replacement source is nearby ground water located one mile distant. The replacement well system was designed using the mean population density of 1.6 people per acre that also was used for the human health risk estimates.

Resource damage was estimated under two scenarios: use value and option value. Use value assumes that the population currently is using the ground water, whereas option value is used when the population is not currently using the resource but may wish to do so in the future. For option value, the resource damage measure recognizes the probabilistic nature of future use; replacement costs are multiplied by an estimated probability of use in each time period. The present value for both option and use value is then determined at a 3-percent real discount rate.

(f) Corrective Action. Under the proposed rule, corrective action can be triggered if a constituent of concern is detected in the uppermost aquifer at levels exceeding the applicable MCL; if an MCL does not exist, a risk-based or background level is used as the standard.

In the corrective action analysis for this RIA, ground-water monitoring wells are located at the POC, which can vary between the landfill unit and the property boundary depending on the regulatory scenario. EPA estimated the effects of corrective action based on detection of constituents of concern in the uppermost aquifer at levels exceeding a 1×10^{-5} risk level.

As stated in the cost methodology, only ground-water recovery wells were modeled as the corrective action technology. The submodel assumes that the corrective action technology is in place one year after the trigger levels are reached and operates at its specified efficiency for the remainder of the modeling period. The model calculates downgradient well concentration profiles following implementation of the corrective action and recalculates risk and resource damage estimates. These results are compared to the estimates calculated for the baseline (i.e., no corrective action scenario) to determine the reductions in risk and resource damage achieved by corrective action.

(2) Risk Model Inputs. EPA modeled three MSWLF sizes for risk and resource damage: 10 TPD, 175 TPD, and 750 TPD. Each size category is characterized by the total volume of waste placed in the landfill, the number of phases used to dispose of the waste, and the dimensions of the landfill at capacity (e.g., surface area, depth, height). The waste volumes and dimensions for each capacity category are consistent with

the cost model described earlier. The number of phases in the risk analysis are 2, 5, and 10 for the 10, 175, and 750 TPD landfills, respectively.

As with the cost model, EPA used the Facility Survey to estimate the frequency with which each landfill size category occurs nationwide. Landfills with capacities of up to 30 TPD are included in the 10 TPD category, 30 to 500 TPD landfills are in the 175 TPD units, and those with larger capacities are modeled as 750 TPD. Using this approach, 61.5 percent of the landfills were modeled at 10 TPD, 33.1 percent as 175 TPD, and 5.5 percent as 750 TPD. The Agency assumed that facility size is independent of hydrogeologic and exposure attributes.

All new MSWLFs are assumed to operate for 20 years. The baseline facility is the same as that used in the cost analysis but risks and resource damage estimates (for the proposal) were not adjusted to reflect existing State requirements for containment systems. This adjustment for liners and leachate collection systems would affect no more than 17 percent of all MSWLFs. To assess the effectiveness of a regulatory option, EPA assumed that a new landfill is constructed at the same site and operated for 20 years plus post-closure care according to the applicable requirements.

Under the proposed option, MSWLF units are required to meet a performance standard by applying appropriate cover and containment designs. Owners or operators have the freedom to choose the type of design they think will meet the performance standard. Because the performance and costs of design elements such as liners and covers are highly dependent on site-specific factors, there are likely to be several types of designs (and combinations of designs) chosen by the regulated community to comply with the performance standard.

As stated previously, to analyze the proposed rule, EPA assigned containment and cover designs to new MSWLFs according to a 10^{-5} design goal (chosen from the allowable protective range of 1×10^{-4} to 1×10^{-7}). In addition, EPA assigned one of three containment and cover designs under the assumption that owners or operators will use the least stringent design capable of meeting the design goal (EPA recognizes that other control technologies beyond the three analyzed could be used to comply with the performance standard). If the most stringent of the three designs did not reduce risk to this level, corrective action would be triggered.

Landfills with average lifetime risks below 1×10^{-5} given the baseline design (unlined with a vegetative cover) were excluded from further design requirements. Landfills with higher risks were assigned a synthetic cover and, if risks for an MSWLF unit still exceeded the design goal, the most stringent design of a synthetic liner, synthetic cover, and leachate collection system was assigned. For existing facilities, EPA used the baseline risks with a 1×10^{-5} cutoff to assign either a synthetic cover (for those with greater than 1×10^{-5} baseline risks) or a vegetative cover (for those with less than 1×10^{-5} baseline risks).

For this analysis, EPA assumed that extended care continues for 80 years after the end of the active life of the MSWLF, and includes maintenance of the vegetative portion of the cover, ground-water monitoring, and corrective action (although an extended care period is analyzed in the RIA, the actual proposed rule requires a two-phased post-closure care period of at least 30 years). For designs with synthetic covers, EPA assumed that the synthetic components would be maintained and replaced if necessary until the end of the first 30 years of post-closure care.

EPA modeled Alternatives 1 through 3 in a manner consistent with the cost analysis. A detailed discussion on how EPA estimated risk and resource damage for the regulatory alternatives is included in the RIA.

b. Risk Results. This part presents results of the risk analysis (including resource damage) for the baseline and each of the regulatory options.

(1) Baseline. For the baseline, EPA estimates that average MEI risks over the 300-year modeling period range from approximately 1×10^{-4} to zero. Results from the Facility Survey indicate that about 54 percent of landfills have no drinking water wells within one mile of the facility boundary. Because the model only estimates human health risks at drinking water wells within one mile of the facility, EPA assigned these facilities (54 percent of all MSWLFs) no human health risk. EPA recognizes that if future wells are located near existing landfills, this subgroup (54 percent) of all MSWLFs would face potential risks in the baseline from contaminated ground water similar to those that currently have nearby wells. Another 6 percent have nearby wells, but have no risk (MEI less than or equal to 1×10^{-10}) because no constituents reach the wells within the modeling period. Risks are low (1×10^{-6} to 1×10^{-8}) or very low (less than 1×10^{-8}) for a total of 82.8 percent of MSWLFs (these MSWLFs include the 54 percent of all facilities) that have no drinking water wells within one mile and, therefore, have an assigned zero health risk). Of the remainder, 11.6 percent have moderate risk (i.e., in the 1×10^{-6} to 1×10^{-5} range), 5.5 percent have high risk (1×10^{-5} to 1×10^{-4}), and a negligible 0.05 percent exceed 1×10^{-4}. Across all units in the baseline, less than 20 percent have risks greater than 1×10^{-6}. EPA recognizes that future increases in well density near MSWLFs would increase baseline risks from those estimated.

The principal constituents contributing to the risk estimates from the model are vinyl chloride, 1,1,2,2-tetrachloroethane, and dichloromethane (methylene chloride). These risk (and resource damage) estimates are based on observed median concentrations. The Agency estimates that the risk associated with the 90th percentile levels in the leachate data would be about one order of magnitude higher than that simulated for the median concentrations. This risk occurs because carcinogens are the primary contributors to risk in this analysis, cancer risk varies linearly with dose, and the reported 90th percentile concentrations are about one order of magnitude higher than the median levels. The leachate data on which these risk estimates are made are extremely limited. Therefore, the risk estimates could change significantly with more comprehensive leachate data.

The Agency estimates that 0.0770 cancer cases per year in the baseline can be expected over the 300-year modeling period. EPA has only estimated risks from drinking ground water, and, therefore, additional risks would exist from other routes of exposure (e.g., surface water, subsurface gas, and ecosystem risk). Risks attributable to existing contamination also are not considered.

Moreover, if future wells are located near existing MSWLFs (or new sites are located near current wells), the overall risk distribution will reflect the estimates for the subset of landfills that currently have wells within one mile of the facility boundary. For this subgroup of the population, nearly 40 percent of landfills have risks exceeding 1×10^{-6}. In addition, the median risk is about 4.3×10^{-7}.

EPA performed a sensitivity analysis of the baseline risk results to the well distance distribution. When all landfills are assumed to have wells at the facility boundary (modeled as 10 meters downgradient from the waste unit boundary for this sensitivity analysis) risk changes dramatically. While less than 20 percent of all MSWLFs have risks exceeding 1×10^{-6} for the actual well distribution, over 67 percent exceed

this risk level when all exposure is assumed to occur at the 10-meter boundary.

The results of the analysis identify several factors that are important in determining risk, namely facility size, distance to nearest well, and environmental setting. These factors interact with many others in a complex manner to produce risk.

Higher levels of contamination and, thus, higher risks are associated with larger facilities that have a greater mass of waste. The high percentage of small facilities (less than 30 tons per day) in the regulated universe tends to weigh the overall distribution to lower risk levels. However, the Agency's economic impact results indicate that smaller communities will have incentive to regionalize their landfill operations in order to share the burden of cost increases with other communities as well as to take advantage of the economies of scale associated with larger facilities. Regionalization would shift the overall risk distribution towards the higher risks associated with larger facilities, although the total number of facilities would be reduced.

All other factors held constant, risk decreases with increasing distance from the facility. Contaminant concentrations diminish over distance due to degradation, dispersion, and attenuation. While the closest wells present the greatest risk, results from the Facility Survey indicate that this occurrence is relatively rare: 54 percent of existing MSWLFs have no wells within one mile, 15 percent have wells within 300 meters, and 25 percent have wells within 500 meters. However, as stated above, the proximity of wells to MSWLFs likely will increase in the future and thus baseline risks and the risk reduction attributable to the proposal would be greater than the estimates based on the current well distribution.

Wetter climates are associated with higher release volumes and consequently greater risks. However, because landfills are almost equally likely to be found in wet or arid climates, no one infiltration rate setting has a dominant influence on the overall risk distribution. Hydrogeologic characteristics of the aquifer also exert a strong influence on risk. Aquifer properties affect the extent of dilution of the leachate and the retardation and degradation of specific pollutants. Aquifers with slow velocities (i.e., one meter per year) generally allow for no pollutant breakthrough at the more distant wells and for considerable pollutant degradation before breakthrough at nearby wells. In the high-velocity flow fields (i.e., 1,000 and 10,000 meters per year), considerably more water flows through the aquifer, which affords more dilution of the leachate. Intermediate velocity aquifers (i.e., 10 and 100 meters per year) have higher risk profiles because they neither allow for much degradation nor provide for much dilution or pollutant dispersion.

Although these factors (i.e., facility size, distance from the facility, infiltration rate, aquifer characteristics) are strong determinants of risk, no single factor is responsible for most of the variability. All of these factors, plus others that were not accounted for in EPA's risk modeling, interact in a complex manner to produce risk.

(2) Regulatory Options. This Subpart will present first the results for the 10-meter POC modeled at 10 meters from the waste boundary and then the 150-meter POC modeled at 150 meters from the waste boundary.

For the 10-meter POC, EPA estimated that, for about 61 percent of all landfills, vegetative covers alone are sufficient to meet a 1×10^{-5} risk-based performance standard. Synthetic covers are sufficient for 11 percent of the landfills, while synthetic liners with leachate collection systems and synthetic covers are needed at the remaining 28 percent. About 40 percent of the landfills with synthetic liners and covers (11 percent of all landfills) trigger corrective action under the proposal.

About 0.1 percent of the landfills have risks exceeding 1×10^{-5} under the proposal, compared to 5.6 percent in the baseline and about 35 percent have risks between 1×10^{-6} and 1×10^{-5}. Population risks for the proposal are 0.0210 cancer cases per year (over the 300-year modeling period), down from a baseline of 0.0770 cases per year.

At the 150-meter POC, EPA estimated that about 79 percent of the landfills are in compliance with the performance standard in the baseline (compared to 61 percent with the 10-meter POC). About 9 percent need synthetic covers and the remaining 13 percent need synthetic liners and covers. About 5 percent of all landfills trigger corrective action.

As with the 10-meter POC, the number of landfills with risks exceeding 1×10^{-5} is reduced from 5.6 percent in the baseline to about 0.1 percent at the 150-meter POC. About 86 percent of the landfills have risks lower than 1×10^{-6} under this option, compared to 83 percent in the baseline. Population risks are 0.0227 cancer cases per year (over the 300-year modeling period), down from a baseline of 0.0770 cases per year.

Under Alternative 1, less than 1 percent of the MSWLFs have high risk (greater than 1×10^{-5}), compared to 5.6 percent in the baseline. Approximately 6.1 percent have moderate risks (1×10^{-5} to 1×10^{-5}) compared to 11.6 percent in the baseline; 15.2 percent have low risks (1×10^{-5} to 1×10^{-6}); and the remaining 78.7 percent have very low or no risks.

Corrective action is never triggered during the first 50 years under Alternative 1, so all of the risk reduction results from the containment system and cover. Overall, about 9 percent of the landfills trigger corrective action under Alternative 1. The cover reduces the amount of infiltration entering the landfill. Before leachate is released from the MSWLF, both synthetic membranes must fail, and the leachate then must travel through three feet of clay. Due to this delay, which ranges from 52 to over 100 years, some of the pollutant mass that would otherwise have been released is not released during the modeling period. The delay also results in additional pollutant degradation prior to release. The leachate collection systems remove some of the pollutant mass from the landfill.

EPA estimates that population risks under Alternative 1 are 0.0086 cancer cases per year (over the 300-year modeling period), reduced from the estimate of 0.0770 cancer cases per year in the baseline.

Under Alternative 2, risk shifts from the moderate- and high-risk ranges to the low and very low categories. Only 0.03 percent of the landfills have risks exceeding 1×10^{-5}, and 7.9 percent have risks between 1×10^{-6} and 1×10^{-5}, compared to 5.6 and 11.6 percent in the baseline, respectively. The percentage of landfills with risks below 1×10^{-6} increases from about 83 percent in the baseline to about 92 percent under Alternative 2. The expected number of cancer cases under Alternative 2 is 0.0105 per year (over the 300-year modeling period), compared to 0.0770 in the baseline.

Under Alternative 3, 0.003 percent of landfills have risks higher than 1×10^{-4}, and 1.8 percent have risks between 1×10^{-5} and 1×10^{-4}. The percentage with risks between 1×10^{-6} and 1×10^{-5} decreases from 11.6 in the baseline to 8.7 percent under Alternative 3. Population risks under this alternative are 0.0216 cancer cases per year over the 300-year modeling period.

Of all the alternatives considered, EPA believes the proposed rule is likely to effectively reduce risk because of the performance standard nature of the proposal. Risk depends on a complex interaction among site-specific factors. This variability affects not only the occurrence of risk, but also the

effectiveness of a particular design. Expressing a regulation in terms of performance allows for the implementation of design and operating procedures that best address site-specific risk factors. Overall, EPA believes that risk is likely to be very low under the proposed option.

Although Alternative 3 requires extended care, it does not require liners or leachate collection systems. With this design, many landfills, particularly those located in the wetter climates, will release leachate to the aquifer during the unit's active life. As a result of these early releases, EPA estimates that corrective action will be triggered more often than under the proposal (39 percent compared to 5 and 11 percent). Because of the uncertainty in the effectiveness of corrective action, risk may be higher under this alternative than estimated in the RIA (this uncertainty, however, is not easily modeled). Alternative 3 represents a reactive approach to potential contamination compared to preventive approaches such as the proposed or Alternative 2, in which landfill design is based in part on achieving a performance standard.

Table 9 shows the number of cancer cases expected annually over the 300-year modeling period, and the reduction in annual population risk for each regulatory option. As estimated by EPA, the reductions in risk are similar among all the regulatory options.

TABLE 9.—PREDICTED POPULATION RISK ACROSS 6,034 NEW MSWLF'S

Regulatory scenario	Cases per year [1]	Reduction (Cases/year)
Baseline	0.0770	
Proposal: 10-meter POC	.0210	0.0560
Proposal: 150-meter POC	.0227	.0543
Alternative 1	.0036	.0659
Alternative 2	.0105	.065
Alternative 3	.0216	.0554

[1] Total population risk over the 300-year simulation period divided by 300.

c. Resource Damage Results. Consistent with the risk analysis, resource damage estimates are made for the baseline, proposed rule, and each regulatory alternative. As discussed in the methodology section, resource damage is measured as the replacement cost (expressed in present value terms) to provide water to users whose supply is contaminated by releases of leachate from MSWLFs. Similar to the risk analysis, EPA has not considered the surface water pathway in the resource damage analysis. Resource damage estimates (modeled for new facilities only) do not take into account existing State requirements for containment systems.

(1) Baseline. The Agency estimates significant resource damage in the baseline for MSWLFs ranging from $0 to more than $4 million. The majority of MSWLFs, however, have resource damages valued at less than $200,000; this result largely reflects the option value estimate for the 54 percent of all MSWLFs that have no drinking water wells within one mile of the facility. EPA predicts that about 29 percent of MSWLFs will have no resource damage. Approximately 31 percent of landfills have resource damage exceeding $200,000, and about 13 percent have resource damage in excess of $1 million. The two components of resource damage are not option value and use value. Because option value is based on the probability that a ground-water source may someday be used, it tends to be much lower than use value for a given set of conditions; option value is estimated to be typically one-tenth of use value. Option value dominates at lower levels of resource damage while use value is the only measure to appear at levels exceeding $400,000.

When both use and option value are considered, the median resource damage is about $79,000. 13-percent of the MSWLFs have damages exceeding $1 million, and 7-percent have damages exceeding $2 million. If only use value is considered, the median estimate for resource damage for this subset of landfills (i.e., the 46 percent of all MSWLFs that report drinking water wells within one mile) is about $485,000, and almost 28 percent of these MSWLFs have damages that exceed $1 million.

The total resource damage for all 6,034 MSWLFs in the baseline is approximately $2.58 billion.

Facility size, distance to nearest well, and environmental setting have an influence on resource damage similar to their influence on the risk estimates presented earlier.

Generally, the resource damage estimates are heavily dependent on the current status of ground-water use, plume size, and the timing of contamination. Because ground water in the vicinity of more than half the MSWLFs is not currently used, most contamination causes resource damage that has relatively low present value. In some cases, however, resource damage can be extensive, valued at as much as $5 million. Environmental factors have an impact on resource damage by affecting plume size and its timing.

(2) Regulatory Options. Resource damage under the proposal reduces the replacement costs from the baseline. Under the proposal at the 10-meter POC, EPA estimates that no landfills will have replacement costs exceeding $3 million (present value), compared to over 3 percent in the baseline. The fraction of landfills with replacement cost between $1 million and $3 million decreases from 9.5 percent in the baseline to 6.5 percent under the proposal. The percentage of landfills with no resource damages is the same for both the baseline and proposal (28.6 percent). EPA estimates that the total resource damage across all landfills is $1.27 billion, a reduction of $1.31 billion from the baseline estimate of $2.58 billion.

Under the proposal at the 150-meter POC, the shift to lower replacement costs is smaller than with the 10-meter POC. Under the 150-meter POC, EPA estimates that there are no landfills with resource damage greater than $3 million. Seven percent have replacement costs between $1 and $3 million, and 64.3 percent have positive resource damage less than $1 million. The total resource damage across all landfills is $1.6 billion, which is $980 million less than the baseline but $33 million more than under the 10-meter POC.

Under Alternative 1, no MSWLFs have replacement costs exceeding $1 million, whereas about 13 percent have replacement costs exceeding $1 million in the baseline. The fraction of MSWLFs with replacement costs between $0.2 million and $1 million decreases from one-fifth to one-tenth under Alternative 1. Over half of the MSWLFs have zero resource damage with Alternative 1 requirements in place, compared to 29 percent in the baseline. The total resource damage across all MSWLFs is $410 million, a reduction of $2.17 billion from the baseline.

The synthetic/composite liner, double leachate collection system, and composite cover reduce resource damage for the same reasons that they reduce risk. As with risk, there is no resource damage estimated in the 0.25-inch net infiltration region because releases do not occur within the first 100 years. If the pollutant release period in the model were extended, it is likely some resource damage would be simulated. None of the reduction in resource damage results from corrective action, which is never triggered during the first 50 years under Alternative 1.

EPA estimates that Alternative 2 effectively reduces resource damage. Virtually none of the landfills have resource damages exceeding $1 million, compared to about 17 percent in the

baseline. The percent of landfills with resource damage between $0.2 million and $1 million decreases from 15.1 percent in the baseline to 12.8 percent under Alternative 2. About 35 percent of the landfills have no resource damage. The total resource damage across all landfills decreases from $2.58 billion in the baseline to $570 million under Alternative 2 for a reduction of $2.01 billion.

Alternative 3 eliminates the occurrence of replacement costs higher than $4 million. About 6.4 percent of the landfills have replacement costs between $1 million and $4 million. The number of landfills with no resource damage remains virtually unchanged from the baseline at about 29 percent. The total resource damage across all landfills under Alternative 3 drops from $2.58 billion to $1.57 billion as a result of corrective action.

In summary, all of the regulatory options reduce resource damage from baseline levels. For each option, the largest reductions occur for those facilities that currently have downgradient wells (i.e., resource damage is measured in terms of use value) and install preventive measures to control releases. At these facilities, the reduction and delay in releases to the subsurface reduce plume size and/or delay formation of plumes. Because replacement costs are discounted, delay in plume formation translates directly into reduced resource damage. Those facilities with no current wells have smaller baseline resource damage (measured as option value), but also have proportionately smaller damage reductions because they are not as strongly affected by the delay in leachate release. Table 10 presents the resource damage results, across all 6,034 new MSWLFs, for the regulatory options.

TABLE 10.—TOTAL RESOURCE DAMAGES FOR 6,034 NEW FACILITIES

[Present value in billions of dollars]

Regulatory scenario	Resource damage	Damage reduction
Baseline	$2.58	
Proposal (10-meter POC)	1.27	$1.31
Proposal (150-State POC)	1.60	0.98
Alternative 1	0.41	2.17
Alternative 2	0.57	2.01
Alternative 3	1.57	1.01

B. Regulatory Flexibility Act

The Regulatory Flexibility Act (RFA) requires Federal regulatory agencies to evaluate the impacts of regulations on small entities. The RFA requires an initial screening analysis to determine whether the proposed rule will have a significant impact on a substantial number of small entities.

This section presents the methodology and results of the Agency's screening analysis for the proposed rule at the 10-meter point of compliance.

1. Methodology

The RFA provides some guidance in developing definitions of what constitutes a substantial number of small entities, what size criteria define a small entity, and what is a significant impact, although it allows the Agency to develop a more appropriate definition if necessary. The Act defines a "substantial number" as more than 20 percent of the affected population of small entities. The RFA provides a definition of a small governmental entity as any government serving a population of less than 50,000.

The RFA allows for several indicators (e.g., compliance costs as a percentage of production costs, compliance costs as a percentage of sales, number and proportion of small entities likely to close) to be used to assess significant impacts. When a recommended threshold is exceeded for a given indicator, this constitutes a "significant impact."

For this RFA screening analysis, the Agency used the same measures and threshold levels as those used in the economic impact analysis. These indicators (and the corresponding threshold values) are cost as a percentage of expenditures (1-percent), cost per household ($220 per year), and cost as a percentage of median household income (1-percent).

2. Results

As stated in the economic impact analysis results, the threshold values are never exceeded for CPH or at the 10-meter POC for the proposed rule. Tables 11 and 12 present data on cost per household and cost as a percentage of expenditures for the proposed rule at the 10-meter POC. (The pattern of impacts is very similar for costs as a percentage of median household income and is not displayed.) The two indicators show similar patterns of impact with the greatest impacts on communities with populations of 5,000 or less. The threshold value for significant impact is exceeded for the cost as a percentage of expenditures indicator.

TABLE 11.—COST PER HOUSEHOLD PER YEAR FOR PROPOSED RULE (10-METER POC)

[Percent of households by community size]

Population size	CPH range (in percent)			>$100
	<$25	$25–$50	$50–$100	
Less than 1,000	72.9	25.2	1.9	0.0
1,001–5,000	80.8	15.9	3.1	0.3
5,001–15,000	87.5	10.8	1.7	0.0
15,001–50,000	88.9	9.9	1.1	0.0
50,001–100,000	88.5	11.5	0.0	0.0
More than 100,000	98.0	2.0	0.0	0.0

TABLE 12.—COMPLIANCE COST AS PERCENTAGE OF EXPENDITURES FOR PROPOSED RULE (10-METER POC)

[Percent of communities by community size]

Population size	Percent of expenditures		
	0–1%	1–2%	>2%
Less than 1,000	78.8	18.9	2.3
1,001 to 5,000	85.6	10.5	4.0
5,001 to 15,000	90.0	7.8	2.2
15,001 to 50,000	90.9	5.6	3.6
50,001 to 100,000	87.7	12.3	0.0
Greater than 100,000	100.0	0.0	0.0

Although the RFA is aimed primarily at mitigating adverse effects on small businesses, it also includes a definition of small governmental entities as any government serving a population of less than 50,000. The municipal data base of primary providers of local government services used for this analysis contains about 29,017 entities, 97.8 percent of these represent a population of 50,000 or smaller. Because such a large proportion of affected entities under the proposed rule meets the 50,000 population criterion suggested in the RFA, and since significant adverse impacts are less on entities with a population larger than 5,000, an alternative definition of a small entity is appropriate. There are 22,191 entities in the data base with populations of 5,000 or less; this represents 77 percent of the total. The proposed regulation will have its most severe impacts on governments serving less than 1,000 people, which include 46 percent of primary local governments. Therefore, the Agency determined that an appropriate size definition for small entities for the purpose of this analysis falls somewhere between governments of 5,000 persons and 1,000 persons.

The Agency determined that the proposed rule is likely to impose

differential economic impacts, although not significant impacts, on a substantial number of small entities. The impacts are more severe on small governments than those on larger communities. The Agency determined that the effects of the proposed rule on small entities should be analyzed in greater detail as part of the final rulemaking effort.

C. Limitations

There are several important caveats to the results presented in this section. Costs and benefits for the proposed rule as estimated in the RIA represent a 1×10^{-5} design goal, actual effects of the proposal will vary as the State-specified-design goal varies within the allowable protective range of 1×10^{-4} to 1×10^{-7}. Moreover, other designs besides the three modeled in the RIA would be sufficient to meet the performance standard and would influence the resulting costs and benefits. Although several provisions (e.g., post-closure care, ground-water monitoring parameters, performance standard for existing units) of the proposal do not exactly reflect what was analyzed in the RIA, the Agency believes that the basic conclusions of the RIA are accurate estimators of the effects of the proposed rule.

Compliance costs represent upper-bound estimates. Factors that may act to reduce the cost estimates including regionalization, waste shifts to resource recovery facilities, recycling, and better siting of new landfills in "good" locations. As noted earlier, EPA has not incorporated these factors into the analysis because they involve site-specific local decisions that are difficult to analyze.

It is unlikely that each of the existing MSWLFs will have a replacement landfill in perpetuity as EPA has assumed in this analysis due to such forces as regionalization. Smaller MSWLFs can achieve substantial economies of scale that will help to reduce their compliance costs by participating in larger regional landfills with other local governments. The economies of scale likely will remain positive even with additional costs due to transfer stations and increased transportation distances. Although these economies of scale exist, there are many local, noneconomic (e.g., political, technical) factors that enter into landfill siting that may inhibit the forces of regionalization.

Future waste shifts to resource recovery facilities will divert the waste volume that potentially needs to be landfilled, and, thus, costs presented in this section will tend to be overstated. It is likely that solid waste combustion will become more attractive in the future due to competitive costs with landfilling or favorable environmental conditions at a given site. EPA has estimated that resource recovery could divert as much as 18 percent of the solid waste stream away from land disposal given future population growth and increases in the volume of solid waste generated (Ref. 16). Alternatives to land disposal other than energy recovery also exist (e.g., recycling, composting). These programs, although often successful due to their inherent flexibility and cost-effectiveness, have historically diverted only modest amounts of municipal solid waste from the waste stream.

EPA has adjusted the compliance costs to reflect State requirements for liners, leachate collection systems, and ground-water monitoring wells; no adjustment was made in the benefits analysis, which used an unlined unit with a vegetative cover to represent baseline conditions. Estimated costs may be overstated for landfills in States with other requirements that may be similar to the proposed rule.

There are also several caveats related to the risk analysis. There is considerable uncertainty in the risk modeling. The model components that introduce the most uncertainty are those that predict: (1) Leachate quality for trace organics, (2) the probability and consequences of containment system failure, (3) the effectiveness of corrective action, and (4) the human health risk resulting from exposure to toxic substances (i.e., the dose-response models).

The risk analysis also considers only the current population that is using the ground water as a drinking water source. In the future, greater numbers of people and wells may be located near MSWLFs. Future population growth would increase the risk reduction estimates presented in this discussion. If regionalization occurs so that the total number of landfills that needs to be sited is reduced, the total exposed population may also be reduced. However, EPA has shown that larger risks are associated with larger facilities. Future population growth, and a corresponding increase in solid waste generation that may be land disposed, will also increase compliance costs over the current estimates.

EPA estimated only risks that are attributable to drinking contaminated ground water. Other risks from MSWLFs were not analyzed (e.g., surface water, subsurface gas, risks to the ecosystem). Analyzing these risks would result in greater risk reduction than currently estimated. The aggregate costs already include some of the controls that would prevent these other forms of risk. The bulk of the compliance costs are for requirements that serve to protect the ground water from leachate contamination.

EPA's modeling period in the risk analysis is 300 years. Greater risk reduction would be obtained if this period were extended.

Many assumptions, such as those discussed above, enter into the risk analysis. Thus, strong reliance on the absolute risk estimates without full realization of the limitations of the analysis should be avoided. Comparisons of the risk estimates across regulatory options are more reliable and valid than absolute estimates for a single option. EPA solicits comments and additional data regarding the assumptions, costs, risks, and potential impacts identified in the regulatory analysis.

D. Paperwork Reduction Act

The information collection requirements in this proposed rule have been submitted for approval to the Office of Management and Budget (OMB) under the Paperwork Reduction Act of 1980, 44 U.S.C. 3501 *et seq.* Submit comments on these requirements to the Office of Information and Regulatory Affairs; OMB; 726 Jackson Place, NW; Washington, D.C. 20503, marked "Attention: Desk Officer for EPA." The final rule will respond to any OMB or public comments on the information collection requirements.

XII. References

A. Background Documents

(1) *U.S. EPA, OSW.* Notification Requirements for Industrial Solid Waste Disposal Facilities—Criteria for Classification of Solid Waste Disposal Facilities and Practices (40 CFR Part 257)—Subtitle D of the Resource Conservation and Recovery Act (RCRA). August 1988 (draft).

(2) *U.S. EPA, OSW.* Location Restrictions (Subpart B)—Criteria for Municipal Solid Waste Landfills (40 CFR Part 258)—Subtitle D of the Resource Conservation and Recovery Act (RCRA). July 1988 (draft).

(3) *U.S. EPA, OSW.* Operating Criteria (Subpart C)—Criteria for Municipal Solid Waste Landfills (40 CFR Part 258)—Subtitle D of the Resource Conservation and Recovery Act (RCRA). July 1988 (draft).

(4) *U.S. EPA, OSW.* Closure/Post-Closure Care and Financial Responsibility Requirements (Subpart C, §§ 258.30–258.32)—Criteria for Municipal Solid Waste Landfills (40 CFR

Part 258)—Subtitle D of the Resource Conervation and Recovery Act (RCRA). July 1988 (draft).

(5) *U.S. EPA, OSW.* Design Criteria (Subpart D)—Criteria for Municipal Solid Waste Landfills (40 CFR Part 258)—Subtitle D of the Resource Conservation and Recovery Act (RCRA). July 1988 (draft).

(6) *U.S. EPA, OSW.* Ground-Water Monitoring and Corrective Action (Subpart E)—Criteria for Municipal Solid Waste Landfills (40 CFR Part 258)—Subtitle D of the Resource Conservation and Recovery Act (RCRA). July 1988.

(7) *U.S. EPA, OSW.* Case Studies on Ground-Water and Surface Water Contamination from Municipal Solid Waste Landfills—Criteria for Municipal Solid Waste Landfills (40 CFR Part 258)—Subtitle D of the Resource Conservation and Recovery Act (RCRA). July 1988 (draft).

(8) *U.S. EPA, OSW.* Summary of Data on Municipal Solid Waste Landfill Leachate Characteristics—Criteria for Municipal Solid Waste Landfills (40 CFR Part 258)—Subtitle D of the Resource Conservation and Recovery Act (RCRA). July 1988.

(9) *U.S. EPA, OSW.* Updated Review of Selected Provisions of State Solid Waste Regulations—Criteria for Municipal Solid Waste Landfills (40 CFR Part 258)—Subtitle D of the Resource Conservation and Recovery Act (RCRA). July 1988.

B. Regulatory Impact Analysis

(10) *U.S. EPA, OSW.* Draft Regulatory Impact Analysis (RIA) of Proposed Revisions to Subtitle D Criteria for Municipal Solid Waste Landfills—Criteria for Municipal Solid Waste Landfills (40 CFR Part 258)—Subtitle D of the Resource Conservation and Recovery Act (RCRA). August 1988.

C. Guidance Documents

(11) *U.S. EPA, OSW.* Criteria for Identifying Areas of Vulnerable Hydrogeology Under the Resource Conservation and Recovery Act, Statutory Interpretative Guidance. Guidance Manual for Hazardous Waste Land Treatment, Storage, and Disposal Facilities. Interim Final. July 1986.

(12) *U.S. EPA, OSW.* Guidance Document on Classifying Solid Waste Disposal Facilities. SW-828. March 1980.

(13) *U.S. EPA, OSW.* Permit Writers' Guidance Manual for Hazardous Waste Land Storage and Disposal Facilities. Phase I Criteria for Location Acceptability and Existing Applicable Regulations, final draft. February 1985.

D. Other References

(14) *Abt Associates Inc.* National Small Quantity Generator Survey. Contract No. 68-01-6892. U.S. Environmental Protection Agency, Office of Solid Waste, Washington, DC 1985.

(15) *Farrell, J. B. and G. K. Dotson.* "The Effects of Municipal Wastewater Sludge on Leachates and Gas Production From Sludge-Refuse Landfills. U.S. EPA/ORD. 1987.

(16) *Franklin Associates, Ltd.* Characterization of Municipal Solid Waste in the United States, 1960 to 2000. U.S. Environmental Protection Agency, Washington, DC June 1986.

(17) *Franklin Associates, Ltd.* Characterization of Municipal Solid Waste in the United States, 1960 to 2000. (1988 Update) U.S. Environmental Protection Agency, Washington, DC. March 1988.

(18) *GCA Corporation and Booz, Allen & Hamilton Inc.* Review of Federal and State Regulations and Other Information on Disposal of Solid Waste in Wetlands. Contract No. 68-01-6871. U.S. Environmental Protection Agency, Washington, DC December 1986.

(19) *ICF Incorporated.* Case Studies of State Financial Responsibility Programs for Subtitle D Solid Waste Disposal Facilities (Draft). March 1987.

(20) *ICF Incorporated.* The Liner Location Risk and Cost Analysis Model: Phase II. (Draft) 1985.

(21) *ICF Incorporated.* Survey of State Closure and Post-Closure Regulations For Solid Waste Facilities. (Draft). May 1987.

(22) *PEI Associates, Inc.* State Subtitle D Regulations on Solid Waste Landfills, Surface Impoundments, Land Application Units and Waste Piles. Contract No. 68-01-7075/02-3890. U.S. Environmental Protection Agency, Washington, DC 1986.

(23) *Planning Research Corporation.* Evaluation of NPL/Subtitle D Landfill Data. U.S. Environmental Protection Agency, Washington, DC. May 1986.

(24) *Pohland, F. G. and F. R. Harper.* Critical Review and Summary of Leachate and Gas Production From Landfills. August 1983.

(25) *Random-Walk Solute Transport Model for Selected Ground Water Quality Evaluations, 1981.* Bulletin No. 65, Illinois State Water Survey.

(26) *Science Applications International Corporation.* Summary of Data on Industrial Nonhazardous Waste Disposal Practices. Contract No. 68-01-7050, U.S. Environmental Protection Agency, Washington, DC 1985.

(27) *SCS Engineers.* A Survey of Household Hazardous Wastes and Related Collection Programs. Contract No. 68-01-6621. U.S. Environmental Protection Agency, Washington, DC October 1986.

(28) *U.S. EPA, OSW.* Subtitle D Study Phase I Report, EPA/530-SW-86-054. October 1986.

(29) *U.S. EPA, OSW.* Industrial Subtitle D Facility Study, List of Questions in Telephone Survey. September 1986.

(30) *U.S. EPA, OSW.* Survey of Solid Waste (Municipal) Landfill Facilities. August 1988.

(31) *U.S. EPA, OSWER.* Understanding the Small Quantity Generator Hazardous Waste Rules: A Handbook for Small Business. September 1986.

(32) *U.S. EPA, OSW.* Notification of Hazardous Waste Activity, Form 8700-12 and Instructions. Revised November 1985.

(33) *U.S. EPA.* EPA Journal, Vol 12, No. 1. January/February 1986.

(34) *U.S. EPA, OSW.* Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW-846). September 1986.

(35) *U.S. EPA, OSW.* Water Balance Method for Predicting Leachate Generation from Solid Waste Disposal Sites. EPA publication number 530/SW-168. 1975.

(36) *U.S. EPA, OSW.* Lining of Waste Impoundment and Disposal Facilities (SW-870). 1983.

(37) *U.S. EPA, OWPO, "Financial Capability Guidebook." February 1983.*

(38) *WESTAT, Inc.* Census of State and Territorial Subtitle D Nonhazardous Waste Programs. Contract No. 68-01-7047. U.S. Environmental Protection Agency, Washington, DC 1986.

(39) *U.S. EPA, OGWP.* DRASTIC: A Standardized System for Evaluating Ground-Water Pollution Potential Using Hydrogeologic Settings, EPA/600/2-85/018. 1985.

(40) *U.S. EPA, OSW.* Process Design Manual—Municipal Sludge Landfills. EPA—625/1-78-010. October 1978.

XIII. List of Subjects

A. 40 CFR Part 257

Reporting and record keeping requirements, Waste disposal.

B. 40 CFR Part 258

Reporting and record keeping requirements, Household hazardous waste, Waste disposal, Security measures, Water pollution control, Liquids in landfills, Small quantity generators, Corrective action, Liner requirements.

Date: August 23, 1988.

Lee M. Thomas,

Administrator.

For reasons set out in the preamble, Title 40 of the Code of Federal Regulations is proposed to be amended as set forth below:

PART 257—CRITERIA FOR CLASSIFICATION OF SOLID WASTE DISPOSAL FACILITIES AND PRACTICES

1. The authority citation is revised to read as follows:

Authority: 42 U.S.C. 6907(a)(3), 6944(a) and 6949a(c), 33 U.S.C. 1345 (d) and (e).

2. Section 257.1 is amended by adding paragraph (c)(10) to read as follows:

§ 257.1 Scope and purpose.

* * * * *

(c) * * *

(10) The criteria of this part do not apply to municipal solid waste landfills, which are subject to the revised criteria contained in Part 258 of this title.

* * * * *

3. Section 257.2 is amended by revising the definition for "facility," and adding definitions in alphabetical order for "construction/demolition waste," "industrial solid waste," "industrial solid waste disposal facility," "land application unit," "landfill," "municipal solid waste landfill," "surface impoundment," and "waste pile" to read as follows:

§ 257.2 Definitions.

* * * * *

"Construction/demolition waste" means the waste building materials, packaging, and rubble resulting from construction, remodeling, repair, and demolition operations on pavements, houses, commercial buildings, and other structures. Such wastes include, but are not limited to, bricks, concrete, other masonry materials, soil, rock, lumber, road spoils, rebar, paving materials, and tree stumps.

* * * * *

"Facility" means all contiguous land and structures, other appurtenances, and improvements on the land used for the disposal of solid waste.

"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 industry; 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.

"Industrial solid waste disposal facility" means any landfill, surface impoundment, land application unit, or waste pile used for the disposal of industrial solid wastes.

"Land application unit" means an area where wastes are applied onto or incorporated into the soil surface (excluding manure spreading operations) for agricultural pruposes or for treatment and disposal.

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

* * * * *

"Municipal solid waste landfill" means any landfill or landfill unit that receives household waste. This landfill also may receive other types of Subtitle D wastes, such as commercial wastes, nonhazardous sewage sludge from publicly owned treatment works, construction/demolition waste, and industrial solid wastes. Such a landfill may be publicly or privately owned.

* * * * *

"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.

* * * * *

"Waste pile" or "pile" means any noncontainerized accumulation of solid, nonflowing waste that is used for treatment or storage.

* * * * *

4. Section 257.3–4 is amended by revising paragraphs (c)(2)(i) and (c)(2)(ii) to read as follows:

§ 257.3–4 Ground Water.

* * * * *

(c) * * *

(2) * * *

(i) The concentration of that substance in the ground water to exceed the Maximum Contaminant Level promulgated under section 1412 of the Safe Drinking Water Act (codified under 40 CFR Part 141, Subpart B), or

(ii) An increase in the concentration of that substance in the ground water where the existing concentration of that substance exceeds the Maximum Contaminant Level promulgated under section 1412 of the Safe Drinking Water Act (codified under 40 CFR Part 141, Subpart B).

* * * * *

5. Section 257.5 is added to read as follows:

§ 257.5 Notification and exposure information requirements for industrial solid waste disposal facilities and construction/demolition waste landfills.

(a) The owner or operator of a construction/demolition waste landfill or industrial solid waste disposal facility must submit the notification and exposure information, specified on EPA Form No. 9410–1 in Appendix I of this Part, to the appropriate State solid waste management agency and to EPA. The notification form must be signed and certified by the owner or operator or an authorized representative of the owner or operator.

(b) Existing facilities must submit the form within six months of the promulgation date of this rule.

6. In 40 CFR Part 257, Appendix I is revised to read as follows:

BILLING CODE 6560-50-M

APPENDIX I

EPA

United States Environmental Protection Agency
Washington, D.C. 20460

Notification for Industrial Solid Waste Disposal Facilities and Construction/Demolition Waste Landfills

Form Approved

Agency Use Only

ID Number

Date Received

I. Owner and Locational Information

1. Facility Owner	2. Location of Facility
Owner Name *(Corporation, Individual, Public Agency, or Other Agency).* Street Address or P.O. Box, City, State, and Zip Code	Establishment or Facility Name and Address *(Street Address or Location Description (not P.O. Box) (e.g., 3 miles west of the intersection of Highway 355 and Route 54), City/County, State, and Zip Code)* Telephone Number *(Including Area Code and Extension)*
Telephone Number *(Including Area Code and Extension)*	Latitude: Degrees / Minutes; Longitude: Degrees / Minutes

3. Name of Contact Person *(Mark the box if contact person is owner)* ☐ — Telephone Number *(Including Area Code and Extension)*

4. If this establishment is a facility operated or owned by the Federal Government, enter the GSA Identification Number | | | | | | | | | | |

II. General Facility Information

1. Which of the Following Unit Types Are at This Facility? *Enter the number of each unit type at this facility. If this facility does not have a unit type, enter "0."*

Type of Unit	Number at Facility
Construction/Demolition Waste Landfill	
Industrial Solid Waste Landfill	
Industrial Solid Waste Surface Impoundment	
Industrial Solid Waste Land Application Unit	
Industrial Solid Waste Pile	

2. Waste Types Disposed of at This Facility *(Check all that apply. Include wastes that currently are accepted or have been accepted in the past)*

☐ Municipal Solid Waste
☐ Sewage Sludge
☐ Construction/ Demolition Waste
☐ Asbestos-Containing Waste Material
☐ Municipal Incinerator Ash
☐ Other
☐ Infectious Wastes
☐ Other Incinerator Ash
☐ Small Quantity Generator Waste
☐ Industrial Solid Waste

3. Total Annual Amount Disposed of at This Facility *(Enter the quantity and check the appropriate unit of measurement.)*

☐ Tons ☐ Gallons ☐ Cubic Yards

Quantity

EPA Form 9410-1 (7-88)

III. Exposure Information (You may need to contact a local planning agency, water authority, or health department for information needed to complete question 1.)	
1. Number of Households Within One Mile of the Facility *(Mark an "X" in the box if the number is an estimate)* ☐	2. Number of Upgradient and Downgradient Ground-water Monitoring Wells at this Facility *(If none of a type, enter "0" for that type)* Upgradient Wells | Downgradient Wells
IV. State Information	
V. Certification	
I certify under penalty of law that I have personally examined and am familiar with the information submitted in this and all attached documents and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate, and complete.	
Name and official title of owner, operator or authorized representative	Signature | Date Signed

EPA Form 9410-1 (7-88) MS-B004/2

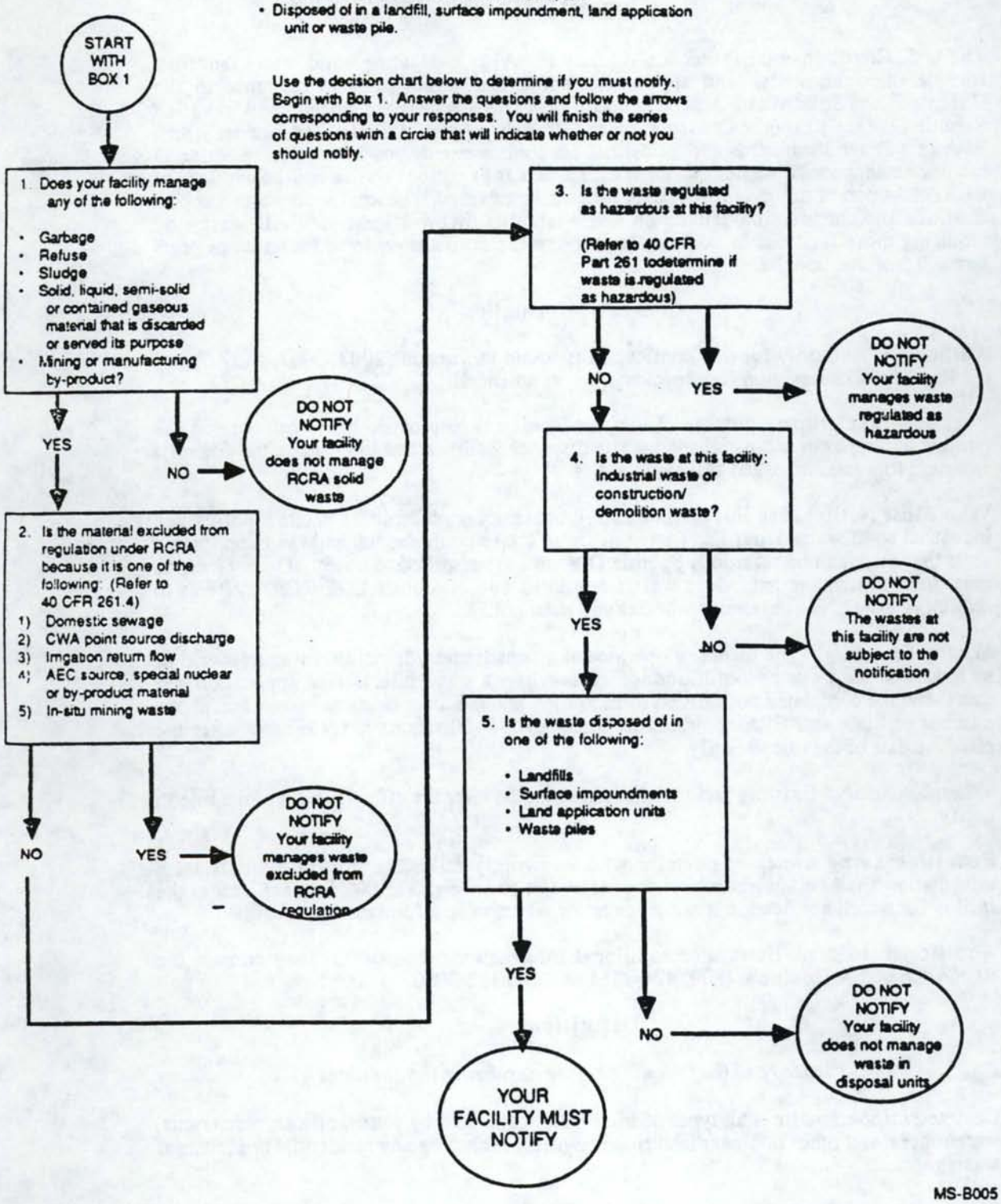
EXHIBIT A

WHO MUST NOTIFY?

You must notify if your facility manages RCRA solid waste that is:

- Not regulated as hazardous under Subtitle C of RCRA, and
- Industrial or construction/demolition waste, and
- Disposed of in a landfill, surface impoundment, land application unit or waste pile.

Use the decision chart below to determine if you must notify. Begin with Box 1. Answer the questions and follow the arrows corresponding to your responses. You will finish the series of questions with a circle that will indicate whether or not you should notify.



MS-B005

Notification for Industrial Solid Waste Disposal Facilities and Construction/Demolition Waste Landfills

The U.S. Environmental Protection Agency (EPA) is evaluating solid waste landfills, surface impoundments, land application units, and waste piles in response to the Hazardous and Solid Waste Amendments of 1984 (HSWA). These amendments modified Subtitle D of the Resource Conservation and Recovery Act of 1976 (RCRA), under which EPA sets Federal standards and guidelines for solid waste disposal facilities. Subtitle D facilities manage solid wastes that are not regulated as hazardous wastes under Subtitle C of RCRA. As part of this evaluation, EPA is compiling data on industrial solid waste disposal facilities and construction/demolition waste landfills that manage Subtitle D wastes by requiring those facilities to complete and return the notification form found on pages 3 through 5 of this booklet.

General Information

Authority: Authority for this notification is found in Sections 2002, 3007, and 4010 of the Resource Conservation and Recovery Act, as amended.

Purpose: The primary purpose of this notification is to provide EPA with data on the number and types of industrial solid waste disposal facilities and to evaluate the potential exposure to wastes managed at these facilities.

Who Must Notify: Facilities with existing construction/demolition waste landfills and industrial solid waste landfills, waste piles, surface impoundments, and land application units that manage nonhazardous Subtitle D wastes are required to notify. Do not include units used to manage hazardous wastes regulated under Subtitle C of RCRA. Refer to Exhibit A to help you determine whether you must notify.

Where To Notify: The owner or operator of a construction/demolition waste landfill or an industrial solid waste landfill, surface impoundment, waste pile, or land application unit must send the completed notification form to EPA and the State (address, name, and phone number of State and EPA contracts are attached). Facilities have six months after the effective date of the rule to notify.

When To Notify: Existing facilities have six months after the effective date of the rule to notify.

Penalties: Any owner or operator who knowingly fails to notify or submits false information shall be subject to a civil penalty not to exceed $25,000 for each unit at the facility for which notification is not given or for which false information is submitted.

Additional Information: For additional information, the notifier may contact the RCRA/CERCLA Hotline at (800) 424-9364 or (202) 382-3000.

Definitions

Please read the following before answering the questions.

Commercial solid waste is all types of solid waste generated by stores, offices, restaurants, warehouses, and other nonmanufacturing activities, excluding any residential or industrial wastes.

Construction/Demolition Waste is waste building materials, packaging, and rubble resulting from the construction, remodelling, repair, and demolition operations on pavements, houses, commercial buildings, and other structures. Such wastes include, but are not limited to, bricks, concrete, other masonry materials, soil, rock, lumber, road spoils, rebar, paving material, and tree stumps

Disposal is the discharging, depositing, injecting, dumping, spilling, leaking, or placing solid waste into or on any land or water so that such solid waste or any constituent thereof, may enter the environment, be emitted into the air, or discharged into any waters, including ground waters.

Downgradient Well is a well located in the flow path of ground water that has passed under a facility.

Facility means all contiguous land and structures, other appurtenances, and improvements on the land used for the disposal of solid waste. A facility may include more than one unit. Units found at a facility include the following

- *Land application unit* is an area where wastes are applied onto or into the soil surface (excluding manure-spreading operations) for agricultural purposes or for treatment and disposal. Common names are landspreading, landfarming, or land treatment.

- *Surface impoundment* is a natural or human-made depression in the ground formed mainly of earthen materials and is designed to hold liquid wastes or wastes containing free liquid. Common names are ponds, pits, or lagoons.

- *Waste pile* is a noncontainerized mass of solid, nonflowing waste material that may or may not be enclosure by a fence, a cover, or some other structure. Waste piles can be used for treatment or storage.

- *Landfill* is 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.

Hazardous Waste is solid waste regulated under 40 CFR Part 261. The regulatory definition of hazardous waste is found at 40 CFR 261.3.

Household Solid Waste is any solid waste including garbage, trash, and sanitary wastes in septic tanks generated by single or multiple residences, hotels, motels, bunkhouses, ranger stations, crew quarters, or any recreational areas such as campgrounds and picnic grounds.

Industrial Solid Waste is 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, wastes 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 industry; 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.

Infectious Waste is any disposable equipment, instruments, utensils, or fomites (substances that may carry pathogenic organisms) from rooms of patients who have been diagnosed or are suspected of having a communicable disease; laboratory wastes such as tissues, blood specimens, excreta, and secretions from patients or laboratory animals;

disposable fomites; and surgical operating room pathologic specimens, fomites, and other materials from outpatient areas and emergency rooms.

Municipal Incinerator Ash is the residue from burning municipal solid waste. The ash is usually produced in two fractions, fly ash and bottom ash, but typically is disposed of in a combined form.

Municipal Solid Waste is any household, residential, and commercial solid waste.

Residual is any material left over at the end of an industrial process that is not sold as a product. Residuals can include solids, liquids, and sludges.

RCRA is the Resource Conservation and Recovery Act of 1976, the Federal statute that regulates the treatment, storage, and disposal of hazardous and nonhazardous solid waste.

Small Quantity Generator is a generator that generates no more than 100 kg/month of hazardous waste.

Solid Waste is any garbage, refuse, or sludge from a waste treatment plant, water supply treatment plant, or air pollution control facility and other discarded material, including solid, liquid, semisolid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations, and from community activities, but does not include solid or dissolved material in domestic sewage, or solid or dissolved material in irrigation return flows or industrial discharges that are point sources subject to permits under 33 USC 1342 or source, special nuclear, or by-product material as defined by the Atomic Energy Act of 1954, as amended (68 Stat. 923).

Storage is the temporary holding of waste, after which it is treated, disposed of, or stored elsewhere.

Treatment is any process that changes the chemical, physical, or biological character of a waste.

Upgradient Well is a well located in the flow path of groundwater before it passes under a facility.

Waste is any material that results from a production or treatment process and is not sold as a product. This includes wastes that are managed in waste piles and surface impoundments even if they are eventually recycled.

Wastewater is any water that is used in an industrial process but is not part of the product after the industrial process is complete. Wastewater includes water that has been used to clean equipment or in a boiler blowdown, but wastewater excludes noncontact cooling water.

7. A new Part 258 is added as set forth below:

PART 258—CRITERIA FOR MUNICIPAL SOLID WASTE LANDFILLS

Subpart A—General

Subpart B—Location Restrictions

Subpart C—Operating Criteria

Subpart D—Design Criteria

Subpart E—Ground-Water Monitoring and Corrective Action

Authority: 42 U.S.C. 6907(a)(3), 6944(a) and 6949(c); 33 U.S.C. 1345 (d) and (e).

Subpart A—General

§ 258.1 Purpose, scope, and applicability.

(a) The purpose of this part is to establish minimum national criteria under the Resource Conservation and Recovery Act (RCRA or the Act), as amended, for municipal solid waste landfills and under the Clean Water Act, as amended, for municipal solid waste landfills that are used to dispose of sludge. These minimum national criteria ensure the protection of human health and the environment.

(b) These criteria apply to owners and operators of new and existing municipal solid waste landfills, except as otherwise specifically provided in this part; all other solid waste disposal facilities and practices that are not regulated under Subtitle C of RCRA are subject to the criteria contained in Part 257.

(c) These criteria do not apply to closed units (as defined in this section) of municipal solid waste landfills that close prior to the effective date of this part.

(d) Municipal solid waste landfills failing to satisfy these criteria are considered open dumps for purposes of State solid waste management planning under RCRA.

(e) Municipal solid waste landfills failing to satisfy these criteria constitute open dumps, which are prohibited under section 4005 of RCRA.

(f) Municipal solid waste landfills containing sewage sludge and failing to satisfy these criteria violate sections 309 and 405(e) of the Clean Water Act.

(g) The effective date of this part is [*insert date 18 months after the promulgation date*], unless otherwise specified.

§ 258.2 Definitions.

Unless otherwise noted, all terms contained in this part are defined by their plain meaning. This section contains definitions for terms that appear throughout this part; additional definitions appear in the specific sections to which they apply.

"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 § 258.30 of this part.

"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 § 258.30 of this part.

"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.

"Closed unit" means any solid waste disposal unit that no longer receives solid waste as of the effective date of this part and has received a final layer of cover material.

"Commercial solid waste" means all types of solid waste generated by stores, offices, restaurants, warehouses, and other nonmanufacturing activities, excluding residential and industrial wastes.

"Existing unit" means any solid waste disposal unit that is receiving solid waste as of the effective date of this part and has not received a final layer of cover material.

"Facility" means all contiguous land and structures, other appurtenances, and improvements on the land used for the disposal of solid waste.

"Ground-water" means water below the land surface in a zone of saturation.

"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).

"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 industry; 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.

"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, as those terms are defined under § 257.2.

"Lateral expansion" means a horizontal expansion of the waste boundaries of an existing landfill unit.

"Leachate" means a liquid that has passed through or emerged from solid waste and contains soluble, suspended, or miscible materials removed from such waste.

"Municipal solid waste landfill" means any landfill or landfill unit that receives household waste. This landfill also may receive other types of RCRA Subtitle D wastes, such as commercial

waste, nonhazardous sludge, and industrial solid waste. Such a landfill may be publicly or privately owned.

"New unit" means any solid waste disposal unit that has not previously received solid waste prior to the effective date of this part. A new unit also means lateral expansions as defined in this section.

"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.

"Operator" means the person responsible for the overall operation of a facility or part of a facility.

"Owner" means the person who owns a facility or part of a facility.

"Run-off" means any rainwater, leachate, or other liquid that drains over land from any part of a facility.

"Run-on" means any rainwater, leachate, or other liquid that drains over land onto any part of a facility.

"Saturated zone" means that part of the earth's crust in which all voids are filled with water.

"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.

"Solid waste" means any garbage, refuse, sludge from a waste 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, but does not include solid or dissolved materials in domestic sewage, or solid or dissolved materials in irrigation return flows or industrial discharges that are point sources subject to permits under 33 U.S.C. 1342, or source, special nuclear, or by-product material as defined by the Atomic Energy Act of 1954, as amended (68 Stat. 923).

"Solid waste disposal unit" means a discrete area of land used for the disposal of solid wastes.

"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 Marianas Islands.

"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.

§ 258.3 Consideration of other Federal laws.

The owner or operator of a municipal solid waste landfill unit must comply with any other applicable Federal rules, laws, regulations, or other requirements.

§§ 258.4-258.9 [Reserved].

Subpart B—Location Restrictions

§ 258.10 Airport safety.

A municipal solid waste landfill unit that may attract birds and is located 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.

§ 258.11 Floodplains.

(a) A municipal solid waste landfill unit located in the 100-year floodplain shall 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.

(b) For purposes of this section:

(1) "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.

(2) "100-year flood" means a flood that has a 1-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.

(3) "Washout" means the carrying away of solid waste by waters of the base flood.

§ 258.12 Wetlands.

(a) New municipal solid waste landfill units shall not be located in wetlands, unless the owner or operator can make the following demonstrations to the State:

(1) There is no practicable alternative that would have less adverse impact on the wetlands and would have no other significant adverse environmental consequences;

(2) The landfill will not:

(i) Cause or contribute to violations of any applicable State water quality standard,

(ii) Violate any applicable toxic effluent standard or prohibition under Section 307 of the Clean Water Act,

(iii) 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, and

(iv) Violate any requirement under the Marine Protection, Research, and Sanctuaries Act of 1972 for the protection of a marine sanctuary;

(3) The landfill will not cause or contribute to significant degradation of wetlands;

(4) Appropriate and practicable steps have been taken to minimize potential adverse impacts of the landfill on the wetlands; and

(5) Sufficient information is available to make a reasonable determination with respect to these demonstrations.

(b) As used in this section, "wetlands" means those areas that are inundated or saturated by surface or ground water 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 include, but are not limited to, swamps, marshes, bogs, and similar areas.

§ 258.13 Fault areas.

(a) New units of a municipal solid waste landfill shall not be located within 200 feet (60 meters) of a fault that has had displacement in Holocene time.

(b) For the purposes of this section:

(1) "Fault" means a fracture along which strata on one side have been displaced with respect to that on the other side.

(2) "Displacement" means the relative movement of any two sides of a fault measured in any direction.

(3) "Holocene" means the most recent epoch of the Quarternary period, extending from the end of the Pleistocene to the present.

§ 258.14 Seismic impact zones.

(a) At a new municipal solid waste landfill unit located in a "seismic impact zone," all containment structures, including liners, leachate collection systems, and surface water control systems, must be designed to resist the maximum horizontal acceleration in lithified material for the site.

(b) As used in paragraph (a) of this section, "seismic impact zone" means an area with a 10 percent or greater probability that the maximum horizontal acceleration in hard rock, expressed as a percentage of the earth's gravitational pull (g), will exceed 0.10g in 250 years.

(c) As used in paragraph (a) of this section, the "maximum horizontal acceleration in lithified 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.

§ 258.15 Unstable areas.

(a) The owner or operator of a municipal solid waste landfill unit located in an unstable area must demonstrate to the State that engineering measures have been incorporated into the unit's design to ensure the stability of the structural components of the unit. The owner or 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).

(b) As used in this section, "structural components" means liners, leachate collection systems, final covers, run-on/run-off systems, and any other component necessary for protection of human health and the environment.

(c) Existing units of a municipal solid waste landfill located in unstable areas that cannot make the demonstration specified in paragraph (a) of this section must close within 5 years of the effective date of this part in accordance with § 258.30 of this part and conduct post-closure activities in accordance with § 258.31 of this part.

(d) The deadline for a closure required by paragraph (c) of this section may be extended by the State after considering, at a minimum, the following factors:

(1) Availability of alternative disposal capacity; and

(2) Potential risk to human health and the environment.

§§ 258.16–258.19 [Reserved].

Subpart C—Operating Criteria

§ 258.20 Procedures for excluding the receipt of hazardous waste.

(a) The owner or operator of a municipal solid waste landfill unit must implement a program at the facility for detecting and preventing the disposal of regulated hazardous wastes as defined in Part 261 of this title and polychlorinated biphenyls (PCB) wastes as defined in Part 761 of this title. This program must include at a minimum:

(1) Random inspections of incoming loads;

(2) Inspection of suspicious loads;

(3) Records of any inspections;

(4) Training of facility personnel to recognize regulated hazardous waste; and

(5) Procedures for notifying the proper authorities if a regulated hazardous waste is discovered at the facility.

(b) As used in this section, "regulated hazardous waste" means a 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 small quantity generator as defined in § 261.5 of this title.

§ 258.21 Cover material requirements.

(a) The owner or operator of a municipal solid waste landfill unit must cover disposed solid waste with suitable materials at the end of each operating day, or at more frequent intervals if necessary, to control disease vectors, fires, odors, blowing litter, and scavenging.

(b) The State may grant a temporary waiver from the requirement of paragraph (a) of this section if the State determines that there are extreme seasonal climatic conditions that make meeting such requirements impractical.

§ 258.22 Disease vector control.

(a) The owner or operator of a municipal solid waste landfill unit must prevent or control on-site populations of disease vectors using techniques appropriate for the protection of human health and the environment.

(b) For purposes of this section, "disease vectors" means any rodents, flies, mosquitoes, or other animals, including insects, capable of transmitting disease to humans.

§ 258.23 Explosive gases control.

(a) The owner or operator of a municipal solid waste landfill unit shall ensure that:

(1) The concentration of methane gas generated by the facility does not exceed 25 percent of the lower explosive limit for methane in facility structures (excluding gas control or recovery system components); and

(2) The concentration of methane gas does not exceed the lower explosive limit for methane at the facility property boundary.

(b) The owner or operator of a municipal solid waste landfill unit must implement a routine methane monitoring program to ensure that the standards of paragraph (a) of this section are met.

(1) The type and frequency of monitoring must be determined based on the following factors:

(i) Soil conditions;

(ii) The hydrogeologic conditions surrounding the disposal site;

(iii) The hydraulic conditions surrounding the disposal site; and

(iv) The location of facility structures and property boundaries.

(2) The minimum frequency of monitoring shall be quarterly.

(c) If methane gas levels exceeding the limits specified in paragraph (a) of this section are detected, the owner or operator must:

(1) Take all necessary steps to ensure immediate protection of human health;

(2) Immediately notify the State of the methane gas levels detected and the immediate steps taken to protect human health; and

(3) Within 14 days, submit to the State for approval a remediation plan for the methane gas releases. The plan shall describe the nature and extent of the problem and the proposed remedy. The plan shall be implemented upon approval by the State.

(d) As used in this section, "lower explosive limit" 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.

§ 258.24 Air criteria.

(a) A municipal solid waste landfill shall not violate any applicable requirements developed under a State Implementation Plan (SIP) approved or promulgated by the Administrator pursuant to section 110 of the Clean Air Act, as amended.

(b) Open burning of solid waste, except for the infrequent burning of agricultural wastes, silvicultural wastes, land-clearing debris, diseased trees, debris from emergency clean-up operations, or ordnance, is prohibited at municipal solid waste landfill units.

§ 258.25 Access requirement.

The owner or operator of a municipal solid waste landfill unit must control public access and prevent unauthorized vehicular traffic and illegal dumping of wastes to protect human health and the environment using artificial barriers, natural barriers, or both, as appropriate.

§ 258.26 Run-on/run-off control systems.

(a) The owner or operator of a municipal solid waste landfill unit must design, construct, and maintain:

(1) A run-on control system to prevent flow onto the active portion of the landfill during the peak discharge form a 25-year storm;

(2) A run-off control system from the active portion of the landfill to collect and control at least the water volume resulting from a 24-hour, 25-year storm.

(b) Run-off from the active portion of the landfill unit must be handled in accordance with § 258.27(a) of this Part.

§ 258.27 Surface water requirements.

A municipal solid waste landfill unit shall not:

(a) Cause a discharge of pollutants into waters of the United States, including wetlands, that violates any requirements of the Clean Water Act, including, but not limited to, the National Pollutant Discharge Elimination System (NPDES) requirements, pursuant to section 402.

(b) Cause the discharge of a nonpoint source of pollution to waters of the United States, including wetlands, that violates any requirement of an area-wide or State-wide water quality management plan that has been approved under section 208 or 319 of the Clean Water Act, as amended.

§ 258.28 Liquids restrictions.

(a) Bulk or noncontainerized liquid waste may not be placed in a municipal solid waste landfill unit unless:

(1) The waste is household waste other than septic waste; or

(2) The waste is leachate or gas condensate derived from the municipal solid waste landfill unit and the landfill unit is equipped with a composite liner and a leachate collection system that is designed and constructed to maintain less than a 30-cm depth of leachate over the liner.

(b) Containers holding liquid waste may not be placed in a municipal solid waste landfill unit unless:

(1) The container is a small container similar in size to that normally found in household waste;

(2) The container is designed to hold liquids for use other than storage, such as a battery or capacitor; or

(3) The waste is household waste.

(c) As used in this section:

(1) "Composite liner" means a system consisting of two components; the upper component must consist of a flexible membrane liner (FML), the lower component must consist of at least a three-foot layer of compacted soil with a hydraulic conductivity of no more than 1×10^{-7} cm/sec. The FML component must be installed in direct and uniform contact with the compacted soil component so as to minimize the migration of leachate through the FML if a break should occur.

(2) "Liquid waste" means any waste material that is determined to contain "free liquids" as defined by Method 9095 (Paint Filter Liquids Test), as described in "Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods" (EPA Pub. No. SW-846 [1]).

(3) "Leachate recirculation" means the recycling or reintroduction of leachate into or on a municipal solid waste landfill unit.

(4) "Gas condensate" means the liquid generated as a result of the gas collection and recovery process at the municipal solid waste landfill unit.

§ 258.29 Recordkeeping requirements.

The following information must be recorded, as it becomes available, and retained by the owner or operator of each municipal solid waste landfill unit:

(a) Any monitoring, testing, or analytical data required by Subpart E;

(b) Gas monitoring results from monitoring required by § 258.23 of this part;

(c) Inspection records, training procedures, and notification procedures required in § 258.20 of this part; and

(d) Closure and post-closure care plans as required by § 258.30(b) and § 258.31(c) of this part.

§ 258.30 Closure criteria.

(a) The owner or operator of a municipal solid waste landfill must close each landfill unit in a manner that minimizes the need for further maintenance and minimizes the post-closure formation and release of leachate and explosive gases to air, ground water, or surface water to the extent necessary to protect human health and the environment.

(b) The owner or operator must prepare a written plan that describes the steps necessary to close all units of the muncipal solid waste landfill at any point during its active life in accordance with the closure performance standard in § 258.30(a). The closure plan, at a minimum, must include the following information:

(1) An overall description of the methods, procedures, and processes that will be used to close each unit of a municipal solid waste landfill in accordance with the closure performance standard in § 258.30(a), including procedures for decontaminating the landfill;

(2) An estimate of the maximum extent of operation that will be open 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 landfill;

(4) A description of the final cover, designed in accordance with §§ 258.40(b) and 258.40(c), and;

(5) A schedule for completing all activities necessary to satisfy the closure performance standard.

(c) The closure plan must be prepared as of the effective date of this part, or by the initial receipt of solid waste, whichever is later, and must be approved by the State. Any subsequent modification to the closure plan also must be approved by the State. A copy of the most recent approved closure plan must be kept at the facility or at an alternate location designated by the owner or operator until closure of the municipal solid waste landfill has been certified in accordance with § 258.30(e) and the owner or operator has been released from financial assurance requirements for closure under § 258.32(f).

(d) The owner or operator must begin closure activities of each landfill unit, in accordance with the approved closure plan, no later than 30 days following the final receipt of wastes at that landfill unit. Extensions of the deadline for beginning closure may be granted at the discretion of the State if the owner or operator of a municipal solid waste landfill demonstrates that the landfill will not pose a threat to human health and the environment.

(e) Following closure of each municipal solid waste landfill unit, the owner or operator must submit to the State a certification that objectively verifies that closure has been completed in accordance with the approved closure plan, based on a review of the landfill unit by a qualified party.

§ 258.31 Post-closure care requirements.

(a) Following closure of each municipal solid waste landfill unit, the owner or operator must conduct two phases of post-closure care. The first phase must be for a minimum of 30 years and 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 settling, subsidence, erosion, or other events, and preventing run-on and run-off from eroding or otherwise damaging the final cover;

(2) Maintaining and operating the leachate collection system in accordance with the requirements in

[1] Copies may be obtained from: Solid Waste Information, U.S. Environmental Protection Agency, 26 West St. Clair St., Cincinnati, Ohio 45268.

§ 258.40(a)–(b), if applicable, until leachate no longer is generated;

(3) Monitoring the ground-water in accordance with the requirements of § 258.50 and maintaining the ground-water monitoring system; and,

(4) Maintaining and operating the gas monitoring system in accordance with the requirements of § 258.23.

(b) Following the period described in § 258.31(a), the owner or operator must conduct a second phase of post-closure care at each municipal solid waste landfill unit that consists of, at a minimum, ground-water monitoring and gas monitoring. The length of this period is determined by the State and must be sufficient to protect human health and the environment.

(c) The owner or operator of a municipal solid waste landfill must prepare a written post-closure plan that describes monitoring and routine maintenance activities that will be carried out during each phase of the post-closure care period in accordance with the requirements of § 258.31(a) and (b). The post-closure plan must include, at a minimum, the following information:

(1) A description of the monitoring and maintenance activities required in § 258.31 (a) and (b) for each 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 both phases of the post-closure period; and

(3) A description of the planned uses of the property during both phases of the post-closure care period. Post-closure use of the property must never be allowed to 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, upon the demonstration by the owner or operator, the State determines that the activities will not increase the potential threat to human health or the environment or the disturbance is necessary to reduce a threat to human health or the environment. The owner or operator must obtain approval from the State in order to remove any wastes or waste residues, the liner, or contaminated soils from the land.

(d) The post-closure plan must be prepared as of the effective date of the rule, or by the initial receipt of solid waste, whichever is later, and must be approved by the State. Any subsequent modification to the post-closure plan must also be approved by the State. A copy of the most recent approved post-closure plan must be kept at the facility or at an alternate location designated by the owner or operator until completion of the post-closure care period has been certified in accordance with § 258.31(f) and the owner or operator has been released from financial assurance for post-closure care under § 258.32(g).

(e) Following closure of the entire municipal solid waste landfill, the owner or operator must record a notation on the deed to the landfill property, or some other instrument that is normally examined during title search. The owner or operator may request permission from the State to remove the notation from the deed if all wastes are removed from the facility in accordance with paragraph (c)(3) of this section. The notation on the deed must in perpetuity notify any potential purchaser of the property that:

(1) The land has been used as a municipal solid waste landfill; and

(2) Its use is restricted under paragraph (c)(3) of this section.

(f) Following completion of the two-phase post-closure care period for each unit, the owner or operator of an MSWLF must submit to the State a certification that objectively verifies that both phases of post-closure care have been completed in accordance with the approved post-closure plan, based on a review of the landfill unit by a qualified party.

§ 258.32 Financial assurance criteria.

(a) The requirements of this section apply to the owner and operator of each municpal solid waste landfill, except an owner or operator who is a State or Federal government entity whose debts and liabilities are the debts and liabilities of a State or the United States.

(b) The owner or operator must have a detailed written estimate, in current dollars, of the cost of hiring a third party to close the municipal solid waste landfill in accordance with the closure plan developed to satisfy the closure requirements in § 258.30 of this part.

(1) The estimate must equal the cost of closing the landfill at the point in the municipal solid waste landfill's active life when the extent and manner of its operation would make closure the most expensive, as indicated by its closure plan (see § 258.30(b) of this part).

(2) During the active life of the municipal solid waste landfill, the owner or operator must annually adjust the closure cost estimate for inflation.

(3) The owner or operator must increase the closure cost estimate and the amount of financial assurance provided under paragraph (f) of this section if changes to the closure plan or landfill conditions increase the maximum cost of closure at any time over the active life of the municipal solid waste landfill.

(4) The owner or operator may request a reduction in the closure cost estimate and the amount of financial assurance provided under paragraph (f) of this section if he can demonstrate that the cost estimate exceeds the maximum cost of closure at any time over the life of the landfill.

(5) The owner or operator must keep a copy of the latest closure cost estimate at the landfill until the owner or operator has been notified by the State that he has been released from closure financial assurance requirements under paragraph (f) of this section.

(c) The owner or operator must have a detailed written estimate, in current dollars, of the cost of hiring a third party to conduct each phase of post-closure monitoring and maintenance of the municipal solid waste landfill in accordance with the post-closure plan developed to satisfy the post-closure requirements in § 258.31 (a) and (b) of this part. The post-closure cost estimate for each phase of post-closure care used to demonstrate financial assurance in paragraph (g) of this section is calculated by multiplying the annual cost estimate for each phase of post-closure care by the number of years of post-closure care required in that phase.

(1) The cost estimate for each phase of post-closure care must be based on the most expensive costs of post-closure care during that phase.

(2) During the active life of the municipal solid waste landfill, the owner or operator must annually adjust the post-closure cost estimate for inflation.

(3) The owner or operator must increase the amount of the post-closure care cost estimate and the amount of financial assurance provided under paragraph (g) of this section if changes in the post-closure plan or landfill conditions increase the maximum costs of post-closure care.

(4) The owner or operator may request a reduction in the post-closure cost estimate and the amount of financial assurance provided under paragraph (g) of this section if he can demonstrate that the cost estimate exceeds the maximum costs of post-closure care remaining over the post-closure care period.

(5) The owner or operator must keep a copy of the latest post-closure care cost estimate at the landfill until he has been notified by the State that he has been released from post-closure financial assurance requirements for the entire landfill under paragraph (g) of this section.

(d) An owner or operator of a municipal solid waste landfill required to undertake a corrective action program under § 258.58 of this part must

have a detailed written estimate, in current dollars, of the cost of hiring a third party to perform the corrective action in accordance with the program required under § 258.58 of this part. The corrective action cost estimate is calculated by multiplying the annual costs of corrective action by the number of years of the corrective action program.

(1) The owner or operator must annually adjust the estimate for inflation until the corrective action program is completed.

(2) The owner or operator must increase the amount of the corrective action cost estimate and the amount of financial assurance provided under paragraph (h) of this section if the annual corrective action costs, in current dollars, for the remaining period over which corrective action will be conducted exceed the cost estimate.

(3) The owner or operator may request a reduction in the amount of the corrective action cost estimate and the amount of financial assurance provided under paragraph (h) of this section if he demonstrates that the cost estimate exceeds the maximum remaining costs of corrective action.

(4) The owner or operator must keep a copy of the latest estimate of the costs of performing corrective action at the landfill until he has been notified by the State that he has been released from corrective action financial assurance requirements under paragraph (h) of this section.

(e) The mechanisms used to demonstrate financial assurance under this section must ensure that the funds necessary to meet the costs of closure, post-closure care, and corrective action for known releases will be available in a timely manner whenever they are needed. Financial assurance requirements must satisfy the following criteria:

(1) The financial assurance mechanisms must ensure that the amount of funds ensured is sufficient to cover the costs of closure, post-closure care, and corrective action for known releases when needed;

(2) The financial assurance mechanisms must ensure that funds will be available in a timely fashion when needed;

(3) The financial assurance mechanisms must guarantee the availability of the required amount of coverage from the effective date of these requirements or prior to the initial receipt of solid waste, whichever is later, until the owner or operator establishes an alternative financial assurance mechanism or is released from the financial assurance requirements under paragraphs (f), (g), and (h) of this section;

(4) The financial assurance mechanisms that may be used to satisfy the requirements in paragraphs (f), (g), and (h) of this section must provide flexibility to the owner or operator; and

(5) The financial assurance mechanisms must be legally valid and binding and enforceable under State and Federal law.

(f) The owner or operator of each municipal solid waste landfill must establish, in a manner in accordance with paragraph (e) of this section, financial assurance for closure of the landfill, in an amount equal to the most recent closure cost estimate prepared in accordance with paragraph (b) of this section. The owner or operator must provide continuous coverage for closure until released from financial assurance requirements in accordance with this paragraph. The owner or operator may be released from financial assurance requirements for closure after the State has received certification that closure has been completed in accordance with the approved closure plan, as required under § 258.30(e) of this part. Following receipt of the closure certification, the State will:

(1) Notify the owner or operator in writing that he/she is no longer required to maintain financial assurance for closure, or;

(2) Provide the owner or operator with a detailed written statement of any reason to believe that closure has not been conducted in accordance with the approved closure plan.

(g) The owner or operator of each municipal solid waste landfill must establish, in a manner in accordance with paragraph (e) of this section, financial assurance for the costs of each phase of post-closure care as required under § 258.31 (a) and (b) of this part, in an amount equal to the sum of the most recent cost estimates for each phase of post-closure care, prepared in accordance with paragraph (c) of this section. The owner or operator must provide continuous coverage for post-closure care until released from financial assurance requirements for post-closure care under paragraph § 258.31(g) of this section. The owner or operator may be released from financial assurance requirements for post-closure care requirements after the State has received a certification that the two-phase post-closure care period has been completed in in accordance with the approved plan, as required under § 258.31(f) of this part. Following receipt of the post-closure care certification, the State will:

(1) Notify the owner or operator in writing that he is no longer required to maintain financial assurance for post-closure care, or;

(2) Provide the owner or operator with a detailed written statement of any reason to believe that post-closure care has not been conducted in accordance with the approved post-closure plan.

(h) The owner or operator of each municipal solid waste landfill required to undertake a corrective action program under § 258.58 of this part must establish, in a manner in accordance with paragraph (e) of this section, financial assurance for the most recent corrective action program, in an amount equal to the corrective action cost estimate prepared in accordance with paragraph (d) of this section. The owner or operator must provide continuous coverage for corrective action until released from financial assurance requirements for corrective action in accordance with this paragraph. The owner or operator may be released from financial assurance requirements for corrective action after the State has received certification that the corrective action remedy has been completed in accordance with the approved corrective plan, as required by § 258.58(e) of this part. Following receipt of the corrective action certification, the State will:

(1) Notify the owner or operator in writing that he is no longer required to maintain financial assurance for corrective action, or;

(2) Provide the owner or operator with a detailed written statement of any reason to believe that corrective action has not been completed in accordance with the approved corrective action plan.

§§ 258.33–258.39 [Reserved].

Subpart D—Design Criteria

§ 258.40 Design Criteria.

(a) New municipal solid waste landfill units must be designed with liners, leachate collection systems, and final cover systems, as necessary, to ensure that the design goal established under paragraph (b) of this section is met in the aquifer at the waste management unit boundary, or an alternative boundary, as specified by the State under paragraph (d) of this section.

(b) The State must establish a design goal for new MSWLF units. This design shall, at a minimum, achieve a ground-water carcinogenic risk level with an excess lifetime cancer risk level (due to continuous lifetime exposure) within the 1×10^{-4} to 1×10^{-7} range.

[Note to § 258.40(b): EPA is considering alternatives to the 1×10^{-4} to 1×10^{-6} risk range. The Agency specifically requests comment on a fixed risk level of 1×10^{-5} or an upper bound risk level of 1×10^{-6} (with the States having discretion to be more stringent) as alternatives to the proposed risk range. A fixed risk level of 1×10^{-5} would provide a uniform level of protection across all States. On the other hand, setting an upper bound risk level of 1×10^{-6} would allow States greater flexibility in establishing more stringent risk levels based on site specific conditions].

(c) When establishing the design necessary to comply with paragraph (a) of this section, the State shall consider at least the following factors:

(1) The hydrogeologic characteristics of the facility and surrounding land;

(2) The climatic factors of the area;

(3) The volume and physical characteristics of the leachate;

(4) Promixity of gound-water users; and

(5) Quality of ground water.

(d) A State may establish an alternative boundary to be used in lieu of the waste management unit boundary. The alternative boundary shall not exceed 150 meters from the waste management unit boundary and shall be located on land owned by the owner or operator of the MSWLF. The establishment of the alternative boundary shall be based on analysis and consideration of at least the following 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 ground water;

(4) The proximity and withdrawal rate of the ground-water users;

(5) The availability of alternative drinking water supplies;

(6) The existing quality of the ground water, including other sources of contamination and their cumulative impacts on the ground water;

(7) Public health, safety, and welfare effects; and

(8) Practicable capability of the owner or operator.

(e) Existing municipal solid waste landfill units must be equipped at closure with a final cover system that is designed to prevent infiltration of liquid through the cover and into the waste.

§§ 258.41–258.49 [Reserved]

Subpart E—Ground-Water Monitoring and Corrective Action

§ 258.50 Applicability.

(a) The requirements in this Part apply to municipal solid waste landfill units, except as provided in paragraph (b) of this section.

(b) Ground-water monitoring requirements under § 258.51 through § 258.55 of this Part will be suspended for an MSWLF unit if the owner or operator can demonstrate to the State that there is no potential for migration of hazardous constituents from that unit to the uppermost aquifer during the active life, including the closure period, of the unit and during post-closure care. This demonstration must be certified by a qualified geologist or geotechnical engineer, and must incorporate reliable site-specific data. If detailed hydrogeologic data are unavailable, the owner or operator must provide an adequate margin of safety in the prediction of potential migration of hazardous constituents by basing such predictions on assumptions that maximize the rate of hazardous consitutent migration.

(c) Within 6 months of the effective date of the rule, the State must specify a schedule for the owners or operators of MSWLF units to comply with the ground-water monitoring requirements specified in §§ 258.51–258.55. This schedule must be specified to ensure that 25 percent of MSWLF units are in compliance within 2 years of the effective date of this rule; 50 percent (50%) of landfill units are in compliance within 3 years of the effective date of this rule; 75 percent of the landfill units are in compliance within 4 years of the effective date of this rule; and all landfill units are in compliance within 5 years of the effective date of this rule. In setting the compliance schedule, the State must consider potential risks posed by the MSWLF unit to human health and the environment. The following factors should be considered in determining potential risk:

(1) Proximity of human and environmental receptors;

(2) Design of the landfill unit;

(3) Age of the landfill unit; and

(4) Resource value of the underlying aquifer, including:

(i) Current and future uses;

(ii) Proximity and withdrawal rate of users; and

(iii) Ground-water quality and quantity.

(d) If the State does not set a schedule for compliance as specified in paragraph (c) of this Section, the following compliance schedule shall apply:

(1) Existing landfill units less than 1 mile from a drinking water intake (surface or subsurface) must be in compliance with the ground-water monitoring requirements specified in §§ 258.51–258.55 within 3 years of the effective date of this rule;

(2) Existing landfill units greater than 1 mile but less than 2 miles from a drinking water intake (surface or subsurface) must be in compliance with the ground-water monitoring requirements specified in §§ 258.51–258.55 within 4 years of the effective date of this rule;

(3) Existing landfill units greater than 2 miles from a drinking water intake (surface or subsurface) must be in compliance with the ground-water monitoring requirements specified in §§ 258.51–258.55 within 5 years of the effective date of this rule; and

(4) A new landfill unit must be in compliance with the ground-water monitoring requirements specified in §§ 258.51–258.55 before waste can be placed in the unit.

(e) Once established at a unit, ground-water monitoring shall be conducted throughout the active life and post-closure care of that municipal solid waste landfill unit as specified in § 258.31.

§ 258.51 Ground-water monitoring systems.

(a) A ground-water monitoring well system approved by the State must be installed at the closest pacticable distance from the waste management unit boundary or the alternative boundary specified by the State under § 258.40. Where subsurface conditions cause hazardous constituents to migrate horizontally past the boundary specified under this paragraph before descending to the uppermost aquifer, the State can designate another appropriate downgradient location for the ground-water monitoring wells.

(b) A ground-water monitoring system must consist of a sufficient number of wells, installed at appropriate locations and depths, to yield ground-water samples from the uppermost aquifer that:

(1) Represent the quality of background ground water that has not been affected by leakage from a landfill unit; and

(2) Represent the quality of ground water passing the locations specified under paragraph (a) of this section.

(c) If approved by the State, separate ground-water monitoring systems are not required for each landfill unit when the facility has several landfill units, provided the multi-unit ground-water monitoring system will be as protective of human health and the environment as individual monitoring systems for each unit.

(d) Monitoring wells must be cased in a manner that maintains the integrity of the monitoring well bore hole. This

casing must be screened or perforated and packed with gravel or sand, where necessary, to enable collection of ground-water samples. 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 ground water.

(1) The design, installation, development, and decommission of any monitoring wells, piezometers and other measurement, sampling, and analytical devices must be documented in the operating record; and

(2) The monitoring wells, piezometers, and other measurement, sampling, and analytical devices must be operated and maintained so that they perform to design specifications throughout the life of the monitoring program.

(e) The number, spacing, and depths of monitoring systems shall be proposed by the owner or operator and approved by the State based upon site-specific technical information that must be developed by the owner or operator and must include thorough characterization of:

(1) Aquifer thickness, flow rate, and flow direction; and

(2) Saturated and unsaturated geologic units and fill materials overlying the uppermost aquifer, including, but not limited to: thicknesses, stratigraphy, lithology, hydraulic conductivities, and porosities.

§ 258.52 Determination of ground-water trigger level.

(a) The State must establish, before a Phase I monitoring program is initiated, ground-water trigger levels that are protective of human health and the environment for all Appendix II constituents.

(b) The levels are to be specified by the State as:

(1) Maximum Contaminant Level (MCL) promulgated under § 1412 of the Safe Drinking Water Act (codified) under 40 CFR Part 141, Subpart B; or

(2) For constituents for which MCLs have not been promulgated, an appropriate health-based level established by the State that satisfies the following criteria:

(i) The level is derived in a manner consistent with Agency guidelines for assessing the health risks of environmental pollutants (51 FR 33992, 34006, 34014, 34028);

(ii) Is based on scientifically valid studies conducted in accordance with the Toxic Substances Control Act Good Laboratory Practice Standards (40 CFR Part 792) or equivalent;

(iii) For carcinogens, the level represents a concentration associated with an excess lifetime cancer risk level (due to continuous lifetime exposure) within the 1×10^{-4} to 1×10^{-7} range; and

(iv) For systemic toxicants, the level represents a concentration to which the human population (including sensitive subgroups) could be exposed to on a daily basis that is likely to be without appreciable risk of deleterious effects during a lifetime.

[Note to § 258.52(b)(2)(iii): EPA is considering alternatives to the 1×10^{-4} to 1×10^{-7} risk range. The Agency specifically requests comment on a fixed risk level of 1×10^{-5} or an upper bound risk level of 1×10^{-4} (with the States having discretion to be more stringent) as alternatives to the proposed risk range. A fixed risk level of 1×10^{-5} would provide a uniform level of protection across all States. On the other hand, setting an upper bound risk level of 1×10^{-4} would allow States greater flexibility in establishing more stringent risk levels based on site specific conditions].

(3) For constituents for which no health-based level is available that meets the criteria in § 258.52(a)(1) or (2) the State may establish a trigger level that shall be:

(i) An indicator for protection of human health and the environment, using the exposure assumptions specified under § 258.52(a)(2), or

(ii) The background concentration.

(4) For constituents for which the background level is higher than health-based levels established under § 258.52(b)(1)–(3), the trigger level shall be the background concentration.

§ 258.53 Ground-water sampling and analysis requirements.

(a) The ground-water monitoring program must include consistent sampling and analysis procedures that are designed to ensure monitoring results that provide an accurate representation of ground-water quality at the background and downgradient wells installed in compliance with § 258.51(b) of this part. At a minimum, the program must be documented in the operating record and must include procedures and techniques for:

(1) Sample collection;

(2) Sample preservation and shipment;

(3) Analytical procedures;

(4) Chain of custody control; and

(5) Quality assurance and quality control.

(b) The ground-water monitoring program must include sampling and analytical methods that are appropriate for ground-water sampling and that accurately measure hazardous constituents and other monitoring parameters in ground-water samples.

(c) The sampling procedures and frequency must be protective of human health and the environment. The sampling requirement must ensure that the statistical procedure used to evaluate samples has an acceptably low probability of failing to identify contamination.

(d) Ground-water elevations must be measured in each well immediately prior to sampling. The owner or operator must determine the rate and direction of ground-water flow in the uppermost aquifer each time ground-water gradient changes as indicated by previous sampling period elevation mesurements.

(e) The owner or operator must establish background ground-water quality on a hydraulically upgradient well(s) for each of the monitoring parameters or constituents required in the particular ground/water monitoring program that applies to the municipal solid waste landfill unit, as determined under § 258.54(a), or § 258.55(a) of this part. The minimum number of samples used to establish background ground-water quality must be consistent with the appropriate statistical procedures determined pursuant to paragraph (h) of this section.

(f) Background ground-water quality at existing units may be based on sampling of wells that are not upgradient from the waste management area where:

(1) Hydrogeologic conditions do not allow the owner or operator to determine what wells are upgradient; and

(2) Sampling at other wells will provide an indication of background ground-water quality that is as representative or more representative than that provided by upgradient wells.

(g) The State may determine alternate background ground-water quality on a site-specific basis if true background ground-water quality cannot be detected on site. The alternate background ground-water quality should be based on monitoring data from the uppermost aquifer that is available to the State.

(h) Statistical procedures are as follows:

(1) Ground-water monitoring data for each phase of the monitoring programs of §§ 258.54, 258.55 and any other applicable section of this rule will be collected from background wells (except as allowed in § 258.53(g)), and at monitoring wells as specified pursuant to § 258.53(a). Based on the site-specific conditions identified in § 258.54(c), the owner or operator must select the appropriate statistical procedure to determine if a statistically significant increase over background value for each parameter or constituent has occurred.

(2) The owner or operator must employ one of the following statistical

procedures, in combination with the designated sampling requirement, to determine a statistically significant increase:

(i) A parametric analysis of variance (ANOVA) followed by multiple comparisons procedures to identify statistically significant evidence of contamination. The procedure must include estimation and testing of the contrasts between each downgradient well's mean and the background mean level for each constituent;

(ii) An analysis of variance based on ranks followed by multiple comparisons procedures to identify statistically significant evidence of contamination. The procedure must include estimation and testing of the contrasts between each downgradient well's mean and the background mean level for each constituent;

(iii) Tolerance or prediction interval procedure in which a tolerance interval for each constituent is established from the distribution of the background data, and the level of each constituent in each downgradient well is compared to the upper tolerance or prediction limit;

(iv) A control chart approach that gives control limits for each constituent; and

(v) Another statistical test procedure that is protective of human health and the environment and meets the ground-water protection standard of § 258.52(b).

(3) The State may establish an alternative sampling procedure and statistical test for any of the constituents listed in Appendix II or parameters listed in § 258.54(b), as required to protect human health and the environment. Factors to consider for establishing this alternative statistical procedure include:

(i) If the distributions for different constituents differ, more than one procedure may be needed. The owner or operator must show that the normal distribution is not appropriate if using a nonparametric or other methodology not requiring an assumption of normality. For any statistic not based on a normal distribution, a goodness of fit test shall be conducted to demonstrate that the normal distribution is not appropriate. Other tests shall be conducted to demonstrate that the assumptions of the statistic or distribution are not grossly isolated;

(ii) Each parameter or constituent is to be tested for separately. Each time that a test is done, the test for individual constituents shall be done at a type I error level or less than 0.01. A multiple comparison procedure may be used at a type I experiment-wide error rate no less than 0.05. The owner or operator must evaluate the ability of the method to detect contamination that is actually present and may be required to increase the sample size to achieve an acceptable error level.

(iii) The monitoring well system should be consistent with § 258.51. The owner or operator must ensure that the number, location, and depth of monitoring wells will detect hazardous constituents that migrate from the municipal solid waste landfill unit;

(iv) The statistical procedure should be appropriate for the behavior of the parameters or constituents involved. It should include methods for handling data below the limit of detection. The owner or operator should evaluate different ways of dealing with values below the limit of detection and choose the one that is most protective of human health and the environment. In cases where there is a high proportion of values below limits of detection, the owner or operator may demonstrate that an alternative procedure is more appropriate; and

(v) The statistical procedure used should account for seasonal and spatial variability and temporal correlation.

(4) If contamination is detected by any of the statistical tests, and the State or the owner or operator suspects that detection is an artifact caused by some feature of the data other than contamination, the State may specify that statistical tests of trend, seasonal variation, autocorrelation, or other interfering aspects of the data be done to establish whether the significant result is indicative of detection of contamination or resulted from natural variation.

(i) The owner or operator must determine whether or not there is a statistically significant increase (or decrease, in the case of Phase I) over background values for each parameter or constituent required in the particular ground-water monitoring program that applies to the landfill unit, as determined under §§ 258.54(a) or 258.55(a) of this part. The owner or operator must make these statistical determinations each time he assesses ground-water quality at the boundary designated under § 258.40 of this part.

(A) In determining whether a statistically significant increase or decrease has occurred, the owner or operator must compare the ground-water quality of each parameter or constituent at each monitoring well designated pursuant to § 258.51 to the background value of that parameter or constituent, according to the statistical procedures specified under paragraph (h) of this section.

(B) Within a reasonable time period after completing sampling (as determined by the State), the owner or operator must determine whether there has been a statistically significant increase or decrease over background at each monitoring well.

§ 258.54 Phase I monitoring program.

(a) Phase I monitoring is required at municipal solid waste landfill units except as otherwise provided in §§ 258.55 and 258.58 of this Part.

(b) At a minimum, a Phase I monitoring program must include the following monitoring parameters or constituents:

(1) Ammonia (as N)
(2) Bicarbonate (HCO_3)
(3) Calcium
(4) Chloride
(5) Iron
(6) Magnesium
(7) Manganese, dissolved
(8) Nitrate (as N)
(9) Potassium
(10) Sodium
(11) Sulfate (SO_4)
(12) Chemical Oxygen Demand (COD)
(13) Total Dissolved Solids (TDS)
(14) Total Organic Carbon (TOC)
(15) pH
(16) Arsenic
(17) Barium
(18) Cadmium
(19) Chromin
(20) Cyanide
(21) Lead
(22) Mercury
(23) Selenium
(24) Silver
(25) The volatile organic compounds (VOCs) listed in Appendix I of this part.

(c) The State must determine an appropriate monitoring frequency on a site-specific basis by considering aquifer flow rate and resource value of the ground water. The minimum monitoring frequency for all parameters specified in paragraph (b) of this section is semiannual except during the post-closure care when minimum monitoring frequency shall be determined by the State on a site-specific basis.

(d) If the owner or operator determines, pursuant to § 258.53(h) of this part, that there is a statistically significant increase or decrease over background for two or more of parameters (1) to (15) specified in paragraph (b) of this section, at any monitoring well at the boundary specified under § 258.51(a), or a statistically significant increase over background for any one or more of parameters (16) to (24) specified in paragraph (b) of this section or the VOCs listed in Appendix I, at any

monitoring well at the boundary specified under § 258.51(a), (s)he:

(1) Must notify the State within 14 days of this finding. The notification must indicate what Phase I parameters have shown statistically significant changes from background levels;

(2) Must establish a Phase II monitoring program meeting the requirements of § 258.55 this part within a reasonable time period as determined by the State; and

(3) May demonstrate that a source other than a municipal solid waste landfill unit cause the contamination or that the contamination resulted from error in sampling, analysis, or evaluation. While the owner or operator may make a demonstration under this paragraph in lieu of establishing a Phase II monitoring program, the owner or operator is not relieved of the requirement to establish a Phase II monitoring program within a reasonable time period unless the demonstration made under this paragraph successfully shows that a source other than the municipal solid waste landfill unit caused the change or that the change resulted from an error in sampling, analysis, or evaluation. In making a demonstration under this paragraph, the owner or operator must:

(i) Notify the State in writing within 7 days of determining statistically significant evidence of contamination that (s)he intends to make a demonstration under this paragraph;

(ii) Within 90 days, or an alternative time period approved by the State, submit to the State a report that demonstrates that a source other than a municipal solid waste landfill unit caused the contamination or that the contamination resulted from error in sampling, analysis, or evaluation; and

(iii) Continue to monitor in accordance with the Phase I monitoring program.

§ 258.55 Phase II monitoring program.

(a) Phase II monitoring is required whenever statistically significant increases or decreases over background have been detected for two or more of parameters (1) to (15) specified under § 258.54(b); or whenever statistically significant increases over background have been detected for one or more of parameters (16) to (24) specified under § 258.54(b), or the VOCs listed in Appendix I; or the State determines, pursuant to § 258.58, that a corrective action remedy has been completed.

(b) At a minimum, Phase II monitoring program must include the constituents in Appendix II of this part.

(c) Within 90 days of triggering a Phase II monitoring program or an alternative time period approved by the State, the owner or operator must sample the ground water in all monitoring wells identified pursuant to § 258.51 of this part and analyze those samples for all constituents identified in Appendix II of this part.

(d) If Appendix II constituents are not detected in response to paragraph (c), the State shall specify an appropriate frequency for repeated sampling and analysis for Appedix II constituents during the active life, closure, and post-closure care of the unit. The following factors should be considered by the State when setting an appropriate frequency for a full Appendix II analysis:

(1) Lithology of the aquifer and unsaturated zone;

(2) Hydraulic conductivity of the aquifer and unsaturated zone;

(3) Aquifer flow velocities;

(4) Minimum distance between upgradient edge of unit and downgradient monitoring well screen (minimum distance of travel); and

(5) Nature of any constituents detected in response to this section.

(e) If, after conducting Phase II monitoring or an appropriate time period approved by the State, the owner or operator determines that there has not been a statistically significant increase over background of parameters or constituent specified pursuant to § 258.55(b) of this part at any monitoring well at the boundary specified under § 258.51(a), that unit may return to Phase I monitoring. The following factors should be considered by the State when determining an appropriate time period for sampling before allowing a unit to return to Phase I monitoring:

(1) Lithology of the aquifer and unsaturated zone;

(2) Hydraulic conductivity of the aquifer and unsaturated zone;

(3) Aquifer flow velocities; and

(4) Maximum distance between upgradient edge of unit and downgradient monitoring well screen (potential maximum distance of travel).

(f) If any Appendix II constituents are detected at statistically significant levels above background response to (c) or (d) of this section, the owner or operator must:

(1) Notify the State in writing within 14 days, or an alternative time period approved by the State, which Appendix II constituents have been detected at statistically significant levels above background; and

(2) Within 90 days, and on a quarterly basis thereafter during the active life and closure of the unit, resample all wells and conduct analyses for those constituents in Appendix II of this part that are determined to be present at levels above background concentrations at the boundary specified under § 258.51(a) of this part.

(3) The State shall determine an appropriate minimum monitoring frequency for these Appendix II constituents during the post-closure period. The following factors should be considered by the State when setting a minimum monitoring frequency:

(i) Lithology of the aquifer and unsaturated zone;

(ii) Hydraulic conductivity of aquifer and unsaturated zone;

(iii) Aquifer flow velocities;

(iv) Minimum distance between upgradient edge of unit and downgradient monitoring well screen (minimum distance of travel); and

(v) Nature of the constituents detected in response to this section.

(g) If any Appendix II parameters or constituents are identified under paragraph (d) of this section that had not been identified previously under (c) or (f)(2) of this section, the owner or operator must, within 14 days, submit to the State a report on the concentration of any Appendix II constituents detected at statistically significant levels above background concentrations.

(h) If any Appendix II constituent is detected at statistically significant levels above the ground-water trigger level established under § 258.52 of this section, the owner or operator:

(1) Must notify the State of this finding in writing within 14 days. The notification must indicate what Phase II parameters or constituents have exceeded the ground-water trigger level;

(2) Must meet the requirements of § 258.56 of this part within a time period determined by the State; and

(3) Must continue to monitor in accordance with the Phase II monitoring program established under this section; or

(4) May demonstrate that a source other than a municipal solid waste landfill unit caused the contamination, or that the increase resulted from error in sampling, analysis, or evaluation. While the owner or operator may make a demonstration under this paragraph in lieu of establishing a corrective action program, (s)he is not relieved of the requirement to establish a corrective action program within a reasonable time period unless the demonstration made under this paragraph successfully shows that a source other than the municipal solid waste landfill unit caused the increase, or that the increase resulted from an error in sampling, analysis, or evaluation. In making a demonstration

under this paragraph, the owner or operator must:

(i) Notify the State in writing within 7 days of determining statistically significant evidence of contamination that (s)he intends to make a demonstration under this paragraph;

(ii) Within 90 days, or an alternate time period approved by the State, submit to the State a report that demonstrates that a source other than a municipal solid waste landfill unit caused the contamination or that the increase resulted from error in sampling, analysis, or evaluation; and

(iii) Continue to monitor in accordance with the Phase II monitoring program.

§ 258.56 Assessment of corrective measures.

(a) An assessment must be conducted by the owner or operator when any of the constituents listed in Appendix II has been detected at a statistically significant level exceeding the ground-water trigger levels defined under § 258.52 of this part during the Phase II monitoring program.

(b) The owner or operator must continue to monitor in accordance with the Phase II monitoring program. The State may require the owner or operator to conduct additional monitoring in order to characterize the nature and extent of the plume.

(c) The State shall specify the scope of the assessment, which may include the following:

(1) Assessment of the effectiveness of potential corrective measures in meeting all of the requirements and objectives of the remedy as described under § 258.57;

(2) Evaluation of 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;

(3) Assessment of the time required to begin and complete the remedy;

(4) Estimation of the costs of remedy implementation;

(5) Assessment of institutional requirements such as State or local permit requirements or other environmental or public health requirements that may substantially affect implementation of the remedy(s); and

(6) Evaluation of public acceptability.

(d) The State may require the owner or operator to evaluate as part of the corrective measure study one or more specific potential remedies. These remedies may include a specific technology or combination of technologies, that, in the State's judgment, achieve the standards for remedies specified in § 258.57.

(e) The owner or operator shall submit a report to the State on the remedies evaluated pursuant to paragraphs (a)–(d). The State shall then select a remedy based on the criteria described in § 258.57.

(f) If at any time during the assessment described under paragraphs (a)–(e) of this section the State determines that the facility poses a threat to human health or the environment, the State may require the owner or operator to implement measures defined under § 258.58(a)(3) and/or (a)(4) to protect human health and the environment.

§ 258.57 Selection of remedy and establishment of ground-water protection standard.

(a) Based on the results of the corrective measure study conducted under § 258.56, the State must select a remedy that, at a minimum, meets the standards listed in paragraph (b) below.

(b) Remedies must:

(1) Be protective of human health and the environment;

(2) Attain the ground-water protection standard as specified pursuant to paragraphs (e) and (f) of this section;

(3) 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

(4) Comply with standards for management of wastes as specified in § 258.58(d).

(c) In selecting a remedy that meets the standards of § 258.57(b), the State, as appropriate, shall consider the following evaluation factors:

(1) Any potential remedy(s) shall be assessed for the long- and short-term effectiveness and protectiveness it affords, along with the degree of certainty that the remedy will provide successful. Factors to be considered include:

(i) Magnitude of reduction of existing risks;

(ii) Magnitude of residual risks in terms of likelihood of further releases due to waste remaining following implementation of a remedy;

(iii) The type and degree of long-term management required, including monitoring, operation, and maintenance;

(iv) Short-term risks that might be posed to the community, workers, or the environment during implementation of such a remedy, including potential threats to human health and the environment associated with excavation, transportation, and redisposal or containment;

(v) Time until full protection is achieved;

(vi) 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;

(vii) Long-term reliability of the engineering and institutional controls; and

(viii) Potential need for replacement of the remedy.

(2) Effectiveness of the remedy in controlling the source to reduce further releases. The following factors should be considered:

(i) The extent to which containment practices will reduce further releases;

(ii) The extent to which treatment technologies may be used.

(3) The ease or difficulty of implementing a potential remedy(s) shall be assessed by considering 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, and disposal services.

(4) Practicable capability of the owner or operator including a consideration of the technical and economic capability.

(5) The degree to which community concerns are addressed by a potential remedy(s) shall be assessed.

(d) The State shall specify as part of the selected remedy a schedule(s) for initiating and completing remedial activities. The State will consider the following factors in determining the schedule of remedial activities;

(1) Extent and nature of contamination;

(2) Practical capabilities of remedial technologies in achieving compliance with ground-water protection standards established under § 258.57(e) 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; and

(6) Resource value of the aquifer including:

(i) Current and future uses;

(ii) Proximity and withdrawal rate of users;

(iii) Ground-water quantity and quality;

(iv) The potential damage to wildlife, crops, vegetation, and physical structures caused by exposure to waste constituent;

(v) The hydrogeologic characteristic of the facility and surrounding land;

(vi) Ground-water removal and treatment costs; and

(vii) The cost and availability of alternative water supplies.

(7) Practicable capability of the owner or operator.

(8) Other relevant factors.

(e) The State shall specify concentration levels for each Appendix II constituent detected in the ground water above trigger levels that the remedy must achieve. Such ground-water protection standards (GWPSs) will be established by the State as follows:

(1) The standard(s) shall be concentration levels in the ground water that protect human health and the environment;

(2) Unless another level is deemed necessary to protect environmental receptors, standards shall be established as follows:

(i) For known or suspected carcinogens, standards shall be established at concentration levels that represent an excess upper bound lifetime risk to an individual of between 1×10^{-4} and 1×10^{-7}, and

(ii) For systemic toxicants, standards shall represent concentration levels to which the human population (including sensitive subgroups) could be exposed on a daily basis without appreciable risk of deleterious effect during a lifetime.

[Note to § 258.57(e)(2)(i): EPA is considering alternatives to the 1×10^{-4} to 1×10^{-7} risk range. The Agency specifically requests comment on a fixed risk level of 1×10^{-5} or an upper bound risk level of 1×10^{-4} (with the States having discretion to be more stringent) as alternatives to the proposed risk range. A fixed risk level of 1×10^{-5} would provide a uniform level of protection across all States. On the other hand, setting an upper bound risk level of 1×10^{-4} would allow States greater flexibility in establishing more stringent risk levels based on site specific conditions.]

(3) In establishing ground-water protection standards that meet the requirements of § 258.57(e) (i) and (ii), above, the State may consider the following:

(i) Multiple contaminants in the ground water;

(ii) Exposure threats to sensitive environmental receptors;

(iii) Other site-specific exposure or potential exposure to ground water; and

(iv) The reliability, effectiveness, practicability, or other relevant factors of the remedy.

(4) For ground water that is a current or potential source of drinking water, the State shall consider maximum contaminant levels promulgated under the Safe Drinking Water Act in establishing ground-water protection standards; and

(5) If the owner or operator can demonstrate to the State that an Appendix II constituent already is present in the ground water at a background level, then the GWPS will not be set below background levels unless the State determines that:

(i) Cleanup to levels below background levels is necessary to protect human health and the environment; and

(ii) Such cleanup is in connection with an area-wide remedial action under other authorities.

(f) The State may determine that remediation of a release of an Appendix II constituent from a municipal solid waste landfill is not necessary if the owner or operator demonstrates to the State's satisfaction that:

(1) The ground water also is contaminated by substances that have originated from a source other than a municipal solid waste landfill unit and those substances are present in concentrations such that cleanup of the release from the municipal solid waste landfill unit would provide no significant reduction in risk to actual or potential receptors; or

(2) The constituent(s) is present in ground water that:

(i) Is not a current or potential 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 represents a statistically significant increase over background concentrations; or

(3) Remediation of the release(s) is technically impracticable or results in unacceptable cross-media impacts.

(g) A determination by the State pursuant to subparagraph (2) above shall not affect the authority of the State to require the owner or operator to undertake source control measures or other measures that may be necessary to eliminate or minimize further releases to the ground water, to prevent exposure to the ground water, or to remediate the ground water to concentrations that are technically practicable and significantly reduce threats to human health or the environment.

(h) The State shall specify in the remedy requirements for achieving compliance with the ground-water protection standards established under § 258.57(e) as follows:

(1) The ground-water protection standard shall be achieved at all points within the plume of contamination that lie beyond the ground-water monitoring well system established under § 258.51(a).

(2) The State shall specify in the remedy the length of time during which the owner or operator must, in order to achieve compliance with a ground-water protection standard, demonstrate that concentrations of Appendix II constituents have not exceeded the standard(s). Factors that may be considered by the State in determining these timing requirements include:

(i) Extent and concentration of the release(s);

(ii) Behavior characteristics of the hazardous constituents in the ground water;

(iii) Accuracy of monitoring or modeling techniques, including any seasonal, meteorological, or other environmental variabilities that may affect the accuracy; and

(iv) Characteristics of the ground water.

§ 258.58 Implementation of the corrective action program.

(a) If any constituent is detected at statistically significant levels above the ground-water protection standard established under § 258.57(e), the owner or operator must:

(1) Establish and implement a corrective action ground-water monitoring program that must:

(i) At a minimum, meet the requirements of a Phase II monitoring program under § 258.54;

(ii) Demonstrate the effectiveness of the corrective action remedy; and

(iii) Demonstrate compliance with ground-water protection standard pursuant to § 258.57(f).

(2) Implement the corrective action remedy selected under § 258.57;

(3) Notify all persons who own the land or reside on the land that directly overlies any part of the plume of contamination; and

(4) Take any interim measures deemed necessary by the State to ensure the protection of human health

and the environment. Interim measures should, to the extent practicable, be consistent with the objectives of and contribute to the performance of any remedy that may be required pursuant to § 258.57. The following factors may be considered by the State in determining whether interim measures are necessary:

(i) Time required to develop and implement a final remedy;

(ii) Actual or potential exposure of nearby populations or environmental receptors to hazardous constituents;

(iii) Actual or potential contamination of drinking water supplies or sensitive ecosystems;

(iv) Further degradation of the ground water that may occur if remedial action is not initiated expeditiously;

(v) Weather conditions that may cause hazardous constituents to migrate or be released;

(vi) 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

(vii) Other situations that may pose threats to human health and the environment.

(b) The State may determine, based on information developed by the owner or operator after implementation of the remedy has begun or other information, that compliance with a requirement(s) for the remedy selected under § 258.57 is not technically practicable. In making such determinations, the State shall consider:

(1) The owner or operator's efforts to achieve compliance with the requirement(s); and

(2) Whether other currently available or new and innovative methods or techniques could practicably achieve compliance with the requirements.

(c) If the State determines that compliance with a remedy requirement is not technically practicable, the State may require that the owner or operator:

(1) Implement alternate measures to control exposure of humans or the environment to residual contamination, as necessary to protect human health and the environment; and

(2) Implement alternate measures for control of the sources of contamination, or for removal or decontamination of equipment, units, devices, or structures required to implement the remedy that are:

(i) Technically practicable; and

(ii) Consistent with the overall objective of the remedy.

(d) All solid wastes that are managed pursuant to a remedy required under § 258.57, or an interim measure required under § 258.58(a)(4), shall be managed in a manner:

(1) That is protective of human health and the environment; and

(2) That complies with applicable RCRA requirements.

(e) Remedies selected pursuant to § 258.57 shall be considered complete when the State determines that:

(1) Compliance with the ground-water protection standards established under § 258.57(e) have been achieved, according to the requirements of § 258.57(f); and

(2) All actions required to complete the remedy have been satisfied.

(f) Upon completion of the remedy, the owner or operator shall submit to the State a certification that the remedy has been completed in accordance with the requirements of § 258.58(e). The certification must be signed by the owner or operator and by an independent professional(s) skilled in the appropriate technical discipline(s).

(g) When, upon receipt of the certification, and in consideration of any other relevant information, the State determines that the corrective action remedy has been completed in accordance with the requirements under paragraph (e) of this section, the State shall release the permittee from the requirements for financial assurance for corrective action under § 258.32.

§ 258.59 [Reserved].

Appendix I—Volatile Organic Constituents for Ground-Water Monitoring

Acetone
Acrolein
Acrylonitrile
Benzene
Bromochloromethane
Bromodichloromethane
cis-1,3-Dichloropropene
Trans-1,3-Dichloropropene
1,4-Difluorobenzene
Ethanol
Ethylbenzene
Ethyl methacrylate
4-Bromofluorobenzene
Bromoform
Bromomethane
2-Butanone (Methyl ethyl ketone)
Carbon disulfide
Carbon tetrachloride
Chlorobenzene
Chlorodibromomethane
Chloroethane
2-Chloroethyl vinyl ether
Chloroform
Chloromethane
Dibromomethane
1,4-Dichloro-2-butane
Dichlorodifluoromethane
1,1-Dichloroethane
1,2-Dichloroethane
2-Hexanone
Iodomethane
Methylene chloride
4-Methyl-2-pentanone
1,1-Dichloroethene
trans-1,2-Dichloroethene
Styrene
1,1,2,2-Tetrachloroethane
Toluene
1,1,1-Trichloroethane
1,1,2-Trichloroethane
Trichloroethene
Trichlorofluoromethane
1,2,3-Trichloropropane
Vinyl acetate
Vinyl chloride
Xylene

Appendix II—Hazardous Constituents

Systematic name	CAS RN	Common name
Acenaphthylene	208-96-8	Acenaphthalene.
Acenaphthylene, 1,2-dihydro-	83-32-9	Acenaphthene.
Acetamide, N-(4-ethoxphenyl)-H	62-44-2	Phenacetin.
Acetamide, N-9H-fluoren-2-yl	53-96-3	2-Acetylaminofluorene.
Acetic acid ethenyl ester	108-05-4	Vinyl acetate.
Acetic acid (2,4-5-trichloro-phenoxy)-	93-76-5	2,4,5-T.
Acetic acid (2,4-dichloro-phenoxy)-	94-75-7	2,4-Dichlorophenoxy-acetic acid.
Acetronitrile	75-05-8	Acetonitrile.
Aluminum	7429-90-5	Aluminum (total).
Anthracene	120-12-7	Anthracene.
Antimony	7440-36-0	Antimony (total).
Aroclor 1016	12674-11-2	Aroclor 1016.
Aroclor 1221	11104-28-2	Aroclor 1221.
Aroclor 1232	11141-16-5	Aroclor 1232.
Aroclor 1242	53469-21-9	Aroclor 1242.
Aroclor 1248	12672-29-6	Aroclor 1248.
Aroclor 1254	11097-69-1	Aroclor 1254.

Systematic name	CAS RN	Common name
Aroclor 1260	11096-82-5	Aroclor 1260.
Arsenic	7440-38-2	Arsenic (total).
Barium	7440-39-3	Barium total).
Benz[a]anthracene, 7,12,-dimethyl-	57-97-6	7,12-Dimethylbenz[a] anthracene.
Benz[j]aceanthrylene, 1,2-dihydo-3-methyl	56-49-5	3-Methylcholanthrene.
Benz[e]acephenanthrylene	205-99-2	Benzo[b]fluoranthene.
Benzamide, 3,5-dichloror-N-(1,1-dimethyl-2-propynl)-	23950-58-5	Benzo[b]fluoranthene.
Benzamide, 3,5-dichloro-N-(1,1-dimethyl-2-propynyl)-	23950-58-5	Pronamide.
Benz[a]anthracene	56-55-3	Benx[a]anthracene.
Benzenamine	62-53-3	Aniline.
Benzenamine, 2-methyl-5-nitro	99-55-8	5-Nitro-o-toluidine.
Benzenamine, 2-nitro	88-74-4	2-Nitroaniline.
Benzenamine, 3-nitro	99-09-2	3-Nitroaniline.
Benzenamine, 4-chloro	106-47-8	p-Chloroaniline.
Benzenamine, 4-nitro-	100-01-6	p-nitroaniline.
Benzenamine, 4,4'-methylenebis [2-chloro	101-14-4	4,4'-Methylenebis (2-chlorcaniline).
Benzenamine, N-nitroso-N-phenyl	86-30-6	N-Nitrosodiphenylmamine.
Benzenamine, N-phenyl-	122-39-4	Diphenylamine.
Benzenamine, N,N-dimethy-4-(phenylazo)-	60-11-7	p-Dimethylamino-azobenzene.
Benzene	71-43-2	Benzene.
Benzene, 1-bromo-4-phenoxy-	101-55-3	4-Bromophenyl phenyl ether.
Benzene, 1-chloro-4-phenoxy-	7005-72-3	4-Chlorophenyl phenyl ether.
Benzene, 1-methyl-2,4-dinitro	121-14-2	2,4-Dinitrotoluene.
Benzene, 1,1'-(2,2,2,-trichloro-ethylidene)bis[4-chloro-	50-29-3	DDT.
Benzene, 1,1'-(2,2,2-trichloro-ethylidene)bis[4-methoxy	72-43-5	Methoxychlor.
Benzene 1,1'-(2,2-dichloro-ethylidene)bis[4-chloro-	72-54-8	DDD.
Benzene 1,1'-(2,2-dichloro-ethenylidene)bis[4-chloro	72-55-9	DDE.
Benzene 1,2-dichloro-	95-50-1	o-Dichlorobenzene.
Benzene 1,2,4-trichloro	120-82-1	1,2,4-trichlorobenzene.
Benzene 1,2,4,5-tetrachloro	95-94-3	1,2,4,5-Tetrachloro-benzene.
Benzene 1,3-Dichloro-	541-73-1	M-Dichlorobenzene.
Benzene 1,4-dichloro-	106-46-7	p-Dichlorobenzene.
Benzene 1,4-dinitro-	100-25-4	meta-Dinitrobenzene.
Benzene, 2-methyl-1,3-dinitro-	606-20-2	2,6-Dinitrotoluene.
Benzene, chloro	108-90-7	Chlorobenzene.
Benzene, dimethyl-	1330-20-7	Xylene (total).
Benzene, ethenyl-	100-42-5	Styrene.
Benzene, ethyl-	100-41-4	Ethyl benzene.
Benzene, hexachloro-	118-74-1	Hexachlorobenzene.
Benzene, methyl	106-88-3	Toluene.
Benzene, nitro-	96-95-3	Nitrobenzene.
Benzene, pentachloro-	608-93-5	Pentachlorobenzene.
Benzene, pentachloronitro-	82-68-8	Pentachloronitrobenzene.
Benzeneacetic acid, 4-chloro-a-(4-chlorophenyl)-a-hydroxy-, ethyl ester	510-15-6	Chlorobenzilate.
1,2-Benzenedicarboxylic acid, bis(2-ethylhexyl)ester	117-81-7	Bis(2-ethyihexyl) phthalate.
1,2-Benzenedicarboxylic acid, butyl phenylmethyl ester	85-68-7	Butyl benzyl phthalate.
1,2-Benzenedicarboxylic acid, dibutyl ester	84-74-2	Di-n-butyl phthalate.
1,2-Benzenedicarboxylic acid, diethyl ester	84-66-2	Diethyl phthalate.
1,2-Benzenedicarboxylic acid, dimethyl ester	131-11-3	Dimethyl phthalate.
1,2-Benzenedicarboxylic acid, dioctyl ester	117-84-0	Di-n-octyl phthalate.
1,3-Benzenediol	108-46-3	Resorcinol.
Benzeneethanamine, a, a-dimethyl-	122-09-8	alpha, alpha-Dimethyl-phenethylamine.
Benzenemethanol	100-51-8	Benzyl alcohol.
Benzenethiol	108-98-5	Benzenethiol.
1,3-Benodioxole, 5-(1-propenyl)-	120-58-1	Isosafrole.
1,3-Benzodioxole, 5-(2-propenyl)-	94-59-7	Safrole.
Benzo[k]fluoranthene	207-08-9	Benzo[k]fluoranthene.
Benzoic acid	65-85-0	Benzoic acid.
Benzo[rst]pentaphene	189-55-9	Dibenzo[a,i]pyrene.
Benzo[ghi]perylene	191-24-2	Benzo(ghi)perylene.
Benzo[a]pyrene	50-32-8	Benzo[a]pyrene.
Beryllium	7440-41-7	Beryllium (total).
1,1'-Biphen[yi]-4,4'-diamine, 3,3'-dichloro-	91-94-1	3,3'-Dichlorobenzidine.
1,1'-Biphen[yi]-4,4'-diamine, 3,3'-dimethoxy-	119-90-4	3,3'-Dimethoxybenzidine.
1,1'-Biphen[yi]-4,4'-diamine, 3,3'-dimethyl-	119-93-7	3,3'-Dimethylbenzidine.
1,1'-Biphenyl[-4-amine	92-67-1	4-Aminobiphenyl.
1,1'-Biphenyl[-4-4-amine	92-87-5	Benzidine.
1,3-Butadiene, 1,1,2,3,4,4-hexachloro-	87-68-3	Hexachorobutadiene.
1,3-Butadiene, 2-chloro-	126-99-8	2-Chloro-1,3-butadine.
1-Butanamine, N-butyl-N-nitroso-	924-16-3	N-Nitrosodi-n-butylamine.
2-Butanone	78-93-3	Methyl ethyl ketone.
2-Butene, 1,4-dichloro-, (E)-	110-57-6	trans-1,4-Dichloro-2-butene.
Cadmium	7440-43-9	Cadmium (total).
Calcium	7440-70-2	Calcium (total).
Carbon disulfide	75-15-0	Carbon disulfide.
Chromium	7440-47-3	Chromium (total).
Chrysene	218-01-9	Chrysene.
Cobalt	7440-48-4	Cobalt (total).
Copper	7440-50-8	Copper (total).
Cyanide	57-12-5	Cyanide.
2,5-Cyclohexadiene-1,4 dione	106-51-4	p-Benzoquinone.
Cyclohexane, 1,2,3,4,5,6-hexachloro-(1a,2a,3B,4a,5B,6B)-	319-84-6	alpha-BHC.

Systematic name	CAS RN	Common name
Cyclohexane, 1,2,3,4,5,6-hexachloro-, (1a,2B,3a,4B,5a,6B)-	319-85-7	beta-BHC.
Cyclohexane, 1,2,3,4,5,6-hexachloro-, (1a,2a,3a,4B,5a,6B)-	319-86-8	delta-BHC.
Cyclohexane, 1,2,3,4,5,6-hexachloro-(1a,2a,3B,4a,5a,6B)-	58-89-9	gamma-BHC.
2-Cyclohexen-1-one, 3,5,5-trimethyl	78-59-1	Isophorone.
1,3-Cyclopentadiene, 1,2,3,4,5,5-hexachloro-	77-47-4	Hexachlorocyclopent-adiene.
Dibenz[a,h]anthracene	53-70-3	Dibenz[a,h]anthracene.
Dibenzo[b,e][1,4]dioxin, 2,3,7,8-tetrachloro-	1746-01-6	2,3,7,8-Tetrachlorodi benzo-p-dioxin; Hexachlorodibenzo-p-dioxin; Pentachlorodi-benzo-p-dioxins; Tetra-chlorodibenzo-p-dioxins.
Dibenzo[b,def]chrysene	189-64-0	Dibenzo[a,h]pyrene.
Dibenzofuran	132-64-9	Dibenzofuran, Hexa-chloro-dibenzofurans; Penta-chlorodibenzo-furans; Tetrachlorodi-benzofurans.
2,7:3,6-Dimethanonaphth [2,3-b]oxirene, 3,4,5,6,9,9-hexachloro-la,2,2a,3,6,6a,7,7a-octahydro, 1aa,2B,2aa,3B,6B,6aa,7B,7aa)-.	60-57-1	Dieldrin.
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, 1aa,2B,2aB,3a,6a,6aB,7B,7aa)-.	72-20-8	Endrin.
1,4:5,8-Dimethanonaphthalene, 1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-, 1aa,4a,4aB,5a,8a,8aB)-.	309-00-2	Aldrin.
1,4:5,8-Dimethanonaphthalene, 1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-, 1aa,4a,4aB,5B,8B,8aB)-.	465-73-6	Isodrin.
1,4-Dioxane	123-91-1	1,4-Dioxane.
Ethanamine, N-ethyl-N-nitroso	55-18-5	N-Nitrosodiethylamine.
Ethanamine, N-methyl-N-nitroso-	10595-95-6	N-Nitrosomethylethylamine.
Ethane, 1,1-dichloro-	75-34-3	1,1-Dichloroethane.
Ethane, 1,1'-[methylenebis (oxy)]bis[2-chloro-	111-91-1	Bis(2-chloroethoxy) methane.
Ethane, 1,1'-oxybis[2-chloro-	111-44-4	Bis(2-chloroethyl) ether.
Ethane, 1,1'-trichloro-	71-55-6	1,1,1-Trichloroethane.
Ethane, 1,1,1,2-tetrachloro-	630-20-6	1,1,1,2-Tetrachloroethane.
Ethane, 1,1,2-trichloro-	79-00-5	1,1,2-Trichloroethane.
Ethane, 1,1,2,2-tetrachloro-	79-34-5	1,1,2,2-Tetrachloroethane.
Ethane, 1,2-dibromo-	106-93-4	1,2-Dibromoethane.
Ethane, 1,2-dichloro-	107-06-2	1,2-Dichloroethane.
Ethane, chloro-	75-00-3	Chloroethane.
Ethane, hexachloro-	67-72-1	Hexachloroethane.
Ethane, pentachloro-	76-01-7	Pentachloroethane.
1,2-Ethanediamine, N,N-dimethyl-N'-'2-pyridinyl-N'-(2-thienylmethyl)-	91-80-5	Methapyrilene.
Ethanone, 1-phenyl-	98-86-2	Acetophenone.
Ethene, (2-chloroethoxy)-	110-75-8	2-Chloroethyl vinyl ether.
Ethene, 1,1-dichloro-	75-35-4	1,1-Dichloroethylene.
Ethene, 1,2-dichloro- (E)-	156-60-5	trans-1,2-Dichloro ethene.
Ethene, chloro-	75-01-4	Vinyl chloride.
Ethene, tetrachloro-	127-18-4	Tetrachloroethene.
Ethene, trichloro-	79-01-6	Trichloroethene.
Fluoranthene	206-44-0	Fluoranthene.
Fluoride	12984-48-8	Fluoride.
9H-Fluorene	86-73-7	Fluorene.
2-Hexanone	591-78-6	2-Hexanone.
Hydrazine, 1,2-diphenyl-	122-66-7	1,2-Diphenylhydrazine.
Indeno[1,2,3-cd]pyrene	193-39-5	Indeno(1,2,3-cd)pyrene.
Iron	7439-89-6	Iron (total).
Lead	7439-92-1	Lead (total).
Magnesium	7439-94-4	Magnesium (total).
Manganese	7439-96-5	Manganese (total).
Mercury	7439-97-6	Mercury (total).
Methanamine, N-methyl-N-nitroso	62-75-9	N-Nitrosodimethylamine.
Methane, bromo-	74-83-9	Bromomethane.
Methane, bromodichloro-	75-27-4	Bromodichloromethane.
Methane, chloro-	74-87-3	Chloromethane.
Methane, dibromo-	74-95-3	Dibromomethane.
Methane, dibromochloro-	124-48-1	Chlorodibromomethane.
Methane, dichloro-	74-09-2	Dichloromethane.
Methane, dichlorodifluoro-	75-71-8	Dichlorodifluoromethane.
Methane, iodo-	74-88-4	Iodomethane.
Methane, tetrachloro-	56-23-5	Carbon tetrachloride.
Methane, tribromo-	75-25-2	Tribromomethane.
Methane, trichloro-	67-66-3	Chloroform.
Methane, trichlorofluoro-	75-69-4	Trichloromonofluoromethane.
Methanesulfonic acid, methyl ester	66-27-3	Methyl methanesulfonate.
Methanethiol, trichloro-	75-70-7	Trichloromethanethiol.
4,7-Methano-1H-indene-1,2,4,5,6,7,8,8-octachloro-2,3,3a,4,7,7a-hexahydro.	57-74-9	Chlordane.
4,7-Methano-1H-indene-1,4,5,6,7,8,8-heptachloro-3a,4,7,7a-tetrahydro-	76-44-8	Heptachlor.
2,5-Methano-2H-indeno[1,2-b] oxirene, 2,3,4,5,6,7,7-heptachloro-1a,1b,5,5a,6,6a-hexahydro-, (1aa,1bB,2a,5a,5aB,6B,6aa).	1024-57-3	Heptachlor epoxide.
6,9-Methano-2,4,3-benzo-dioxathiepin, 6,7,8,9,10,10-hexachloro-1,5,5a,6,9,9a-hexahydro-, 3-oxide, (3a,5aB,6a,9a,9aB).	959-98-8	Endosulfan I.
6,9-Methano-2,4,3-benzo-dioxathiepin, 6,7,8,9,10,10-hexachloro,1,5,5a,6,9,9a-hexahydro-, 3-oxide, (3a,5aa,6B,9B,9aa).	33213-65-9	Endosulfan II.
1,3,4-Methano-2H-cyclobutal [cd]pentalen-2-one, 1,1a,3,3a,4,5,5,5a,5b,6-decachloro-octahydro-.	143-50-0	Kepone.
1,2,4-Methanocyclopenta[cd] pentalene-5-carboxaldehyde, 2,2a,3,3,4,7-hexachloro-decahydro-, (1a,2B,2aB,4B,4aB,5B,6aB,6aB,7R*).	7421-93-4	Endrin aldehyde.
Morpholine, 4-nitroso-	59-89-2	N-Nitrosomorpholine.

Systematic name	CAS RN	Common name
1-Naphthalenamine	134-32-7	1-Naphthylamine.
2-Naphthalenamine	91-59-8	2-Naphthylamine.
Naphthalene	91-20-3	Naphthalene.
Naphthalene, 2-chloro-	91-58-7	2-Chloronaphthalene.
Naphthalene, 2-methyl-	91-57-6	2-Methylnaphthalene.
1,4-Naphthalenedione	130-15-4	1,4-Naphthoquinone.
Naphtho[1,2,3,4-def]chrysene	192-65-4	Dibenzo[a,e]pyrene.
Nickel	7440-02-0	Nickel (total).
Osmium	7440-04-2	Osmium (total).
Oxirane	75-21-8	Ethylene oxide.
2-Pentanone, 4-methyl-	108-10-1	4-Methyl-2-pentanone.
Phenanthrene	85-01-8	Phenanthrene.
Phenol	108-95-2	Phenol.
Phenol, 2-(1-methylpropyl)-4,6-dinitro	88-85-7	2-sec-Butyl-4,6-dinitro-phenol.
Phenol, 2-chloro-	95-57-8	2-Chlorophenol.
Phenol, 2-methyl-	95-48-7	ortho-Cresol.
Phenol, 2-methyl-4,6-dinitro-	534-52-1	4,6-Dinitro-o-cresol.
Phenol, 2-nitro-	88-75-5	2-Nitrophenol.
Phenol, 2,2'-methylenebis [3,4,6-trichloro-	70-30-4	Hexachlorophene.
Phenol, 2,3,4,6-tetrachloro-	58-90-2	2,3,4,6-Tetrachlorophenol.
Phenol, 2,4-dichloro-	120-83-2	2,4-Dichlorophenol.
Phenol, 2,4-dimethyl-	105-67-9	2,4-Dimethylphenol.
Phenol, 2,4-dinitro-	51-28-5	2,4-Dinitrophenol.
Phenol, 2,4,5-trichloro-	95-95-4	2,4,5-Trichlorophenol.
Phenol, 2,4,6-trichloro-	88-06-2	2,4,6-Trichlorophenol.
Phenol, 2,6-dichloro-	87-65-0	2,6-Dichlorophenol.
Phenol, 4-chloro-3-methyl-	59-50-7	p-Chloro-m-cresol.
Phenol, 4-methyl-	106-44-5	para-Cresol.
Phenol, 4-nitro-	100-02-7	4-Nitrophenol.
Phenol, pentachloro-	87-86-5	Pentachlorophenol.
Phosphorodithioic acid, 0,0-diethyl S-[(ethylthio) methyl] ester	298-02-2	Phorate.
Phosphorodithioic acid, 0,0-diethyl S-[2-(ethylthio) ethyl] ester	298-04-4	Disulfoton.
Phosphorothioic acid, 0-[4-[(dimethylamino) sulfonyl)] phenyl] 0,0-dimethyl ester.	52-85-7	Famphur.
Phosphorothioic acid, 0,0-diethyl 0-(4-nitrophenyl) ester	56-38-2	Parathion.
Phosphorothioic acid, 0,0-diethyl 0-pyrazinyl ester	297-97-2	0,0-Diethyl 0,2-pyrazinyl phosphorothioate.
Phosphorothioic acid, 0,0-dimethyl 0-(4-nitrophenyl) ester	298-00-0	Methyl parathion.
Piperidine, 1-nitroso-	100-75-4	N-Nitrosopiperidine.
Potassium	7440-09-7	Potassium (total).
1-Propanamine, N-nitroso-N-propyl-	621-64-7	Di-n-propylnitrosamine.
Propane, 1,2-dibromo-3-chloro	96-12-8	1,2-Dibromo-3-chloro-propane.
Propane, 1,2,-dichloro-	78-87-5	1,2-Dichloropropane.
Propane, 12,3-trichloro-	96-18-4	1,2,3-Trichloropropane.
Propane, 2,2'-oxybis[1-chloro-	108-60-1	Bis(2-chloroisopropyl) ether.
Propanedinitrile	109-77-3	Malononitrile.
Propanenitrile	107-12-0	Ethyl cyanide.
Propanenitrile, 3-chloro-	542-76-7	3-Chloropropionitrile.
Propanoic acid, 2-(2,4,5-trichlorophenoxyl)-	93-72-1	Silvex.
1-Propanol, 2,3-dibromo-phosphate (3:1)	126-72-7	Tris(2,3-dibromopropyl) phosphate.
1-Propanol, 2-methyl-	78-83-1	Isobutyl alcohol.
2-Propanone	67-64-1	Acetone.
2-Propenal	107-02-8	Acrolein.
1-Propene, 1,1,2,3,3,3-hexachloro-	1888-71-7	Hexachloropropene.
1-Propene, 1,3-dichloro-, (E)-	10061-02-6	trans-1,3-Dichloropropene.
1-Propene, 1,3-dichloro-, (Z)-	10061-01-5	cis-1,3-Dichloropropene.
1-Propene, 1,3-chloro-	107-05-1	3-Chloropropene.
2-Propenenitrile, 2-methyl-	126-98-7	Methacrylonitrile.
2-Propenenitrile	107-13-1	Acrylonitrile.
2-Propenoic acid, 2-methyl-, ethyl ester	97-63-2	Etnyl methacrylate.
2-Propenoic acid, 2-methyl-, methyl ester	80-62-6	Methyl methacrylate.
2-Propen-1-ol	107-18-6	Allyl alcohol.
2-Propyn-1-ol	107-19-7	2-Propyn-1-ol.
Pyrene	129-00-0	Pyrene.
Pyridine	110-86-1	Pyridine.
Pyridine, 2-methyl-	109-06-8	2-Picoline.
Pyridine, 1-nitroso-	930-55-2	N-Nitrosopyrrolidine.
Selenium	7782-49-2	Selenium (total).
Silver	7440-22-4	Silver (total).
Sodium	7440-23-5	Sodium (total).
Sulfide	18496-25-8	Sulfide.
Sulfurous acid, 2-chloroethyl 2-[4-(1,1-dimethylethyl) phenoxy)-1-methylethyl ester.	140-57-8	Aramite.
Thallium	7440-28-0	Thallium (total).
Thiodiphosphoric acid ([HO)$_2$ P(S)]$_2$O), tetraethyl ester	3689-24-5	Tetraethyldithiopyro-phosphate.
Tin	7440-31-5	Tin (total).
Toxaphene	8001-35-2	Toxaphene.
Vanadium	7440-62-2	Vanadium (total).
Zinc	7440-66-6	Zinc (total).

APPENDIX III.—CARCINOGENIC SLOPE FACTORS (CSF's) AND REFERENCE DOSES (RfD's) FOR SELECTED HAZARDOUS CONSTITUENTS

CAS No.	Class	Chemical name	Health based levels for	
			Systemic toxicants—RFD (mg/kg/day)	Carcinogens—CSF (mg/kg/day)
67-64-1		Acetone	1.0×10^{-1}	
75-05-8		Acetonitrile	6.0×10^{-3}	
98-86-2		Acetophenone	1.0×10^{-1}	
107-13-1	(B1)	Acrylonitrile		5.4×10^{-1}
309-00-2	(B2)	Aldrin	3.0×10^{-5}	17
62-53-3	(C)	Aniline		2.6×10^{-3}
7440-36-0		Antimony	4.0×10^{-4}	
7440-39-3		Barium [a]	5.0×10^{-2}	
71-43-2	(A)	Benzene [a]		2.9×10^{-2}
7440-41-7		Beryllium	5.0×10^{-3}	
111-44-4	(B2)	Bis(chloroethyl)ether		1.1
117-81-7	(B2)	Bis(2-ethylhexyl)phthalate	2.0×10^{-2}	8.4×10^{-3}
75-27-4		Bromodichloromethane	2.0×10^{-2}	
75-25-2		Bromoform	2.0×10^{-2}	
74-83-9		Bromomethane	4.0×10^{-3}	
75-15-0		Carbon disulfide	1.0×10^{-1}	
56-23-5	(B2)	Carbon tetrachloride [a]	7.0×10^{-4}	1.3×10^{-1}
57-74-9	(B2)	Chlordane	5.0×10^{-4}	1.3
108-90-7		Chlorobenzene	3.0×10^{-2}	
67-66-3	(B2)	Chloroform	1.0×10^{-2}	6.1×10^{-3}
16065-83-1		Chromium (III) [a]	1	
7440-47-3		Chromium (VI) [a]	5.0×10^{-3}	
108-39-4		Cresol, meta	5.0×10^{-2}	
95-48-7		Cresol, ortho	5.0×10^{-2}	
106-44-5		Cresol, para	5.0×10^{-2}	
57-12-5		Cyanide	2.0×10^{-2}	
72-55-9	(B2)	DDE		3.4×10^{-1}
72-54-8	(B2)	DDD		2.4×10^{-1}
50-29-3	(B2)	DDT	5.0×10^{-4}	3.4×10^{-1}
124-48-1		Dibromochloromethane	2.0×10^{-2}	
84-74-2		Dibutyl phthalate	1.0×10^{-1}	
924-16-3	(B2)	Dibutylnitrosamine (N-Nitrosodi-n-butylamine)		5.4
75-71-8		Dichlorodifluoromethane	2.0×10^{-1}	
107-06-2	(B2)	1,2-Dichloroethane [a]		9.1×10^{-2}
75-35-4	(C)	1,1-Dichloroethylene [a]	9.0×10^{-3}	0.6
120-83-2		2,4-Dichlorophenol	3.0×10^{-3}	
60-57-1	(B2)	Dieldrin	5.0×10^{-5}	16
84-66-2		Diethyl phthalate	8.0×10^{-1}	
55-18-5	(B2)	Diethylnitrosamine (N-Nitrosodiethylamine)		150
60-51-5		Demethoate	2.0×10^{-2}	
62-75-9	(B2)	Dimethylnitrosamine (N-Nitrosodimethylamine)		51
51-28-5		2,4 Dinitrophenol	2.0×10^{-3}	
88-85-7		Dinoseb	1.0×10^{-3}	
122-39-4		Diphenylamine	3.0×10^{-2}	
298-04-4		Disulfotan	4.0×10^{-5}	
100-41-4		Ethylbenzene	1.0×10^{-1}	
76-44-8	(B2)	Heptachlor	5.0×10^{-4}	4.5
1024-57-3	(B2)	Heptachlor epoxide		9.1
87-68-3	(C)	Hexachlorobutadiene	2.0×10^{-3}	7.8×10^{-2}
319-84-6	(B2)	Hexachlorocyclohexane—alpha (alpha—BHC)		6.3
319-85-7	(C)	Hexachlorocyclohexane—beta (beta—BHC)		1.8
58-89-9	(C)	Hexachlorocyclohexane—gamma (Lindane) [a]	3.0×10^{-4}	1.3
77-47-4		Hexachlorocyclopentadiene	7.0×10^{-3}	
67-72-1	(C)	Hexachloroethane	1.0×10^{-3}	1.4×10^{-2}
78-83-1		Isobutyl alcohol	3.0×10^{-1}	
78-59-1		Isophorone	2.0×10^{-1}	
126-98-7		Methacrylonitrile	1.0×10^{-4}	
78-93-3		Methyl ethyl ketone	5.0×10^{-2}	
108-10-1		Methyl isobutyl ketone	5.0×10^{-2}	
298-00-0		Methyl parathion	3.0×10^{-4}	
75-09-2	(B2)	Methylene chloride	6.0×10^{-3}	7.5×10^{-3}
10595-95-6	(B2)	N-Nitroso-N-methylethylamine		22
621-64-7	(B2)	N-Nitrosodi-N-propylamine		7.0
86-30-6	(B2)	N-Nitrosodiphenylamine		4.9×10^{-3}
930-55-2	(B2)	N-Nitrosopyrrolidine		2.1
7440-02-0		Nickel	2.0×10^{-2}	
98-95-3		Nitrobenzene	5.0×10^{-4}	
56-38-2		Parathion	3.3×10^{-4}	
608-93-5		Pentachlorobenzene	8.0×10^{-4}	
82-68-8		Pentachloronitrobenzene	3.0×10^{-3}	
87-86-5		Pentachlorophenol	3.0×10^{-2}	
108-95-2		Phenol	4.0×10^{-2}	
1336-36-2	(B2)	Polychlorinated biphenyls		7.7
23950-58-5		Pronamide	8.0×10^{-2}	
110-86-1		Pyridine	1.0×10^{-3}	
7440-22-4		Silver [a]	3.0×10^{-3}	
100-42-5	(B2)	Styrene	2.0×10^{-1}	3.0×10^{-3}

APPENDIX III.—CARCINOGENIC SLOPE FACTORS (CSF's) AND REFERENCE DOSES (RfD's) FOR SELECTED HAZARDOUS CONSTITUENTS—Continued

CAS No.	Class	Chemical name	Health based levels for	
			Systemic toxicants—RFD (mg/kg/day)	Carcinogens—CSF (mg/kg/day)
95-94-3		1,2,4,5-Tetrachlorobenzene	3.0×10^{-4}	
79-34-5	(C)	1,1,2,2-Tetrachloroethane		0.2
127-18-4	(C)	Tetrachloroethylene	1.0×10^{-2} [b]	5.1×10^{-2}
58-90-2		2,3,4,6-Tetrachlorophenol	3.0×10^{-2}	
108-88-3		Toluene	3.0×10^{-1}	
8001-35-2	(B2)	Toxaphene [a]		1.1
120-82-1		1,2,4-Trichlorobenzene	2.0×10^{-2}	
71-55-6		1,1,1-Trichloroethane [a]	9.0×10^{-2}	
79-00-5	(C)	1,1,2-Trichloroethane	2.0×10^{-2} [b]	5.7×10^{-2}
79-01-6	(B2)	Trichloroethylene [a]		1.1×10^{-2}
75-69-4		Trichloromonofluoromethane	3.0×10^{-1}	
95-95-4		2,4,5-Trichlorophenol	1.0×10^{-1}	
88-06-2	(B2)	2,4,6-Trichlorophenol		0.02
96-18-4		1,2,3-Trichloropropane	1.0×10^{-2}	
1330-20-7		Xylenes	2	

[a] MCL's are available for these constituents (see Table 2). MCL's should be used as trigger levels.
[b] Constituent is considered a carcinogen by the oral route. RfD is based on non-carcinogenic effects only. Trigger levels should be based on the lower of the two levels (unless an MCL exists).

How to calculate trigger levels from RfDs and RSDs:

I. Systemic Toxicants:

To calculate a trigger level based on a reference dose (RfD), multiply the RfD by the average adult body weight (70 kg) over the average water intake (2 liters of water per day).

Example for acetonitrite:

RfD = 6.0×10^{-3} mg/kg/day

$$\frac{6.0\times10^{-3}\text{ mg}}{\text{kg-day}} \times \frac{70\text{ kg}}{2\text{L/day}} = 0.2\text{ mg/L}$$

II. Carcinogens:

To calculate a trigger level based on a carcinogenic slope factor (CSF), derive a risk-specific dose (RSD), then multiply the RSD by the average adult body weight (70 kg) over the average water intake (2 liters of water per day).

example of aldrin:

A. Aldrin is classified as a Group B2 carcinogen; it has a CSF of 17 $(mg/kg/day)^{-1}$. Using a 10^{-6} risk level, the RSD is:

$$\frac{1\times10^{-6}}{17\text{ (mg/kg/day)}^{-1}} = 5.9\times10^{-8}\text{ mg/kg/day}$$

The trigger level is:

$$\frac{5.9\times10^{-8}\text{ mg}}{\text{kg-day}} \times \frac{70\text{ kg}}{2\text{L/day}} = 2.1\times10^{-6}\text{ mg/L}$$

B. Using a 10^{-4} risk level, the RSD is:

$$\frac{1\times10^{-4}}{17\text{ (mg/kg/day)}^{-1}} = 5.9\times10^{-6}\text{ mg/kg/day}$$

The trigger level is:

$$\frac{5.9\times10^{-6}\text{ mg}}{\text{kg-day}} \times \frac{70\text{ kg}}{2\text{L/day}} = 2.1\times10^{-4}\text{ mg/L}$$

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